

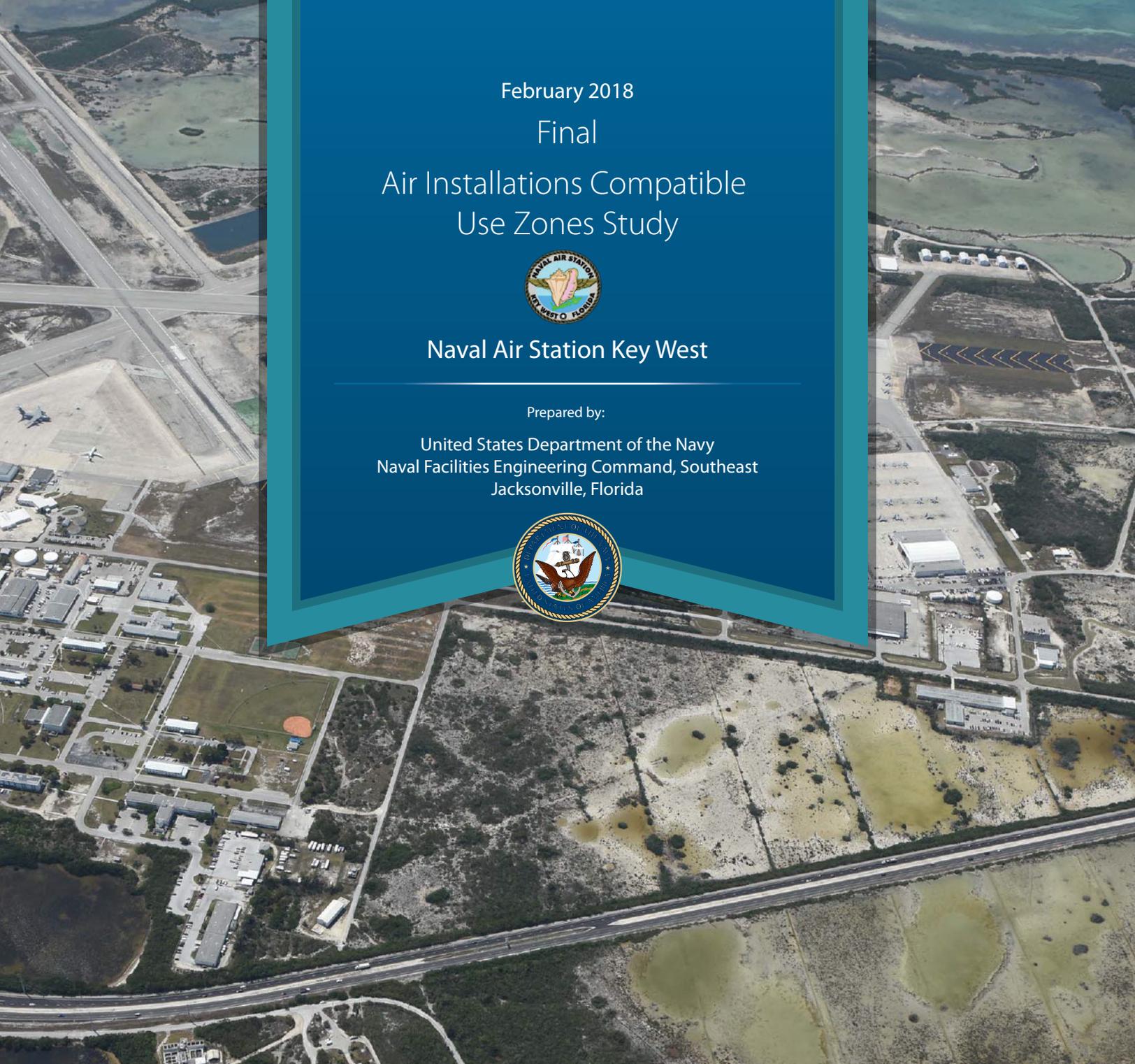
February 2018
Final
Air Installations Compatible
Use Zones Study



Naval Air Station Key West

Prepared by:

United States Department of the Navy
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Jacksonville, Florida



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FINAL

AIR INSTALLATIONS COMPATIBLE USE ZONES STUDY FOR NAVAL AIR STATION KEY WEST

FEBRUARY 2018



PREPARED BY

UNITED STATES DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST

PREPARED FOR

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NAVAL AIR STATION KEY WEST

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The United States Department of Defense (DOD) initiated the Air Installations Compatible Use Zones (AICUZ) Program to assist governments and communities in identifying and planning for compatible land use and development near military installations. The goal of the AICUZ Program is to protect the health, safety, and welfare of the public while also protecting the operational capabilities of the military. Today, the AICUZ Program is a vital tool used by the Navy to communicate with neighboring communities, government entities, and individuals regarding compatible land uses and development concerns.

This AICUZ Study was prepared for Naval Air Station (NAS) Key West in accordance with federal regulations, guidelines, and Office of the Chief of Naval Operations Instruction (OPNAVINST 11010.36C), and is an update to the 2007 AICUZ Study. Pursuant to Navy Instruction, this 2018 AICUZ Study evaluates historical noise contours and accident potential zones (APZs) as well as projected noise contours and APZs. Noise contours and APZs, together, are commonly called the “AICUZ footprint.” The 2018 AICUZ footprint is shown on Figure ES-1, and discussed further in Section 7.1, Land Use Compatibility Guidelines and Classifications.

- ES.1 Introduction
- ES.2 Naval Air Station Key West
- ES.3 Aircraft Operations
- ES.4 Aircraft Noise
- ES.5 Airfield Safety
- ES.6 Land Use Planning Authorities, Policies, Regulations, and Programs
- ES.7 Land Use Compatibility Analysis and Recommendations

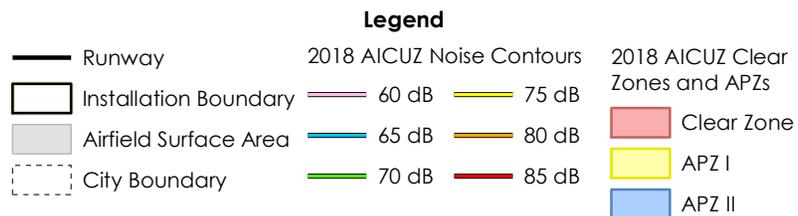
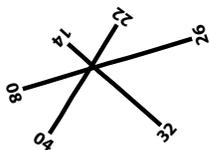
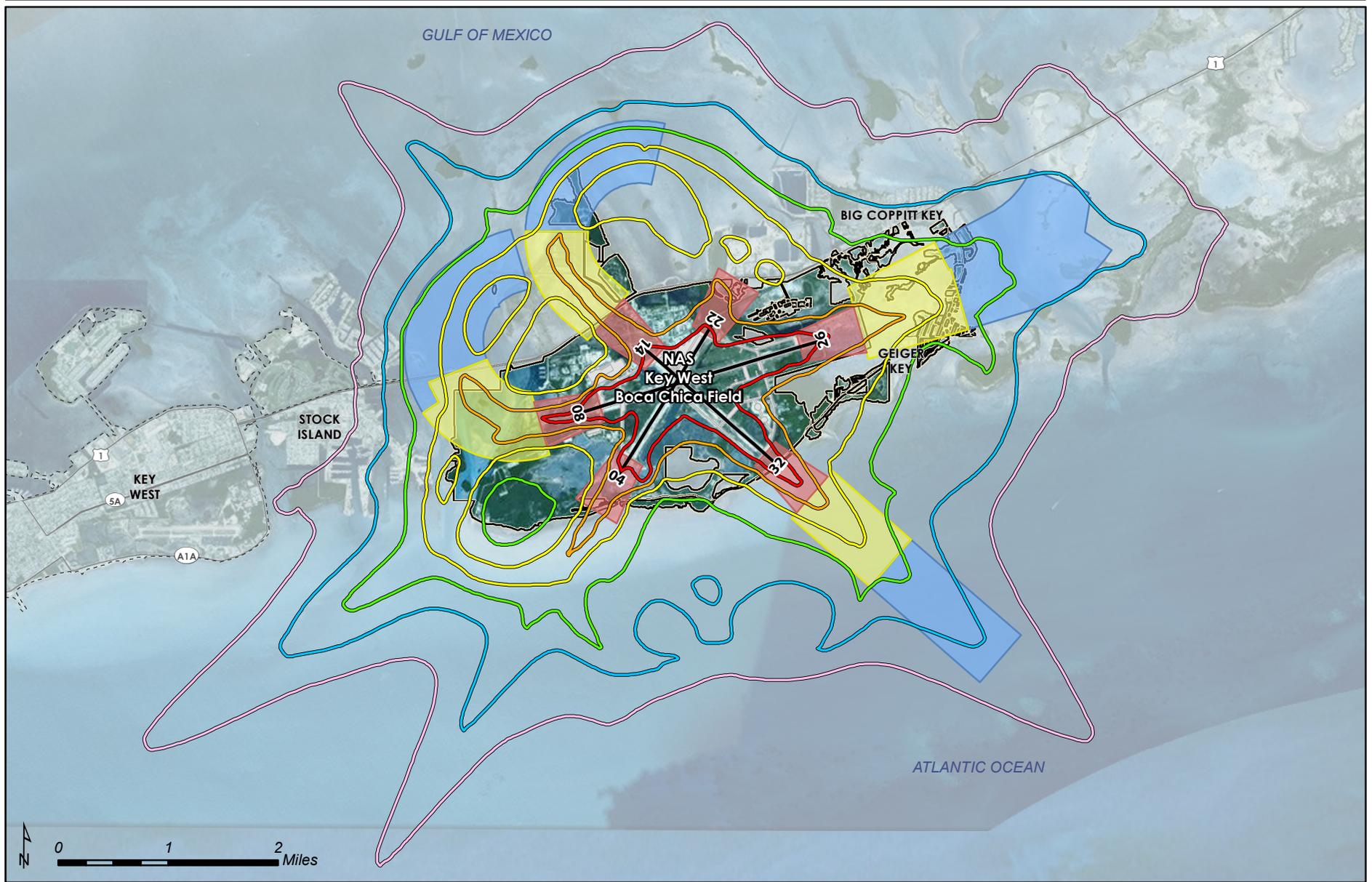


Figure ES-1
2018 AICUZ Footprint
 NAS Key West
 Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County 2015; NAVFAC SE 2015; Wyle 2013. © 2017 Ecology and Environment, Inc.

The 2018 AICUZ Study's APZs and noise contours differ from the 2007 AICUZ Study. This is because the 2018 AICUZ Study's APZs were based on the flight tracks and the number of annual operations used in the 2013 NAS Key West Airfield Operations Final Environmental Impact Statement (EIS) preferred alternative (proposed action [Alternative 2]) and the Record of Decision, dated October 31, 2013. The 2013 NAS Key West Airfield Operations Final EIS will hereinafter be referred to as the "2013 Airfield Operations EIS." The NAVFAC AICUZ Program Manager validated the EIS noise study methodology of the preferred alternative as sufficient for use in this 2018 AICUZ Study. Thus, the 2018 AICUZ footprint represents the validated EIS preferred alternative noise contours and air operations. Changes in the APZs are the result of the overlap of operational flight tracks off runway ends (approach/departure ends of Runway 08 and Runway 26), resulting in a wider than usual standard APZ configuration.

This 2018 AICUZ Study utilizes the 2013 Airfield Operations EIS data, which projected operations over a 10-year period by assessing changes in mission, aircraft, and projected operational levels through Calendar Year (CY) 2023. As a planning document, this 2018 AICUZ Study has a 10-year outlook. The Navy reviewed the 2013 Airfield Operations EIS data and determined that the projected annual operations were accurate and should be extended through CY2028 to be in line with the AICUZ update planning horizon.

ES.2 NAVAL AIR STATION KEY WEST

NAS Key West is located approximately 156 miles southwest of Miami and 90 air miles north of Cuba. Key West is the closest point in the United States to Cuba, South America, and the Caribbean Sea, which makes NAS Key West an important military and homeland security asset, independent of its role as an aviation training facility. Boca Chica Field, the primary site and airfield at NAS Key West, is located on Boca Chica Key. Boca Chica Field is approximately 4,700 acres and is located about 3 miles east of the city of Key West. NAS Key West has proven to be a year-round training facility for various types of DOD pilots and aircraft, and a variety of airfield training operations have been conducted at the airfield, including touch-and-go's, field carrier landing practice (FCLP), and other pattern operations.

NAS Key West's primary mission supports operational and readiness requirements for the DOD, Department of Homeland Security, National Guard units, federal agencies, and allied forces. NAS Key West maintains mission-critical facilities, infrastructure, and property, which support readiness training exercises and operations as well as its various tenant commands' mission responsibilities.

NAS Key West is home to 22 aircraft (various) and has the ability to support up to approximately 80 visiting aircraft and 1,200 visiting personnel at one time in addition to providing port operations for

visiting ships (Navy 2013). NAS Key West also hosts various tenant and transient activities supporting such critical missions as unique naval research, development testing, counter-drug operations, and special warfare training, and includes users such as Joint Interagency Task Force South, United States Coast Guard (USCG), and U.S. Army Special Forces Underwater Training School, among others (NAS Key West 2016).

ES.3 AIRCRAFT OPERATIONS

Aircraft operations are the primary source of noise associated with an installation. The level of noise exposure relates to several variables, including aircraft type, engine power setting, altitude flown, direction of the aircraft, flight track, temperature, relative humidity, frequency, time of operation, and duration of run-ups.

AICUZ studies account for future missions and operations. As such, this 2018 AICUZ Study analyzes and presents two conditions: (1) the historical (2007) noise contours and APZs, as presented in the 2007 AICUZ Study (NAVFAC 2007); and (2) the projected (CY2028) noise contours and operational levels, as presented in the 2013 Airfield Operations EIS (Navy 2013). Based on the changes captured in the EIS, the Navy forecasts that total annual flight operations at NAS Key West will be approximately 52,000.

The number of annual arrivals and departures are similar for the historical to projected scenario with the exception of overhead break arrivals, which decreased by approximately 4,800 annual operations. The daytime split of operations is similar for the historical and projected scenarios, with a difference of only approximately 5,000 operations. However, there is a 78 percent decrease in acoustic nighttime (10:00 p.m. to 7:00 a.m.) operations from the historical and projected scenarios.

ES.4 AIRCRAFT NOISE

This 2018 AICUZ Study discusses noise associated with aircraft operations, including average noise levels, noise abatement/flight procedures, noise complaints, sources of noise, airfield-specific noise contours, and analysis of changes from the historical (2007 AICUZ) and projected (CY2028) noise contours.

The 2018 AICUZ noise contours and projected operational data used in this 2018 AICUZ Study were adopted from the 2013 Airfield Operations EIS. In support of the 2013 Airfield Operations EIS, NAS Key West conducted a noise analysis. Data were then collected from NAS Key West, compiled, and input into computer models that graphically depict noise exposure as noise contours.

Day-night average sound level (DNL) is depicted on a map as a noise contour that connects points of equal noise value. Contours are displayed in 5-decibel (dB) increments (i.e., 60, 65, 70, 75, 80, and 85 dB DNL). The projected noise contours for NAS Key West overlay the area in the immediate vicinity of the airfield, with the vast majority of the higher noise contours concentrated within the installation boundary. The projected noise exposure primarily derives from FA-18E/F Super Hornets, F-5 Tigers, and F-35C Lightning IIs.

The historical noise contours (Noise Zones 1, 2, and 3) covered 32,986 acres as compared to 24,823 acres for the projected scenario (both on- and off-station), resulting in the total affected land area within the noise contours (Noise Zones 1, 2, and 3) decreasing by approximately 25 percent.

ES.5 AIRFIELD SAFETY

While the likelihood of an aircraft mishap is unlikely, accidents do occur. The Navy has designated areas with an accident potential based on historical data for aircraft mishaps near military airfields to assist in land use planning. APZs identify areas where an aircraft accident is most likely to occur if an accident were to take place. The APZs are not a prediction of accidents or accident frequency. When adopted by local zoning authorities, APZs minimize potential harm to the public, pilots, and property if a mishap does occur by limiting incompatible uses in the designated APZ areas.

APZs follow departure, arrival, and pattern flight tracks. There are three types of APZs: the Clear Zone, APZ I, and APZ II. APZs extend from the end of the runway, but apply to the predominant arrival and/or 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.

APZs in this 2018 AICUZ Study have been developed based on the projected annual aircraft operations presented in the 2013 Airfield Operations EIS and NAS Key West's unique training environment.

As noted in Section ES.1, Introduction, the 2018 APZs presented in this AICUZ were developed and modeled based on the operations and flight tracks approved in the 2013 Airfield Operations EIS. Changes in the APZs are the result of the overlap of operational flight tracks off Runway ends 08 and 26 (approach/departure ends), resulting in a wider than usual standard APZ configuration. The 2018 AICUZ Clear Zones and APZs for NAS Key West impact approximately 4,748 acres. About 25 percent of the impacted areas are within the installation boundary. The remaining 75 percent of impacted areas are off-station—with 88 percent (3,132 acres) of these off-station areas located over water, resulting in only 12 percent (440 acres) of the off-station areas located over land.

ES.6 LAND USE AUTHORITIES, POLICIES, REGULATIONS, AND PROGRAMS

Successful AICUZ land use compatibility implementation is the collective responsibility of the Navy, state and local governments, and private sector and non-profit organizations. This AICUZ Study discusses federal, state, and local planning authorities, regulations, and programs that encourage compatible land use practices. Ultimate control over land use and development surrounding NAS Key West is the responsibility of local governments and landowners, therefore, the Navy encourages local governments to plan for compatible development. In addition, the Navy focuses efforts on outreach and coordination with local jurisdictions to provide greater awareness and transparency of the operations in and around the installation.

The AICUZ footprint (noise contours and APZs) is located in an unincorporated area of Monroe County, Florida, and near the City of Key West's jurisdiction. Although NAS Key West's AICUZ footprint is not located within the city limit, the City has policies that relate to and affect NAS Key West. Land use planning programs, Comprehensive Plans, zoning codes, ordinances, and overlay districts, among others, with potential to influence land use near the airfield are discussed as part of this AICUZ Study.

ES.7 LAND USE COMPATIBILITY ANALYSIS AND RECOMMENDATIONS

The AICUZ Study presents the land use compatibility analysis that identifies any existing or planned land use, zoning, and development compatibility issues, as well as to provide recommendations to manage existing and future development within and around the AICUZ footprint to ensure long-term land use compatibility between local land development and the Navy's operational mission. The 2018 AICUZ footprint (Figure ES-1) is discussed further in Section 7.1, Land Use Compatibility Guidelines and Classifications.

The Navy has developed land use compatibility recommendations for noise zones and APZs to foster land use compatibility. For land use planning purposes in AICUZ studies, noise exposure areas are divided into three noise zones, based on DNL measurements. Noise Zone 1 (<55 to <65 dB DNL) is an area of low or no impact. Noise Zone 2 (65 to <75 dB DNL) is an area of moderate impact where some land use controls are recommended. Noise Zone 3 (>75 dB DNL) is the most impacted area where the greatest degree of compatible land use controls are recommended. Likewise, recommended land use compatibility guidelines are established for Clear Zones, APZ I, and APZ II.

AICUZ guidelines recommend that land uses that concentrate large numbers of people (e.g., apartments, churches, and schools) be avoided within the APZs.

This AICUZ Study addresses land use compatibility within aircraft noise zones and APZs by examining existing and planned land uses near NAS Key West. To analyze whether existing land uses are compatible with aircraft operations, the 2018 AICUZ noise contours and APZs were overlaid on parcel data and land use classification information. The land use compatibility analysis was performed on a case-by-case basis and at the land parcel level using the Navy's land use compatibility guidance and land use data from Monroe County. Noise contours and/or APZs impact areas off the installation in all directions. While the majority of the areas impacted are military, conservation, and water, there are limited amounts of residential areas located within certain APZs and noise zones.

The Navy has the responsibility to communicate and collaborate with local governments on land use planning, zoning, and compatibility concerns that can have an impact on its mission. State and local governments have the authority to implement regulations and programs to control development and direct growth to ensure land use activity is compatible within the AICUZ footprint. Local governments are encouraged to recognize their responsibility in providing land use controls in those areas encumbered by the AICUZ footprint by incorporating AICUZ information into their planning policies and regulations. Cooperation between NAS Key West and their neighboring communities is key to the AICUZ Program's success. The AICUZ Study recommendations, when implemented, will continue to advance the goal, "to protect the health, safety, and welfare of those living near military airfields, while preserving the defense flying mission."

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ACRONYMS AND ABBREVIATIONS

AICUZ	Air Installations Compatible Use Zones
Air Ops	Air Operations
APHIS WS	United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services
APZ	accident potential zones
ATC	Air Traffic Control
BASH	bird/animal aircraft strike hazard
BPAS	Building Permit Allocation System
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
CNIC	Commander Navy Installations Command
CO	Commanding Officer
CPLO	Community Planning and Liaison Officer
CY	calendar year
dB	decibel
dba	A-weighted decibel
DNL	day-night average sound level
DOD	United States Department of Defense
du/acre	dwelling units per acre
EA	environmental assessment
EAP	encroachment action plan
EIS	environmental impact statement
EMI	electromagnetic interference
F.S.	Florida Statutes
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FCLP	field carrier landing practice
FRS	Fleet Replacement Squadron

GCA	ground control approach
GIS	geographic information system
HUD	United States Department of Housing and Urban Development
KWIA	Key West International Airport
Marine Corps	United States Marine Corps
MIAI	Military Installation Area of Impact
MOA	Military Operations Area
MSL	mean sea level
NAS	Naval Air Station
NATOPS	Naval Air Training and Operating Procedures Standardization
NAVFAC	Naval Facilities Engineering Command
Navy	United States Department of the Navy
NEPA	National Environmental Policy Act
NLR	noise level reduction
NOTMAR	Notice to Mariners
OPNAVINST	Office of the Chief of Naval Operations Instruction
PAO	Public Affairs Officer
REPI	Readiness and Environmental Protection Integration
RPC	Regional Planning Council
RV	recreational vehicle
SUA	Special Use Airspace
TDR	transfer of development rights
U.S.C.	United States Code
UFC	Unified Facilities Criteria
USCG	United States Coast Guard
US Hwy 1	Overseas Highway
VFA	Strike Fighter Squadron
VFC	Fighter Squadron Composite
W-###	Warning Area

1

INTRODUCTION

- 1.1 AICUZ Program
- 1.2 Responsibility for Compatible Land Use
- 1.3 Previous AICUZ Efforts and Related Studies

Recognizing the need to foster compatible land and air uses, the United States Department of Defense (DOD) initiated the Air Installations Compatible Use Zones (AICUZ) Program in 1973 to help governments and communities identify and plan for coordinated compatible land use and development around installations. The goal of the AICUZ 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 around an air installation, and mutual cooperation between installations and their neighboring communities is key to the AICUZ Program’s success.

Military installations and their host communities often have a history of cooperation and mutual benefits. Installations provide economic benefits through jobs and contracts, while host communities provide housing, services, retail, and schools. The presence of a military installation attracts nearby community and private development of housing, restaurants, shops, and other land uses. This development can be complementary in nature, enhancing an installation’s value and function, or the surrounding land uses may be located in areas of high noise zones or accident potential, making it incompatible with the sustained long-term mission of the 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 policies and activities to minimize impacts to the military mission and the residents in the surrounding communities.

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.

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 and mission impacts. As stakeholders in the community, installations provide awareness of the military mission and operations to local communities to ensure the health, safety, and welfare of the local community and to protect the mission.

This AICUZ Study was prepared for Naval Air Station (NAS) Key West in accordance with federal regulations, guidelines, and Office of the Chief of Naval Operations Instruction (OPNAVINST 11010.36C), and is an update to the 2007 AICUZ Study. Pursuant to Navy Instruction, this 2018 AICUZ Study evaluates historical AICUZ noise contours and APZs as well as projected noise contours and APZs. The 2018 AICUZ APZs and noise contours differ from the 2007 AICUZ, as they are derived from noise contours, flight tracks, and the number of annual operations used in the 2013 Naval Air Station Key West Airfield Operations Final Environmental Impact Statement (EIS), hereinafter referred to as the 2013 Airfield Operations EIS. The NAVFAC AICUZ Program Manager validated the EIS noise study methodology of the preferred alternative (proposed action [Alternative 2]) as sufficient for use in the 2018 AICUZ Study. The historical scenario utilized in this AICUZ Study is the 2007 AICUZ Study.

In 2013, the Navy completed the NAS Key West Airfield Operations EIS. The 2013 Airfield Operations EIS preferred alternative (proposed action [Alternative 2]) and the Record of Decision, dated October 31, 2013, projected operations over 10 years (through CY2023). The noise contours and operational levels serve as the basis for this 2018 AICUZ Study.

This 2018 AICUZ Study utilizes the 2013 Airfield Operations EIS data, which projected operations over a 10-year period by assessing changes in mission, aircraft, and projected operational levels through Calendar Year (CY) 2023. As a planning document, this 2018 AICUZ Study has a 10-year outlook. The Navy reviewed the 2013 Airfield Operations EIS data, determined that the projected annual operations were accurate, and should be extended through CY2028 to be in line with the AICUZ update planning horizon.

This 2018 AICUZ Study analyzes and presents two conditions:

- (1) The historical (2007) noise contours and APZs, as presented in the 2007 AICUZ Study (NAVFAC 2007); and
- (2) The projected (CY2028) noise contours and operational levels, as presented in the 2013 Airfield Operations EIS (Navy 2013).

1.1 AICUZ PROGRAM

The DOD established the AICUZ Program to balance the need for aircraft operations with community concerns regarding aircraft noise and accident potential. The AICUZ Program provides a format to document the effects of aircraft operations in a community, while encouraging compatible development to minimize future conflicts.

The objectives of the AICUZ Program, according to the OPNAVINST 11010.36C, are:

- ❑ 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 (Marine Corps) installation investments by safeguarding the installation's operational capabilities.

To help meet AICUZ Program objectives, 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 pilots operating aircraft near an airfield. Examples of such development or land uses include: lighting (direct or reflected) that would impair pilot vision; towers, tall structures, and vegetation that penetrate navigable airspace or are constructed near an airfield; uses that generate smoke, steam, or dust; uses and/or vegetation that attract birds (especially waterfowl) as well as deer or other wildlife; and electromagnetic interference (EMI) sources that may adversely affect aircraft communication, navigation, or other electrical systems.

To meet the objectives of the AICUZ Program, the Navy recommends that local community planning authorities incorporate development criteria in areas surrounding an installation and incorporate noise exposure contours and APZs into local plans and development ordinances. Noise exposure contours and APZs, which are described in detail in Chapter 4, Aircraft Noise, and Chapter 5, Airfield Safety, respectively, are areas of concern for air installations and neighboring communities. Noise contours and APZs, together, are commonly called the "AICUZ footprint." Because noise exposure contours and APZs often extend beyond the "fence line" of an installation, presenting current noise exposure contours and APZs to local governments is essential to fostering mutually beneficial land uses and development.

1.1.1 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 local communities to foster compatible development.

The scope of this AICUZ Study analyzes:

- ❑ Historical and projected aircraft operations, including arrivals, departures, and pattern work (e.g., touch-and-go);
- ❑ Noise contours;
- ❑ Aircraft APZs;
- ❑ Land use compatibility;
- ❑ Noise reduction strategies; and
- ❑ Possible solutions to existing and potential incompatible land uses.

An AICUZ Study presents analysis of community development trends, land use tools, and mission requirements to recommend strategies for communities to prevent incompatible development. Implementation of these strategies requires cooperation between the Installation Commanding Officer, Community Planning and Liaison Officer (CPLO), and the local governments. Key documents 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 (incorporating Change 1, Effective March 12, 2015);
- ❑ OPNAVINST 11010.36C, "Air Installations Compatible Use Zones Program," dated October 9, 2008;
- ❑ Unified Facilities Criteria (UFC) 3-260-01, "Airfield and Heliport Planning and Design," dated November 17, 2008;
- ❑ Naval Facilities Engineering Command (NAVFAC) P-80.3, "Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations: Airfield Safety Clearances," dated January 1982; and

The Navy's AICUZ Program Instruction (OPNAVINST 11010.36C) currently governs the AICUZ Program.

- ❑ United States Department of Transportation, FAA Regulations, Title 14 Code of Federal Regulations (CFR) Part 77, “Objects Affecting Navigable Airspace.”

1.2 RESPONSIBILITY FOR COMPATIBLE LAND USE

The AICUZ Program promotes compatible land use development and activities around military air installations through cooperation and engagement with the community. Therefore, ensuring land use compatibility near an air installation is a collaborative effort by many organizations, including the DOD, Navy, local naval installation command, state and local governments, planning and zoning agencies, developers, real estate agencies, and residents.

State and local governments have the responsibility to protect public health, safety, and welfare. The Navy has similar responsibilities, while concurrently preserving the mission and operations of the installation. The Navy actively works with state and local government agencies to engage and inform the local communities throughout the development and implementation of compatible land use recommendations that minimize noise impacts and the potential for accidents around air installations. While military installations can advise local government agencies on land use near the installation by providing information on aircraft noise and accident potential, the state and local government agencies have the authority to preserve land use compatibility through the adoption and implementation of appropriate control measures. This AICUZ Study provides recommendations to encourage the local community to consider and adopt such measures.

Cooperative action by all parties is essential in promoting compatible land use and deterring potential hazards. Chapter 7, Land Use Compatibility Analysis and Recommendations, discusses the Navy’s compatible land use tools and recommendations in more detail.

1.3 PREVIOUS AICUZ EFFORTS AND RELATED STUDIES

Updates to an AICUZ Study often account for changes in aircraft that utilize an installation, changes in operational parameters, and changes derived from revisions to the Navy AICUZ Instruction. Since the inception of the AICUZ Program in 1973, NAS Key West has experienced many mission and operational changes, and has undergone several AICUZ studies. The following sections highlight the AICUZ Study history at NAS Key West, describe the changes that require an AICUZ Study Update, summarize the changes that necessitate this AICUZ Study update, and provide an overview of this document.

1.3.1 PREVIOUS AICUZ EFFORTS

There have been various AICUZ studies completed for NAS Key West since the inception of the AICUZ Program. The following sections present the key elements of the two AICUZ studies completed for NAS Key West.

1977 AICUZ STUDY FOR NAS KEY WEST

This original AICUZ Study, published in 1977, was prepared following the establishment of the DOD AICUZ Program under the authority of the 1975 DOD Instruction. The 1977 AICUZ Study served as the basis for NAS Key West's AICUZ Program and formalized the installation's communication and outreach with the local communities.

2004 AICUZ STUDY UPDATE FOR NAS KEY WEST

In May of 2004, the Chief of Naval Operations approved an AICUZ Study Update for NAS Key West. The AICUZ Study Update superseded the 1977 AICUZ and incorporated more modern analytical tools to address noise, safety, and land use compatibility issues associated with then current and projected future aircraft training in the vicinity of the installation.

2007 AICUZ STUDY UPDATE FOR NAS KEY WEST

The 2007 AICUZ Study Update, published in March 2007, revised the original 1977 AICUZ Study and was an update to the 2004 AICUZ Study Update. The 2007 AICUZ Study Update was published under the authority of OPNAVINST 11010.36B, "Air Installations Compatible Use Zones Program (AICUZ)," dated December 19, 2002.

1.3.2 OTHER RELATED PLANNING DOCUMENTS

Other planning documents related to NAS Key West provide additional context in the development and management of their existing AICUZ Program. In addition to the previously conducted AICUZ studies, there has also been an EIS (2013).

NAS KEY WEST AIRFIELD OPERATIONS ENVIRONMENTAL IMPACT STATEMENT (2013)

The 2013 Airfield Operations EIS described the Navy's proposed actions to support and conduct aircraft training operations at NAS Key West by maintaining current and existing airfield operations, supporting airfield operations by new types of aircraft, and modifying airfield operations, as necessary in support of the Fleet Readiness Training Plan (Navy 2013). The 2013 Airfield Operations EIS preferred alternative and Record of Decision, dated October 31, 2013, represent the projected

(CY2028) operations used for this 2018 AICUZ Study. The noise contours and operational levels (up to approximately 52,000 annual airfield operations) serve as the basis for this 2018 AICUZ Study.

1.3.3 CHANGES THAT NECESSITATE THIS AICUZ UPDATE

AICUZ updates follow DOD and Navy Instruction. Updates are determined necessary based on a variety of factors, but primarily are conducted if an air installation has a significant change or projected change in aircraft operations, a significant increase in nighttime flying activities, a change in the aircraft based and operating at the installation, or changes in flight paths or runway utilization. Another critical determining factor is an installation's acquisition or discontinuation of a mission that affects aircraft operations. Other factors to consider include the year of the previous AICUZ Study, updates to the DOD or Navy Instruction, updates to noise modeling methods, and local community land use changes and developments.

This 2018 AICUZ Study was developed in accordance with OPNAVINST 11010.36C and is a formal update to the 2007 AICUZ Study Update. This 2018 AICUZ Study provides NAS Key West's projected aircraft operations for CY2028. The justifications for this 2018 AICUZ Study include:

- ❑ Updated AICUZ Program guidance and instructions:
 - OPNAVINST was updated in 2008; and
 - DOD Instruction was updated in 2011.
- ❑ Changes in aircraft types operating at the installation.
- ❑ Changes in transient aircraft types at the installation.
- ❑ Adjustments to flight tracks and flight track utilization.
- ❑ Changes in designated locations for aircraft maintenance and engine run-ups.
- ❑ The age of the current AICUZ Study (> 10 years old).
- ❑ Advancements in the DOD NOISEMAP suite of computer-based noise modeling tools that are used to generate the AICUZ noise contours:
 - Updated aircraft acoustical data;
 - Addition of terrain into noise modeling;
 - Conducted using the "Average Annual Day" methodology; and

- Improved geographical technology.
- Changes in the local planning and governmental settings and the recommendations and strategies for local land use compatibility.

These factors have differing effects on the noise contours and APZs, commonly called the AICUZ footprint. These effects, as well as the extent of changes from the 2007 AICUZ Study, are discussed further in Chapter 3, Aircraft Operations, Chapter 4, Aircraft Noise, and Chapter 5, Airfield Safety.

1.3.4 AICUZ STUDY

Pursuant to Navy Instruction, this AICUZ Study evaluates historical (2007 AICUZ) noise contours and APZs and projected (CY2028) noise contours and APZs. The comparison of these data sets provides an understanding of the changes at NAS Key West that have occurred and provides the basis for the projected scenario. This AICUZ Study addresses the expected changes in mission, aircraft, and projected operational levels through CY2028.

This AICUZ Study is comprised of the following chapters:

- **Chapter 1:** Provides background information on the AICUZ Program, NAS Key West AICUZ overview, and changes that require an AICUZ Update;
- **Chapter 2:** Describes the location, history, mission, users, and operational areas;
- **Chapter 3:** Discusses aircraft types, operations, and operational alternatives;
- **Chapter 4:** Contains the AICUZ noise contours, outlines the methodology for determining noise contours, and discusses measures the Navy has implemented to mitigate any community noise concerns;
- **Chapter 5:** Discusses AICUZ APZs and airfield safety;
- **Chapter 6:** Describes land use authorities, policies, regulations, and programs, and how they promote, or can promote, the land use goals of the AICUZ Program; and
- **Chapter 7:** Provides an analysis of land use compatibility, as well as recommendations for promoting land use compatibility consistent with the goals of the AICUZ Program.

2

NAVAL AIR STATION KEY WEST

- 2.1 Location and History
- 2.2 Mission and Installation Activities
- 2.3 Operational Areas
- 2.4 Local Economic Impacts and Population Growth

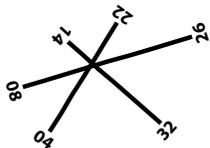
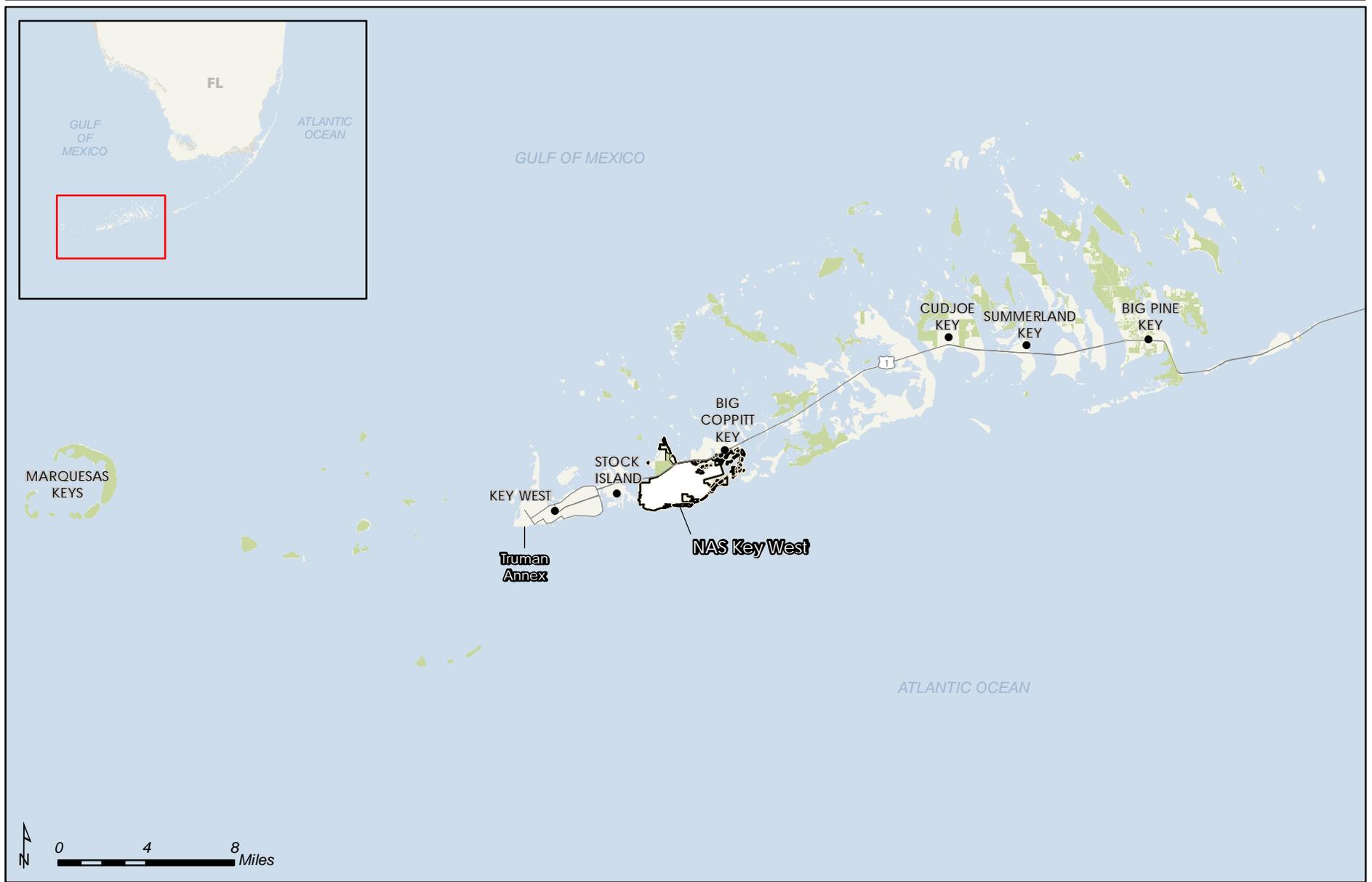
2.1 LOCATION AND HISTORY

NAS Key West is comprised of approximately 6,500 acres of land distributed over several properties in the Florida Keys in Monroe County, Florida (Figure 2-1). NAS Key West is located approximately 156 miles southwest of Miami and 90 air miles north of Cuba. Key West is the closest point in the United States to Cuba, South America, and the Caribbean Sea, which makes NAS Key West an important military and homeland security asset, independent of its role as an aviation training facility. Boca Chica Field, the primary site and airfield at NAS Key West, is located on Boca Chica Key. Boca Chica Field is approximately 4,700 acres and is located about three miles east of the city of Key West (Figure 2-2). In addition to the airfield, the Boca Chica Field property also includes administrative and industrial facilities as well as recreational areas.

The Navy’s presence in Key West dates back to 1823 when a naval base was established to stop piracy in the area. Over time, the base has evolved to support different operations and missions. (Navy 2013)

The Navy’s presence in Key West dates back to 1823 when a naval base was established to stop piracy in the area. NAS Key West was sited at its present location on Boca Chica Key in the early 1940s during World War II.

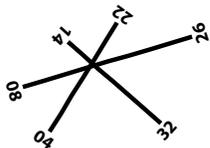
NAS Key West was established at its present location on Boca Chica Key in the early 1940s during World War II. Boca Chica Field originated as a civilian airfield. When three paved runways were built in 1942, the airfield was leased to the Army and it was then transferred to the Navy by the end of that same year. During the war, the installation was used to train carrier pilots, among other functions. (Navy 2013)



Legend

- Populated Place
- Major Road
- Installation Boundary
- National Wildlife Refuge

Figure 2-1
Regional Location Map
NAS Key West
Florida



Legend

- Runway
- Installation Boundary
- Airfield Surface Area
- City Boundary

Figure 2-2
NAS Key West
Monroe County, Florida

During the Cuban missile crisis in the early 1960s, operational and reconnaissance flights were flown from the air station in support of the blockade around Cuba. After the Cuban missile crisis, permanent missile sites were constructed at various locations around the air station, and alert aircraft were maintained at the airfield. (Navy 2013)

Although much of the military presence in the Lower Keys was disestablished in March 1979, NAS Key West continues to be a fully operational naval air station (Navy 2013). Throughout the decades, NAS Key West has proven to be a year-round training facility for various types of DOD pilots and aircraft, and a variety of airfield training operations have been conducted at the airfield, including touch-and-go's, field carrier landing practice (FCLP), and other pattern operations. NAS Key West's access to offshore ranges and its temperate weather conditions provide an ideal flying environment with unparalleled aerial ranges that offer aircrew training within minutes after takeoff (NAS Key West 2016).

2.2 MISSION AND INSTALLATION ACTIVITIES

NAS Key West's primary mission supports operational and readiness requirements for the DOD, Department of Homeland Security, National Guard units, federal agencies, and allied forces. NAS Key West maintains mission-critical facilities, infrastructure, and property, which support readiness training exercises and operations, as well as its various tenant commands' mission responsibilities.

NAS Key West is equipped with a Tactical Combat Training System that tracks and records aerial maneuvers, making it the Navy's premier East Coast transient pilot training facility for tactical aviation squadrons. Ideal weather throughout the year, efficient access to offshore training areas, and existing aviation-related assets allow NAS Key West to serve as an ideal operating base for opposition and aggressor forces that conduct operations against Carrier Strike Group assets during readiness exercises. Military assets in training evolutions utilize designated airspace and the Tactical Combat Training System in the Key West area. (NAS Key West 2016)

2.2.1 TENANT COMMANDS

NAS Key West is home to 22 aircraft (various) and has the ability to support up to approximately 80 visiting aircraft and 1,200 visiting personnel at one time in addition to providing port operations for visiting ships (Navy 2013). NAS Key West also hosts various tenant and transient activities supporting such critical missions as unique naval research, development testing, counter-drug operations, and special warfare training, and includes users such as Joint Interagency Task Force South, United States Coast Guard (USCG), and U.S. Army Special Forces Underwater Training School, among others (NAS Key West 2016).

Aviation squadrons from around the country utilize NAS Key West on a regular basis to fulfill their missions, and include active and reserve fighter/strike fighter communities, Fleet Replacement Squadrons (FRSs), and other military service users. NAS Key West has been a home base to various squadrons and squadron detachments flying anti-submarine warfare, tactical electronic warfare, reconnaissance, attack, combat adversary, and strike fighter aircraft.

The most frequent operators at NAS Key West utilizing the airfield include:

- ❑ **Fighter Squadron Composite (VFC) 111 “Sundowners” Adversary Squadron:**
VFC-111 is part of the Navy Reserves’ fleet adversary program and acts as an opposing force in air-to-air combat training. VFC-111’s primary role is to serve as an air-to-air combat training adversary squadron for various visiting detachments. VFC-111 flies F-5N Tiger aircraft and is the only fighter squadron home based at NAS Key West. (Wyle 2013)



- ❑ **Strike Fighter Squadron (VFA) 106 “Gladiators” Detachment Key West:** Based at NAS Oceana, Virginia, VFA 106 flies FA-18 C/D Hornet and FA-18 E/F Super Hornet aircraft and prepares fleet pilots for assignment to deploying FA-18 squadrons. VFA-106 is a Fleet Replacement Squadron (FRS) with a permanent detachment in Key West.



Table 2-1 provides a list of NAS Key West’s major tenants and transient users.

TABLE 2-1 NAS KEY WEST MAJOR TENANTS AND TRANSIENT USERS

TENANTS:
<p>Naval Air Detachment Key West. Supports the mission of the parent command in providing research, design, development, and systems engineering; acquisition; test and evaluation; training facilities and equipment; repair and modification; and in-service engineering and logistics support and other pertinent system developments within the scope of the Naval Air Warfare Center Detachment.</p>
<p>Fleet Readiness Center Southeast. Maintains capability for and performs a complete range of depot-level rework operations on designated weapon systems, accessories, and equipment; manufactures parts and assemblies; provides engineering services in the development of changes of hardware design; furnishes technical and other professional services on aircraft maintenance and logistics problems.</p>
<p>Fleet and Industrial Supply Center Jacksonville Detachment Key West. Provides air operations support (storage and distribution of liquid oxygen and nitrogen) and administrative support services (administrative supplies, purchasing, Defense Reutilization Marketing Office).</p>
<p>VFC 111 “Sundowners” Adversary Squadron. Part of the Navy Reserves’ fleet adversary program and provides dissimilar air combat training; VFC 111 flies F-5N Tiger aircraft and acts as an opposing force in air-to-air combat training.</p>

TABLE 2-1 NAS KEY WEST MAJOR TENANTS AND TRANSIENT USERS

VFA 106 “Gladiators” Detachment Key West. Based at NAS Oceana, Virginia; flies FA-18 C/D Hornet and FA-18 E/F Super Hornet aircraft and prepares fleet pilots for assignment to deploying FA-18 squadrons.

Joint Interagency Task Force South. Conducts interagency and international detection and monitoring operations, reconnaissance, counter-drug, and counterterrorism; facilitates the interdiction of illicit trafficking in support of national security.

U.S. Army Special Forces Underwater Operations School. Provides Special Operations training centered on maritime operations and techniques used to infiltrate enemy areas to avoid detection.

Naval Research Laboratory. Operates the Marine Corrosion Facility, which conducts research, development, testing, and evaluation in corrosion control to provide engineering solutions to the Navy fleet to reduce the effects of the marine environment on naval systems.

Navy Branch Health Clinic. Provides medical and dental services for Navy personnel, dependents, transients, and tenants, and is the southernmost clinic in Navy Medicine Support Command Jacksonville.

Navy Munitions Command Detachment. Provides ammunition and other ordnance material, operates and maintains explosive ordnance outloading/transshipment, and maintains aviation weapons support equipment to support Atlantic Fleet and DOD ammunition requirements.

Center for Security Forces. Provides training and human performance solutions to meet fleet requirements for antiterrorism/security force, expeditionary warfare, and code of conduct mission areas.

United States Coast Guard. USCG Sector Key West provides maritime safety, search and rescue, and national security mission support under the Department of Homeland Security. The Sector was created from combining the resources of Group Key West and Marine Safety Detachment Marathon and authorities from Marine Safety Office Miami.

TRANSIENTS:

Commander, Naval Air Forces, Chief of Naval Air Training (CNATRA). Headquartered on board NAS Corpus Christi, Texas, CNATRA leads the Naval Air Training Command (NATRACOM) composed of five Training Air Wings. CNATRA conducts six Student Naval Aviator training pipelines – Strike, Rotary, Maritime, Tilt-rotor, E-2/C-2, and E-6.

Naval Special Warfare Groups. Command, train, equip, and deploy components of Naval Special Warfare squadrons built around deployed sea, air, and land (SEAL) teams to meet exercise, contingency, and wartime requirements around the world.

Fleet Replacement Squadrons (FRS). Strike Fighter Squadron (VFA) VFA-101, based at Eglin Air Force Base in Fort Walton Beach, Florida, trains and qualifies F-35C aircrew and maintenance professionals as part of a Carrier Air Strike Group; VFA 106 flies FA-18 C/D Hornet and FA-18 E/F Super Hornet aircraft and prepares fleet pilots for assignment to deploying FA-18 squadrons.

Marine Tactical Electronic Warfare Training Squadron 1 (VMAQT-1). The Marine Corps electronic warfare training squadron consisting of EA-6B Prowler jets. The squadron is based at Marine Corps Air Station Cherry Point, North Carolina, and falls under the command of Marine Aircraft Group (MAG) 14.

2.3 OPERATIONAL AREAS

NAS Key West is comprised of Boca Chica Airfield and several separate annexes, properties, and training areas located within the boundaries of Monroe County and near the City of Key West (Navy 2016). While NAS Key West maintains mission-critical facilities, infrastructure, and property, which support readiness training exercises and operations, as well as its various tenant commands' mission responsibilities, the focus of this AICUZ Study is on aircraft operations conducted at Boca Chica Field.

2.3.1 AIRFIELD

Boca Chica Field, NAS Key West's airfield, is comprised of three asphalt runways (Runways 04/22, 08/26 and 14/32) and is utilized by fixed-wing aircraft. Runways are numbered according to their magnetic heading for aircraft approach or departure. For example, on Runway 04/22, the number 04 and 22 signify that this runway is most closely aligned with a compass heading of 40 and 220 degrees, respectively.

The runways discussed in this 2018 AICUZ Study have been renumbered from the runway numbers presented in the 2007 AICUZ and 2013 Airfield Operations EIS, which were labeled as 03/21, 07/25, and 13/31. This is due to magnetic variation, sometimes called magnetic declination, which changes over time and with location. In order to determine the magnetic variation, the DOD uses the World Magnetic Model (WMM) developed by the National Centers for Environmental information and the British Geological Survey. The WMM is the standard model used by the DOD for navigation, attitude, and heading referencing systems using the geomagnetic field. The latest update to the WMM was published in December of 2014 for the 2015 to 2020 time period (NOAA, n.d.). Per FAA Advisory Circular 150/5340-1, Standards for Airport Markings, the runway designation number should be the whole number nearest one-tenth of the magnet azimuth when viewed from the direction of approach. For example, where the magnetic azimuth is 183 degrees, the runway designation marking would be 18; and for a magnetic azimuth of 87 degrees, the runway designation marking would be 9. For a magnetic azimuth ending in the number "5", such as 185 degrees, the runway designation marking can be either 18 or 19. Although the runways were renumbered since the 2007 AICUZ Study and the 2013 Airfield Operations EIS, the runway layouts and configurations remains the same at NAS Key West and as presented in this 2018 AICUZ Study.

The Boca Chica Field's runways have been renumbered from the numbers presented in the 2007 AICUZ and 2013 Airfield Operations EIS, which were labeled as 03/21, 07/25, and 13/31. This is due to magnetic variation, sometimes called magnetic declination, which changes over time and with location.

Runway 08/26 is 10,000 feet by 200 feet, and crosswind Runways 04/22 and 14/32 are both 7,000 feet by 150 feet. The NAS Key West airfield elevations are 6 feet above mean sea level (MSL).

Normal hours of operation at NAS Key West are during acoustic daytime (7:00 a.m. to 10:00 p.m.), seven days a week, except in observance of federal holidays when the airfield is closed for air operations; however, operational requirements may necessitate operations to take place outside of these hours, such as during acoustic nighttime hours (10:00 p.m. to 7:00 a.m.).

2.3.2 AIRSPACE

The FAA’s National Airspace System dictates the use of airspace over NAS Key West and also seeks to ensure the safe, orderly, and efficient flow of commercial, private, and military aircraft. 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 Air Traffic Control (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 (Figure 2-3) (FAA 2016).

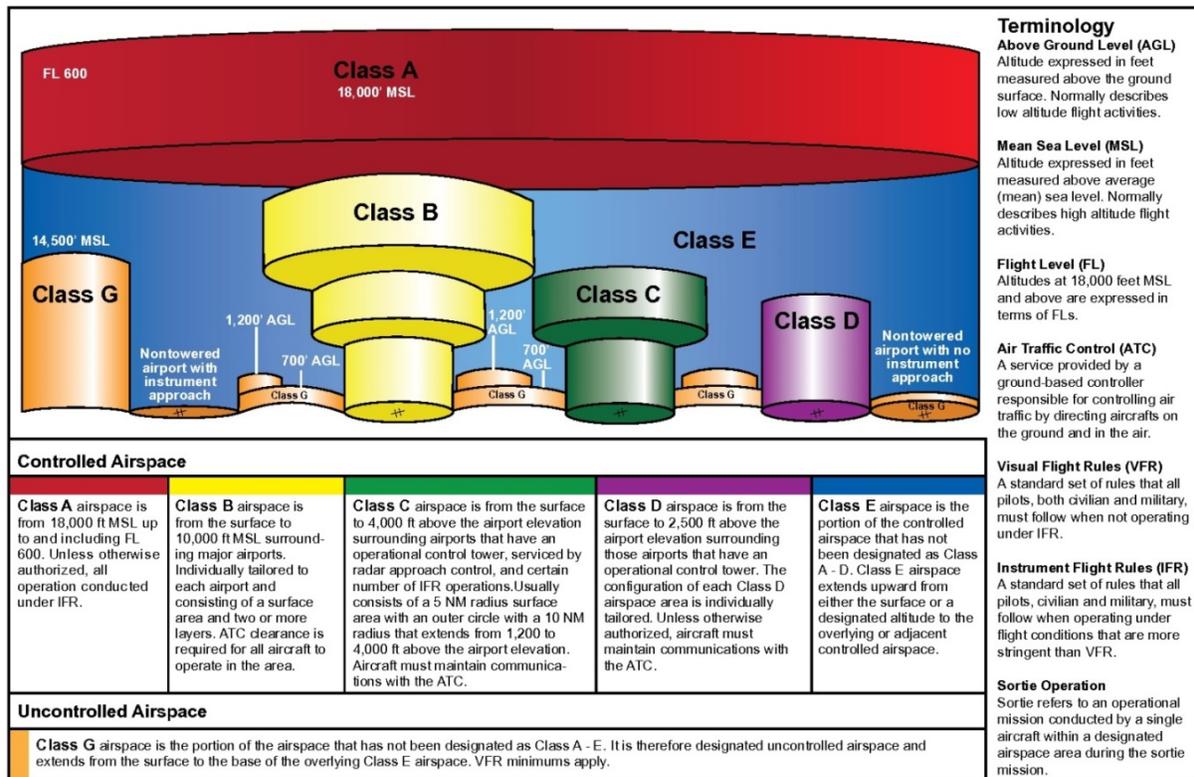


FIGURE 2-3 GENERAL AIRSPACE CLASSIFICATIONS

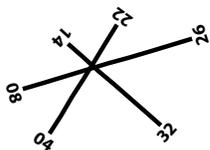
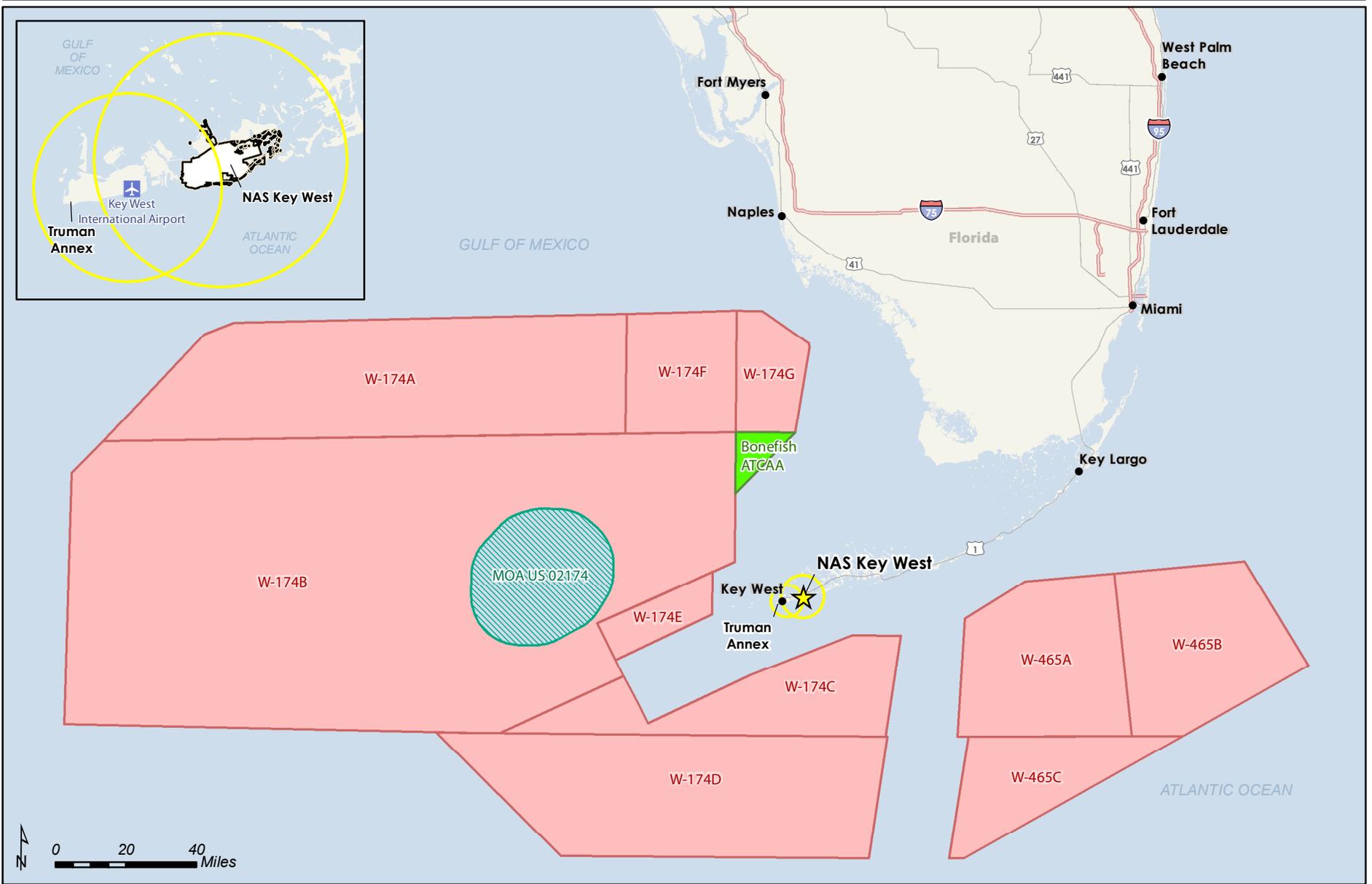
NAS Key West is the East Coast's premier transient pilot training facility and includes an air-to-air venue that is able to accommodate a variety of training exercises that include air combat maneuvering, live-fire activity, and ordnance delivery. NAS Key West's airspace consists of two large blocks of Special Use Airspace (SUA), Warning Areas W-174 and W-465, which are divided into 17 individual SUA grids. W-174 is a 19,459-square-nautical-mile area of offshore SUA, west and north of NAS Key West. W-174 is divided into nine sub-areas (A, B[A], B[B], C[A], C[B], D, E, F, and G). SUA extends from the surface to flight level 700 in areas W-174A/B/C/D/F/G and from the surface to flight level 300 in area W-174E. The entire warning area is designated for concurrent use. Under these conditions, military aircraft share the airspace with commercial air traffic. W-465 is an approximately 3,687-square-nautical-mile area of offshore SUA, located 50 nautical miles east of NAS Key West. W-465 is divided into three sub-areas (A, B, and C). SUA extends from the surface to flight level 700 in areas W-465A and B and from flight level 210 to FL 700 in area W-465C.

Boca Chica Field is located within a Class D controlled airspace complex that serves NAS Key West and Key West International Airport (KWIA). The Class D airspace extends from the ground to 2,500 feet above ground level within a 3.9-mile radius of KWIA and within a 5.3-mile radius of NAS Key West (Figure 2-4). NAS Key West's ATC provides approach control services for both airfields during the normal operating hours of 7:00 a.m. to 10:00 p.m. (Navy 2013).

2.4 LOCAL ECONOMIC IMPACTS AND POPULATION GROWTH

The military provides direct, indirect, and induced economic benefits to the regional and local communities where they are located through jobs and wages, regional sales and production, and contracts (expenditures). Benefits include employment opportunities and increases in local business revenue, property sales, and tax revenue. The military creates a stable and consistent source of revenue for surrounding communities. Working to achieve compatibility with local development and activities with NAS Key West's mission continues to ensure its viability into the future and its positive impact on the local communities and the surrounding region.

In 2014, NAS Key West employed an estimated workforce of approximately 2,700 personnel on-station (Department of Transportation Aviation and Spaceports Office 2014). Overall, NAS Key West accounted for 8,606 jobs in Monroe County and \$1 billion in total Gross Regional Product (total value of all goods and services produced in the region), which was roughly 26 percent of county's total estimated 2014 Gross Regional Product (Enterprise Florida, and Exponential Analytics, Inc. 2015).



- Legend**
- NAS Key West
 - Interstate Highway
 - U.S. Highway
 - Installation Boundary
 - Class D Airspace
 - Bonefish Air Traffic Control Assigned Airspace
 - Tortugas Military Operations Area (Military Special Use Airspace)
 - Warning Area (Military Special Use Airspace)

Figure 2-4
Regional Airspace
 NAS Key West
 Florida

NAS Key West payroll and expenditures in 2014 totaled \$159,200,000 and \$69,800,000, respectively (Department of Transportation Aviation and Spaceports Office 2014). This includes active and inactive duty military pay, military retirement and disability payments, civilian pay, and procurements. By 2012, the ratio of average military earnings per military worker to average earnings per worker had reached 283% (Enterprise Florida, and Exponential Analytics, Inc. 2015). As a result, the military creates a stable and consistent source of employment and tax revenue for the area's local economies. Besides military spending, other key economic drivers of the area around NAS Key West include tourism, accommodations, and food services.

NAS Key West is located east of the City of Key West and is situated in Monroe County. In 2000, there were 79,589 residents in Monroe County and 73,090 residents in 2010, resulting in an 8.17 percent decrease, (U.S. Census Bureau 2010). It is estimated that the population will increase to 74,414 by 2020, or 1.81 percent more than the 2010 population. Florida population data and growth projections for the city of Key West, Monroe County, and the state of Florida are summarized in Table 2-2.

Although the population of the City of Key West and Monroe County have experienced negative growth since 2000, the population of Monroe County is projected to grow by 2.04 percent between 2010 and 2030. This regional growth has the potential to impact NAS Key West in terms of new developments around the installation. A discussion of local and regional compatibility issues is provided in Chapter 7, Land Use Compatibility Analysis and Recommendations, of this AICUZ.

TABLE 2-2 REGIONAL POPULATION ESTIMATES AND PROJECTIONS

Population Area	1990 ^a	2000 ^a	2010 ^a	2020 ^{b,c}	2030 ^{b,c}	% Growth 2010-2020	% Growth 2020-2030
Key West	24,832	25,478	24,649	23,997 ^c	23,350 ^c	-2.65%	-2.7%
Monroe County	78,024	79,589	73,090	74,414 ^b	74,583 ^b	1.81%	0.23%
Florida	12,938,071	15,982,824	18,802,847	21,372,207 ^b	24,070,978 ^b	13.66%	12.63%

Sources:

- ^a U.S. Census Bureau 2010
- ^b Bureau of Economic and Business Research 2016
- ^c City of Key West 2013

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3

- 3.1 Aircraft Types that Operate at NAS Key West
- 3.2 NAS Key West Aircraft Operations

AIRCRAFT OPERATIONS

Aircraft operations are the primary source of noise associated with an installation. The level of noise exposure relates to a number of variables, including aircraft type, engine power setting, altitude flown, direction of the aircraft, flight track, temperature, relative humidity, frequency, time of operation, and duration of run-ups.

This chapter of the AICUZ Study discusses aircraft types and aircraft operations at NAS Key West, including based aircraft and transient aircraft, as well as preflight and maintenance operations, flight operations, annual operations, flight track use, and operational alternatives.

3.1 AIRCRAFT TYPES THAT OPERATE AT NAS KEY WEST

This AICUZ Study analyzes two types of aircraft: fixed-wing and rotary-wing (called rotary wings or rotor blades). Fixed-wing aircraft include turbine (jet) and propeller-driven aircraft, and generate lift by forward motion through the air. Rotary-wing aircraft, commonly called helicopters, generate lift by wing motion relative to the aircraft.

Aircraft that operate at NAS Key West are either based or transient. Based aircraft are permanently assigned at NAS Key West. Based aircraft utilize NAS Key West on a regular basis and are the most common aircraft conducting operations at and around the airfield. Transient aircraft are all other aircraft not permanently based at NAS Key West. Transient aircraft conduct training or other mission-related operations at the airfield for weeks at a time, but some may only land briefly to refuel.

3.1.1 TYPICAL AIRCRAFT MIX

The aircraft described in this section are associated with the squadrons and/or tenants described in Section 2.2, Mission and Installation Activities, and are the most common aircraft conducting operations at and around the NAS Key West airfield (Boca Chica field).

Approximately 52,000 airfield operations are conducted each year at NAS Key West (Navy 2013). Aircraft that currently operate at NAS Key West include the FA-18C/D Hornet, FA-18E/F Super Hornet, F-5N Tiger, E-2C Hawkeye, EA-6B Prowler, AV-8B Harrier, F-16 Fighting Falcon, F-15 Eagle, and F-22 Raptor, as well as various helicopters and other aircraft (see Table 3-1).

Nomenclature following the aircraft identifier often designates different models/series of the aircraft to identify changes to the aircraft or equipment. These differences are commonly called “variants” of the aircraft. For example, the F-35 has three variants: (A) conventional takeoff and landing; (B) short takeoff and vertical landing; and (C) carrier-based.

Next generation aircraft began to replace those currently in the DOD inventory, including the F-35 Lightning II, EA-18G Growler, and P-8 Poseidon. The gradual transition to next generation aircraft that operate at NAS Key West includes:

- ❑ The Navy F-35C Lightning II, Joint Strike Fighter carrier variant, began to replace the Navy FA-18C/D Hornet in 2016, with the transition expected to be completed by 2029; however, the end date for the transition may shift, depending on the Navy’s procurement budget.
- ❑ The Navy P-8A Poseidon began to replace the P-3 Orion in 2012, with the transition scheduled to be completed by 2019 (Navy 2008).
- ❑ The Marine Corps F-35B Lightning II (short takeoff and vertical landing variant) and F-35C Lightning II (aircraft carrier variant) Joint Strike Fighter began to replace Marine Corps AV-8B Harrier and FA-18C/D Hornet aircraft in 2012, with the transition scheduled to be completed by 2023; however, the end date for the transition may shift depending on the Navy’s procurement budget.
- ❑ The Air Force F-35A Lightning II, Joint Strike Fighter conventional takeoff and landing variant, began to replace the F-16 Fighting Falcon in 2013; the transition is expected to be completed by the mid-2030s; however, the end date for the transition may shift depending on the Air Force’s procurement budget.
- ❑ The Air Force F-22 Raptor is replacing some F-15 Eagle aircraft.

TABLE 3-1 AIRCRAFT CURRENTLY OPERATING AT NAS KEY WEST

AV-8B Harrier



EA-6B Prowler



F-5N Tiger



F-15 Eagle



F-16 Falcon



F-22 Raptor



FA-18 C/D Hornet



FA-18 E/F Super Hornet



F-35C Lighting II



T-45 Goshawk



C-2 Greyhound



C-130 Hercules



E-2C Hawkeye



P-3 Orion



P-8A Poseidon



HH-60 Pave Hawk



HH-65 Dolphin



MH-60S Sea Hawk



3.2 NAS KEY WEST AIRCRAFT OPERATIONS

A primary function of an AICUZ Study is to present noise contours and APZs for an airfield. The foundation for development of both noise contours and APZs are aircraft operations. “Aircraft operation” is a term that describes the pre-flight and flying activities of an aircraft. These activities make up the two primary sources of aircraft noise at NAS Key West: (1) pre-flight and maintenance operations; and (2) flight operations. The level of noise exposure from an aircraft operation is related to the aircraft type, engine power setting, altitude flown, direction of the aircraft, duration of run-up, flight track, temperature, relative humidity, frequency, and time of operation.

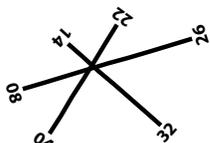
3.2.1 PRE-FLIGHT AND MAINTENANCE OPERATIONS

“Pre-flight run-ups” refer to aircraft engine checks conducted immediately prior to takeoff. Pre-flight run-ups are conducted on the runway ends or within designated areas. To perform various tests or repairs, run-ups are also conducted when an aircraft is parked on the ground and the engine is running. Maintenance run-up operations (i.e., aircraft engine maintenance) are conducted along the flight line at designated areas commonly referred to as high-power turn-up pads. Engine maintenance activities include engine rinses and washes, maintenance turn-ups, and high-power turn-ups. In some instances, the engine may be removed from the aircraft and placed on an engine stand. Figure 3-1 shows the locations of pre-flight and engine maintenance operations at NAS Key West.

3.2.2 FLIGHT OPERATIONS

A flight operation refers to any occurrence of an aircraft taking off or landing on the runway at an airfield. A common example of a takeoff operation is a departure of an aircraft to another location; a landing operation is an aircraft arrival from another location to the airfield. Additionally, a takeoff and landing may be part of a training maneuver or pattern (e.g., touch-and-go), which includes a takeoff and landing back to the same runway. These patterns are considered two operations because the departure and arrival each count as one operation. Typical flight operations at NAS Key West are described below:

- ❑ **Departure.** An aircraft takes off to leave the installation or as part of a training maneuver.
- ❑ **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.



Legend

- Pre-Flight and Engine Run-Up Location
- Runway
- Installation Boundary
- Airfield Surface Area

Figure 3-1
Pre-Flight and Engine
Maintenance Operations Locations
NAS Key West
Monroe County, Florida

- ❑ **Overhead Break Arrival.** An expeditious arrival where an aircraft approaches the runway 200 feet above the altitude of the landing pattern (1,500 feet above ground level) and, 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. A carrier break is nearly identical to an overhead break except the landing pattern is 600 feet above the ground, which is the same pattern used when aircraft land on an aircraft carrier.
- ❑ **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 landing. Traffic pattern training is demanding and utilizes all of the basic flying maneuvers a pilot learns: takeoffs, climbs, turns, climbing turns, descents, descending turns, and straight and level landings. Most patterns have a left-handed orientation (counter clockwise, as viewed from above), which mimics how pilots fly on an aircraft carrier at sea. Specific types of pattern work include:
 - 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 takeoff power and takes off again. A touch-and-go pattern is counted as two operations—the landing is counted as one operation, and the takeoff is counted as another.
 - Field Carrier Landing Practice (FCLP). FCLP is a training procedure that simulates landing an aircraft on the flight deck of a carrier. It is similar to a touch-and-go, but has specific altitudes, turning radii, and power settings to replicate, as closely as possible, the procedures of landing on a carrier.
 - Ground Control Approach (GCA). GCA is a radar or “talk down” approach directed by ATC on the ground. ATC personnel provide pilots with verbal course and glide slope information, allowing them to make an instrument approach during inclement weather. A box pattern is normally flown to practice GCA approaches and utilizes a “box-shaped” flight pattern with four 90-degree turns conducted at a set altitude.

Each airfield has designated runways with designated flight procedures that 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 to/from a Military Operations Area (MOA), and demonstrates how the aircraft will fly in relation to the airfield.

Flight tracks are graphically represented as single lines, but how closely an aircraft flies to the specified track can vary due to aircraft performance, pilot technique, and weather conditions, such that the actual flight track could be considered a band or corridor varying from a few hundred feet to

several miles wide. Flight tracks are typical or average representations based on pilot and ATC input. Representative flight tracks for NAS Key West are shown on Figure 3-2.

3.2.3 ANNUAL OPERATIONS

“Annual operations” describe all aircraft operations that occur at NAS Key West during a calendar year. As described above, total annual operations account for each arrival and departure, including those conducted as part of a pattern operation. Aircraft operations are tracked using systems maintained by ATC personnel. For the projected scenario analyzed in this AICUZ Study, the operational data were adopted from the 2013 Airfield Operations EIS preferred alternative and the Record of Decision, dated October 31, 2013. The historical scenario utilized in this AICUZ Study is the 2007 AICUZ Study.

For the purposes of this AICUZ Study, and to develop noise contours and APZs, annual operations are further detailed by the following factors:

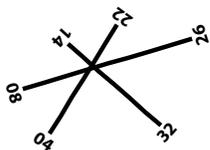
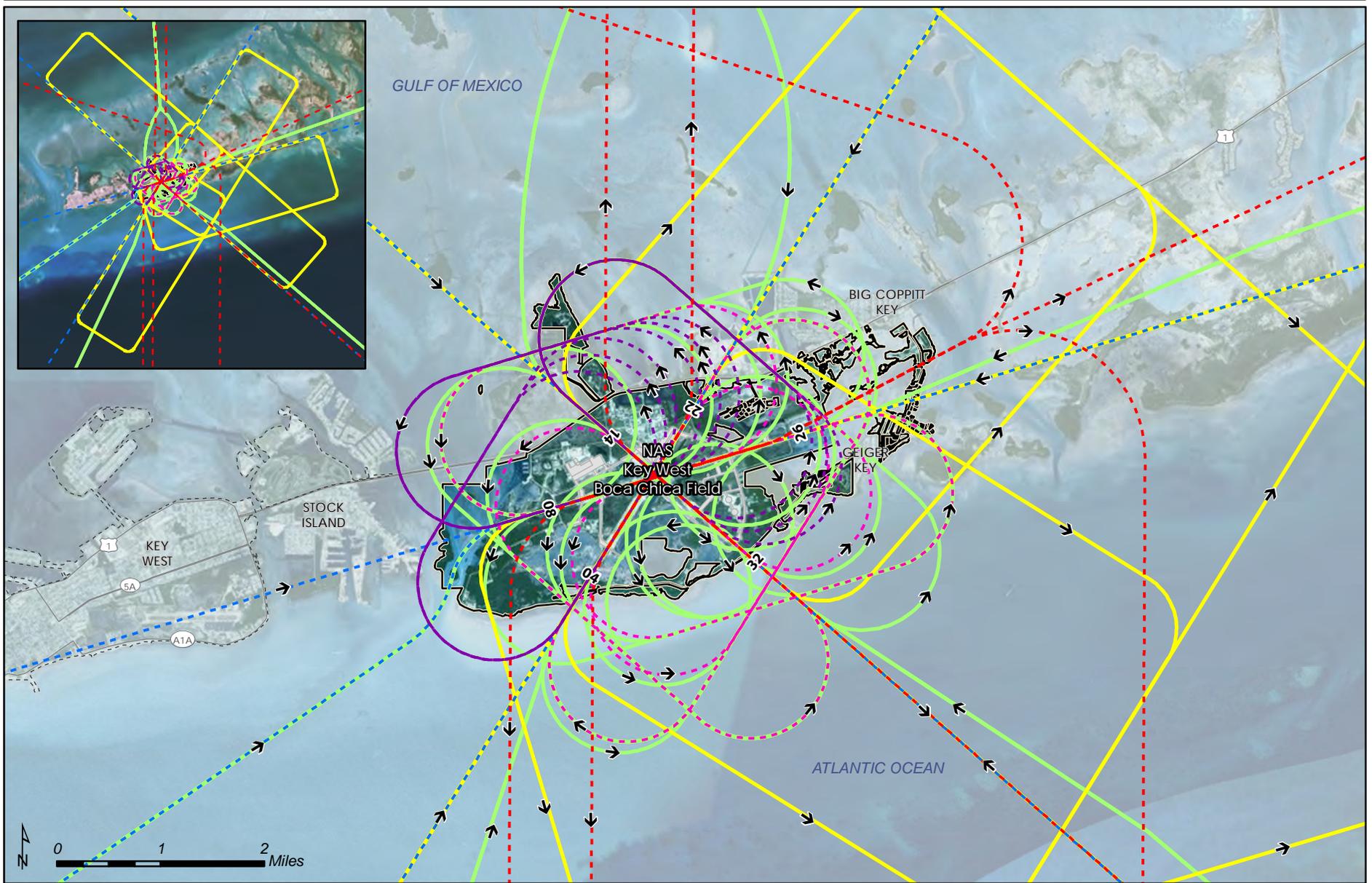
- Aircraft conducting the operation;
- Operation performed;
- Aircraft identified as based or transient;
- Runway the operation is conducted on;
- Squadron the aircraft is assigned to;
- Number of operations performed; and
- Time of day the operation is conducted;
- Flight track flown to conduct the operation.

These factors all have differing effects on noise contours and APZs and provide key information into the changes in the AICUZ footprint from the historical (2007 AICUZ) and projected (CY2028) scenario. Additional parameters, such as altitude, power setting, and speed, are collected and considered for the noise modeling analysis and are discussed in Chapter 4, Aircraft Noise.

This AICUZ Study considers two operational scenarios:

- The historical, or 2007 AICUZ Study; and
- The projected scenario, or average annual flight operations over a 10-year period (CY2028), which are based on 2013 Airfield Operations EIS operational data.

This section describes how operations information was gathered and provides a concise interpretation of operations data for each of the scenarios listed above.



- Legend
- Runway
 - Installation Boundary
 - Airfield Surface Area
 - Flight Tracks
 - Arrivals
 - Departures
 - FCLP
 - GCA
 - Overhead/Carrier Break
 - Touch-and-Go

Figure 3-2
 Representative Flight Tracks
 NAS Key West
 Monroe County, Florida

HISTORICAL: 2007 AICUZ STUDY

The operational tempo has fluctuated over time due to changes in mission and based aircraft. As missions change, so do training requirements, which changes the amount and type of operations flown and flight tracks utilized. The historical scenario's 61,402 annual operations, as presented in the 2007 AICUZ, (see Table 3-2) are attributed to the variety of missions operations and aircraft that were at the airfield during CY2007. Eighteen aircraft types were included in the 2007 total flight operations, including 60,631 fixed-wing aircraft and 771 rotary-wing aircraft operations (NAVFAC 2007). The operations types include departures, straight-in full-stop arrivals, overhead break arrivals, carrier break arrivals, and touch-and-go, FCLP, and GCA box patterns. Approximately 3,925 operations, or 6 percent of the grand total for aircraft operations, occurred during acoustic nighttime hours (10:00 p.m. to 7:00 a.m.), with nearly 31 percent of those nighttime operations conducted by FA-18C/D and FA-18E/F aircraft and 57 percent by the E-2/C-2 turboprop aircraft (NAVFAC 2007). The FA-18E/F, FA-18C/D and the E-2/C-2 aircraft contributed to approximately 70 percent of the grand total (see Table 3-3) (NAVFAC 2007).

PROJECTED (CY2028): 2018 AICUZ STUDY

AICUZ studies account for future missions and operations. As such, this AICUZ Study provides analysis for the projected scenario and incorporates known and anticipated changes in mission and operations for 2018 through 2028, as analyzed in the 2013 Airfield Operations EIS. Based on the changes captured in the EIS, the Navy forecasts that total annual operations at NAS Key West will decrease to approximately 52,000. As shown in Tables 3-1 and 3-2, projected operations will decrease to 51,914 total operations from the historical, with 50,083 fixed-wing and 1,831 rotary-wing operations.

The primary factor attributed to the decrease in operations is the reduction in pattern operations flown at the airfield. Pattern operations are projected to decrease by approximately 6,100 annual operations, from 28 percent of the historical annual operations to 21 percent of the projected (CY 2028) annual operations (see Table 3-3).

The number of annual arrivals and departures are similar for the historical to projected scenarios with the exception of overhead break arrivals, which decreased by approximately 4,800 annual operations. The daytime split of operations is similar for the historical and projected scenarios, with a difference of only approximately 5,000 operations. However, there is a 78 percent decrease in acoustic nighttime (10:00 p.m. to 7:00 a.m.) operations from the historical and projected scenarios.

The historical and projected scenarios are comprised of a mix of aircraft, both based and transient, conducting various operation types at NAS Key West.

TABLE 3-2 COMPARISON OF ANNUAL OPERATIONS BY OPERATION TYPE

Operation Type	Historical (2007 AICUZ ^a)			Projected (CY2028) (2018 AICUZ ^b)		
	Daytime	Nighttime	Total	Daytime	Nighttime	TOTAL
Fixed-Wing						
Departure	21,012	500	21,512	19,179	264	19,442
Straight-In/Non-Break Arrival	4,169	308	4,477	5,358	508	5,866
Overhead Break Arrival	8,170	275	8,445	3,504	124	3,628
Carrier Break Arrival	8,867	14	8,881	9,948	0	9,948
Touch-and-Go Pattern	0	3,555	3,555	3,254	28	3,282
FCLP Pattern	9,799	2,687	12,486	5,210	600	5,810
GCA Box Pattern	1,196	79	1,275	2,028	78	2,106
Fixed-Wing Total	53,213	7,418	60,631	48,481	1,602	50,083
Rotary-Wing (Various)						
Rotary-Wing Total			771			1,831
GRAND TOTAL			61,402			51,914

Sources:

^a Navy 2007^b Wyle 2013 and Navy 2013

Notes:

Acoustic daytime hours are from 7:00 a.m. to 10:00 p.m.

Acoustic nighttime hours are from 10:00 p.m. to 7:00 a.m.

TABLE 3-3 COMPARISON OF ANNUAL OPERATIONS BY AIRCRAFT TYPE

Aircraft Type	Historical (2007 AICUZ ^a)	Projected (CY2028) (2018 AICUZ ^b)
Fixed-Wing		
FA-18C/D	14,149	0
F-35C*	0	10,718
FA-18E/F	15,953	13,848
E-2/C-2	12,968	0
F-5N/F	0	12,714
F-5E/F	486	0
P-3	0	0
P-8	0	4,007
F-16	1,060	0
F-35A*	0	1,421
F-15A/E	960	0
F-22*	0	445

TABLE 3-3 COMPARISON OF ANNUAL OPERATIONS BY AIRCRAFT TYPE

Aircraft Type	Historical (2007 AICUZ ^a)	Projected (CY2028) (2018 AICUZ ^b)
AV-8	600	0
F-35B*	0	344
EA-6	200	0
EA-18G	0	62
Transient Jet – Fighter/Trainer (e.g., T-45, Hunter, A-10, A-4, T-38)	6,039	1,310
Transient Jet – Cargo/Passenger (e.g., C-21, C-560, Gulfstream, Learjet, Beech, Saber)	332	1,003
Transient Jet – Medium Transport (e.g., C-9, C-40)	0	540
Transient Jet – Large Transport and Refuel (e.g., C-17, KC-10, C-5)	21	181
Transient Prop – Small/Medium (e.g., CASA, G-159, T-34, C-12, C26, T-6, Beech-36, Beech-9, Mitsubishi-20)	2,456	2,209
Transient Prop – Large (e.g., C-130)	0	1,281
Transient Transport (not specified)	5,407	0
Rotary-Wing (Various)	771	1,831
GRAND TOTAL	61,402	51,914

Sources:

^a Navy 2007

^b Wyle 2013 and Navy 2013

Notes:

*= modeled as a next generation aircraft, as presented in Section 3.1.1.

Acoustic daytime hours are from 7:00 a.m. to 10:00 p.m.

Acoustic nighttime hours are from 10:00 p.m. to 7:00 a.m.

3.2.4 RUNWAY AND FLIGHT TRACK UTILIZATION

The frequency with which a runway is used by different aircraft types is determined by a variety of factors, including runway length, winds, location of airfield features (e.g., lights, arresting gear), number of aircraft in the pattern, or the preference of a runway for noise abatement or safety concerns (e.g., birds). Runway use at NAS Key West is determined by the Air Operations (Air Ops) Manual, which the Air Ops Officer maintains. The Air Ops Manual sets the course rules for the airfield and establishes the patterns and procedures for aircraft movement. All aircraft operating at NAS Key West follow the course rules in the Air Ops Manual.

As discussed in Section 3.2.2, Flight Operations, and depicted on Figure 3-2, flight tracks are the general paths aircraft fly while conducting missions or operations. The following factors determine flight track utilization: operation performed; runway utilized for the operation; and flight track followed to conduct the operation.

Flight tracks are nominal representations (often a few hundred feet to several miles wide) depicting an aircraft's typical route. Flight tracks demonstrate how and where aircraft fly in relation to an airfield. Flight tracks provide safety, consistency, and control of an airfield and are selected based on multiple factors, including operation performed, runway utilized for the operation, and flight track followed to conduct the operation. The flight tracks and utilization data gathered from the 2013 Airfield Operations EIS were utilized in this AICUZ Study to inform the flight frequency concentrations of aircraft flights for the historical and projected scenarios. The effect of flight track utilization on noise contours is presented in Chapter 4, Aircraft Noise; the association between flight tracks and APZs is included in Chapter 5, Airfield Safety.

NAS Key West's airfield is comprised of three asphalt runways—Runways 04/22, 08/26, and 14/32. The changes in runway utilization from historical to projected levels are shown in Table 3-4. Runway utilization varies significantly by aircraft type. Historically, Runway 08 has been the most active runway and was used 49 percent of the time at the time of the 2007 AICUZ. The second-most active runway was Runway 14, which was used 32 percent of the time.

TABLE 3-4 CHANGES IN RUNWAY UTILIZATION

Runway	Percent Utilization for Each Scenario	
	Historical (2007 AICUZ ^a)	Projected (CY2028) (2018 AICUZ ^b)
04	11	10
22	1	3
08	49	59
26	5	8
14	32	17
32	2	3

Sources:

^a Navy 2007

^b Wyle 2013 and Navy 2013

3.2.5 OPERATIONAL ALTERNATIVES

Operational alternatives are changes in operations that should reduce noise and APZ impacts and can include flight track modifications, altering hours of operation, changes in pattern altitude, or construction of acoustical enclosures (for ground engine maintenance). This AICUZ Study evaluation of operational alternatives balanced noise and APZ changes with impacts on flight safety and operational capability.

NAS Key West Air Ops and the FAA provide rules that all aircraft are required to follow when utilizing controlled airspace and the airfield. The course rules establish control and safety by providing procedures that account for aircraft separation, traffic patterns for runways in use, arrivals/departures, noise abatement, altitudes and airspeed, allowable weather conditions, and aircraft emergencies. As such, aviators performing operations at NAS Key West and associated airspace follow established rules and procedures while operating at the airfield. Likewise, aviators perform operations at specific altitudes, airspeeds, and power settings, and follow set flight tracks to operate the aircraft at peak performance and to train for operations conducted at sea. Aircraft operating procedures are performed according to OPNAVINST 3710.7, "Naval Air Training and Operating Procedures Standardization (NATOPS) General Flight and Operating Instruction." NATOPS are published for the purpose of standardizing ground and flight procedures. The purpose of the NATOPS Program is to increase combat readiness and improve flight safety. Limitations or restrictions on performing such operations pose a risk to pilots and the mission at NAS Key West.

NAS Key West is committed to the health, safety, and welfare of the local community, and considers alternatives to mitigate the impact to the local community as they are identified; however, NAS Key West's capacity to implement operational alternatives is limited by several factors that are outlined in the Air Ops Manual or otherwise identified. NAS Key West course rules are updated in response to changes in mission and safety hazards and to minimize noise and safety impacts, some of which restrict certain operation types from being conducted on all runways. The following course rules and factors are implemented operational alternatives that apply limitations or restrictions on flight tracks, altitudes, or runway usage in efforts to reduce off-station noise and impacts, as described below:

- ❑ FCLP operations are only conducted on Runways 04, 08, and 14, and carrier break arrivals are not conducted on Runway 04 (Wyle 2013).
- ❑ The primary use of Runways 08 and 14 accounts for approximately 75 percent of operations and allow for departures and arrivals to remain mostly over installation property and/or over the ocean, thus avoiding populated areas and reducing noise and safety impacts.
- ❑ High-performance/unrestricted climbs are prohibited.
- ❑ Pilots avoid overflying Key Haven, Stock Island, East Rockland Key, and Geiger Key, per course rules.
- ❑ In the pattern for Runway 14, aircraft remain within 2 miles on the downwind leg of the pattern (i.e., the northeast leg of this track).

- ❑ Aircraft do not overfly Key West or any other Florida Key below 3,000 feet unless on published instrument approach, instructed by ATC or for safety of flight.
- ❑ The arrival to Runway 08 is south of Key West and Stock Island and is adjusted to remain over water (the Boca Chica Channel) near the final approach to the runway.
- ❑ Resident and migratory bird activity increases the potential for bird/animal aircraft strike hazard (BASH). To reduce this hazard, flight patterns are altered during times of increased bird activity.
- ❑ Potential for conflict exists with light/low/slow aircraft in the vicinity of the airfield.
- ❑ Variations in flight operations around the installation shifts impacts from urbanized areas.
- ❑ NAS Key West typically operates from 7:00 a.m. to 10:00 p.m. daily, except in observance of federal holidays when the field is closed for air operations. However, operational requirements may necessitate operations outside of normal hours of operation.
- ❑ The engine maintenance run-up location more interior to the installation (near the southern end of Runway 04) is used for the majority (approximately 80 percent) of engine maintenance run-ups.
- ❑ NAS Key West Command Staff provides an in-brief to all arriving squadrons to review course rules and to make pilots aware of noise issues associated with airfield operation at NAS Key West.

4

AIRCRAFT NOISE

4.1 What is Noise?

4.2 NAS Key West Airfield Noise Sources and Noise Modeling

4.3 Noise Abatement and Complaints

4.4 AICUZ Noise Contours

How an installation manages its aircraft noise plays a key role in the installation's relationship with neighboring communities. Aircraft noise is also a factor in local land use planning. Because noise from aircraft operations could have an impact on areas near NAS Key West, the Navy has analyzed the noise resulting from its aircraft and has established noise contours around the installation using the guidance provided in the AICUZ Instruction. Noise contours provide communities and planning organizations with information to better plan for development near airfields. The noise contours developed for this AICUZ Study represent the noise generated by aircraft based on aircraft type, aircraft operations, and the time of day aircraft are flown. This chapter discusses noise associated with aircraft operations, including average noise levels, noise abatement/flight procedures, noise complaints, sources of noise, airfield-specific noise contours, and analysis of changes from the historical (2007 AICUZ) and projected (CY2028) noise contours. The 2018 AICUZ noise contours for NAS Key West are presented in the following sections along with detailed descriptions of the noise environments for the airfield. Also provided are comparisons and figure overlays of the 2007 AICUZ Study and the 2018 AICUZ noise contours.

4.1 WHAT IS NOISE?

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

In this AICUZ Study, all sound or noise levels are measured in A-weighted decibels (dBA), which represent sound pressure adjusted to better represent human hearing response. (Note: For brevity, the adjective “A-weighted” is often omitted and the measurements are expressed as dB.) Humans are most sensitive to sound frequencies within the range of human speech and less sensitive to lower and higher frequencies. The A-weighted scale emphasizes those mid-range frequencies while de-emphasizing the remaining frequencies.

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

The noise exposure from aircraft at NAS Key West 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, presents a reliable measure of community sensitivity to aircraft noise and has become the standard metric used in the United States. 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. These decibel adjustments represent the added intrusiveness of sounds due to increased sensitivity to noise when ambient sound levels are low.

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

DNL provides a single measure of overall noise impact by combining disparate noise events (e.g., brief events with high noise levels, longer duration events at lower noise levels, and events occurring during different times of day which are more likely to disturb people in the community). Scientific studies and social surveys conducted to evaluate community annoyance with all types of environmental noise have found DNL to be the best measures available for predicting community annoyance (Federal Interagency Committee on Urban Noise 1980; Federal Interagency Committee on Noise 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 dB could result from only a few noisy events or from a large number of quieter events.

DNL is depicted on a map as a noise contour that connects points of equal noise value. Contours are displayed in 5-dB increments (i.e., 60, 65, 70, 75, 80, and 85 dB DNL). 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 more gradual. Calculated noise contours do not represent exact measurements and are discussed further in Section 4.3, Noise Abatement and Complaints.

For land use planning purposes, the AICUZ Program divides noise exposure into three categories, known as “noise zones,” based on DNL measurements:

- ❑ **Noise Zone 1:** less than 65 dB DNL (<55 to <65 dB DNL);
- ❑ **Noise Zone 2:** 65 to <75 dB DNL; and
- ❑ **Noise Zone 3:** Greater than 75 dB DNL (>75 dB DNL).

Land use recommendations within these zones are discussed and provided in Chapter 7, Land Use Compatibility Analysis and Recommendations.

4.2 NAS KEY WEST AIRFIELD NOISE SOURCES AND NOISE MODELING

The Navy conducts noise studies, as needed, to assess the noise impacts of aircraft operations. This AICUZ Study presents the historical (2007 AICUZ) and projected (CY2028) noise contours at NAS Key West. The Navy utilized NOISEMAP, the DOD standard model for assessing noise exposure from military aircraft operations at air installations. NOISEMAP calculates DNL contours resulting from aircraft operations using variables such as aircraft types and aircraft profiles comprised of changing power settings, speeds, and altitudes as aircraft traverse the airspace.

In support of the 2013 Airfield Operations EIS, NAS Key West conducted a noise analysis. Data were then collected from NAS Key West and compiled and input into computer models that graphically depict noise exposure as noise contours. The primary Navy-generated sources of noise at an airfield are aircraft flight operations and ground maintenance (run-ups). The inputs and data provided by the Navy and analyzed with the NOISEMAP software suite include:

- ❑ Operation performed (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).

Noise contours generated from this information represent NAS Key West's noise environment and planning contour for 2018 through 2028. The noise contours used in this 2018 AICUZ Study were adopted from the 2013 Airfield Operations EIS and are discussed further in Section 4.4, AICUZ Noise Contours.

4.3 NOISE ABATEMENT AND COMPLAINTS

NAS Key West conducts noise abatement to the best of its ability, commensurate with safety and operational training requirements. Noise abatement procedures at NAS Key West are implemented under the Air Ops Manual and are summarized below. The purpose of these procedures is to minimize impacts from aircraft noise.

Even with noise abatement procedures in place, noise impacts cannot be completely minimized or avoided; therefore, on occasion, NAS Key West receives calls from concerned citizens regarding noise. NAS Key West manages noise concerns and complaints according to the set protocol discussed below.

4.3.1 NOISE ABATEMENT

NAS Key West actively employs noise abatement or avoidance procedures with which all aviators are required to comply. Noise abatement procedures also apply to engine maintenance operations conducted on-station, which are documented in the Air Ops Manual. The purpose of noise abatement and avoidance procedures is to minimize noise in recognition of community response to aircraft noise. While the Navy cannot alter critical portions of flight patterns to accommodate noise complaints without increasing the risk to pilots, there are other measures in place to reduce noise impacts. Noise abatement procedures at NAS Key West are listed below:

- ❑ NAS Key West conducts noise abatement procedures commensurate with safety and operational training requirements.
- ❑ The minimum altitude for military fixed-wing aircraft is normally 3,000 feet, unless the mission requires lower altitude. Aircraft do not normally fly over the Florida Keys (part of the Florida Keys

National Marine Sanctuary) below 3,000 feet, unless under radar control or executing an approved instrument approach.

- ❑ Pilots of aircraft departing from or remaining in the Runway 08 traffic pattern will use climb and flight paths that avoid flying over Key Haven, Big Coppitt, Tamarac Park, and Geiger Key Marina.
- ❑ Supersonic flight operations are conducted in accordance with OPNAVINST 3710.7.
- ❑ Aircraft remain above 2,500 feet while within a 3.9-statute-mile radius of the center of KWIA unless they are: under radar control; executing a published instrument approach; in direct radio communications with the KWIA Tower; or operating within the NAS Key West Class D Surface Area.
- ❑ The engine maintenance run-up location more interior to the installation (near the southern end of Runway 04) is used for the majority (approximately 80 percent) of engine maintenance run-ups.
- ❑ NAS Key West Command Staff provides an in-brief to all arriving squadrons to review course rules and to make pilots aware of noise issues associated with airfield operation at NAS Key West.

4.3.2 NOISE COMPLAINTS

The origin and nature of noise complaints is 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 individual sensitivity. 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 overflowed or a new aircraft begins operating in the region. In general, individual responses to noise levels vary and are influenced by several 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 the noise;
- ❑ The predictability of the 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; however, as the change in noise level increases, individual perception becomes greater.

Noise complaints are received by NAS Key West Air Ops via a designated hotline and are coordinated with the Public Affairs Office and CPLO. During normal business hours, calls are answered and information is collected from the caller concerning the time, location, and description of the noise-

NAS Key West
Noise Complaint
Hotline Number

(305) 293-2166

generating event. After normal business hours, the calls are logged and responded to the following business day. The complaint is reviewed by NAS Key West Air Ops, and (when appropriate) the responsible flight squadron is notified and any deviations from standard procedures are identified. If a "call back" is requested by the individual submitting the complaint, the Air Ops Officer or representative will contact the individual to gather more information and to personally address any concerns of the caller. Unlike most airfields that generally receive noise complaints in the summer, NAS Key West typically receives complaints in the winter months when residents turn off their air conditioners and open windows. Historically, noise complaints have been minimal. Complaints typically occur with several calls regarding one event. Because the resident population in the NAS Key West area is generally accustomed to the presence of aircraft and the accompanying noise, noise complaints typically occur during unscheduled operations and repetitious aircraft activity.



4.4 AICUZ NOISE CONTOURS

Noise contours can be mapped to show noise exposure resulting from modeled aircraft operations. Noise contours, when overlaid with local land uses, can assist NAS Key West, local community planning organizations, and citizens in locating and addressing incompatible land uses and in planning for future development.

The noise contours provided in this AICUZ Study are identified as either historical (2007 AICUZ) or projected (CY2028). The projected noise contours represent NAS Key West's noise environment and planning contour for 2018 through 2028. The 2018 AICUZ noise contours and projected operational data used in this 2018 AICUZ Study were adopted from the 2013 Airfield Operations EIS. Aircraft operations are projected into the future to help ensure that the future operational capability of the air installation is accounted for. As a planning document, the AICUZ Study forecasts aircraft operations out 10 to 15 years into the future to assess an air station's impact on the local community. Therefore, projected operations are incorporated into this 2018 AICUZ Study. The operational tempo over time and the projected operations for NAS Key West are presented in Chapter 3, Aircraft Operations, and detailed in Tables 3-2 through 3-3.

The 2018 AICUZ noise contours match the 2013 Airfield Operations EIS preferred alternative noise contours (Record of Decision dated October 31, 2013).

The 2018 AICUZ noise contours for NAS Key West are presented in the following sections, along with detailed descriptions of the noise environment. Also provided are comparisons and figure overlays of the historical and projected scenarios. The comparison identifies changes to noise exposure (based on changes and projected changes in aircraft operations) and allows the identification of incompatible land use and potential recommendations to mitigate noise impacts. Land use and recommendations for addressing incompatibility issues within noise contours are provided and discussed in Chapter 7, Land Use Compatibility Analysis and Recommendations.

4.4.1 PROJECTED NOISE CONTOURS

The 2018 projected noise contours for NAS Key West overlay the area in the immediate vicinity of the airfield, with the vast majority of the higher noise contours concentrated within the installation boundary (Figure 4-1). The projected noise exposure primarily derives from FA-18E/F Super Hornets, F-5 Tigers, and F-35C Lightning IIs.

West of NAS Key West, both the 65 dB DNL and the 70 dB DNL projected noise contours extend onto the eastern portion of Stock Island. Geiger Key, along the eastern edge of NAS Key West, is primarily exposed to DNL values greater than or equal to 70 dB. The projected noise exposure in the northern portion of Geiger Key primarily results from FA-18E/F Super Hornet arrivals to Runway 26 and departures from Runway 08. Southern Geiger Key's projected noise exposure primarily results from FA-18E/F Super Hornet and F-35C Lightning II FCLP patterns on Runway 14 and departures from Runway 08.

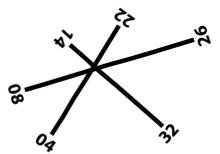
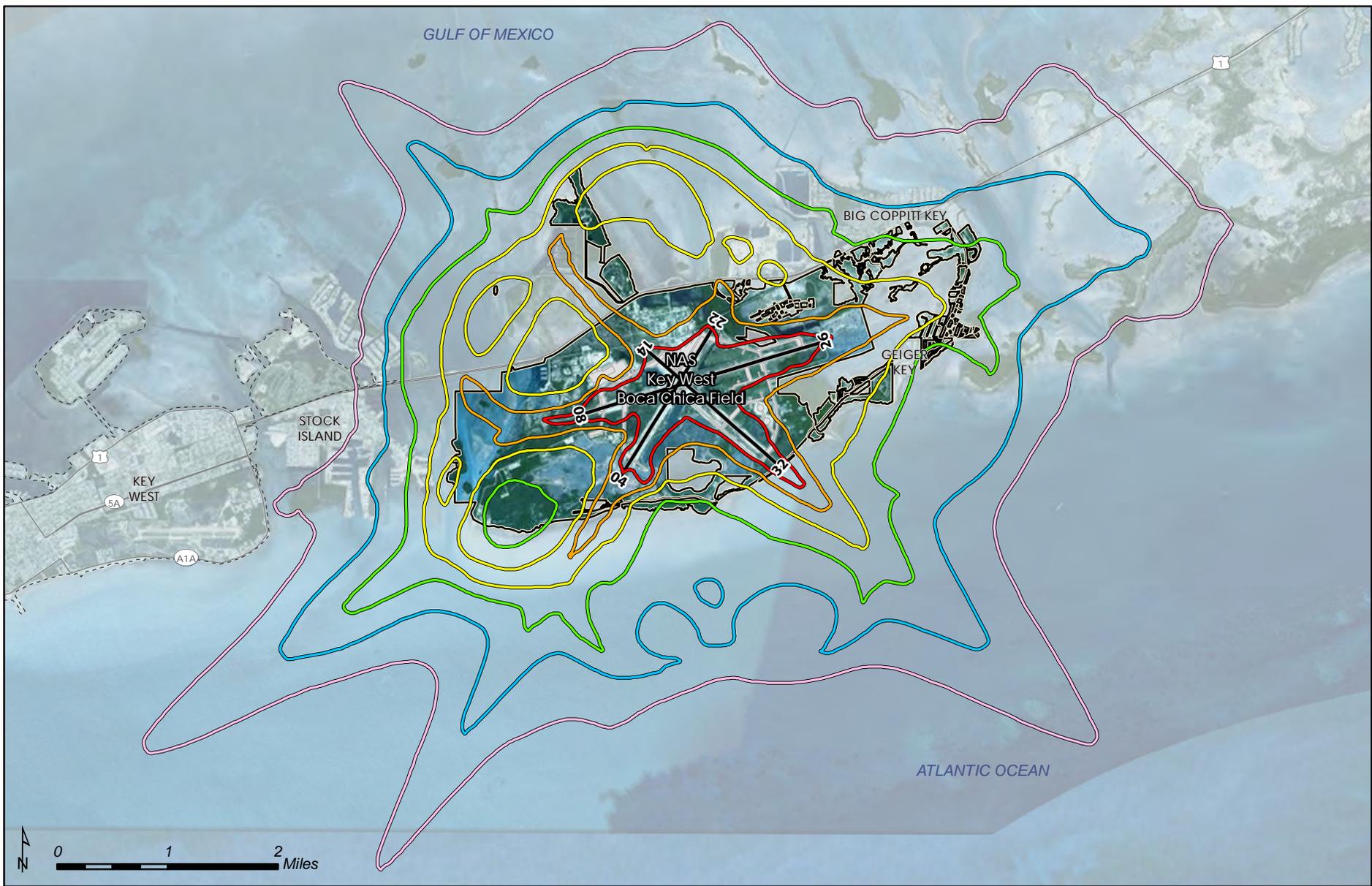


Figure 4-1
2018 AICUZ Noise Contours
NAS Key West
Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County
2015; NAVFAC SE 2015; Wyle 2013.
© 2017 Ecology and Environment, Inc.

At the northeast edge of NAS Key West, the 65 dB DNL projected noise contour extends over the southern half of Big Coppitt Key. The increased noise exposure in the easternmost region of Big Coppitt Key (south of Route 1) is due to additional FCLP operations, but continue to primarily result from FA-18E/F Super Hornet, F-5 Tiger, and F-35C Lightning II departures from Runway 08. The noise exposure in the southwestern region of Big Coppitt Key (north of Route 1) results primarily from FA-18E/F Super Hornet, and F-35C Lightning II departures from Runway 08 and FA-18E/F Super Hornet break arrivals to Runway 22. To further describe noise contours, they are divided into four general areas: inside the installation boundary (on-station), outside the installation boundary (off-station), over land, and over water. The acreages within the projected noise contours were calculated using geographic information system (GIS) overlay analysis and are presented in Table 4-1.

TABLE 4-1 COMPARISON OF LAND AND WATER AREAS IMPACTED WITHIN THE NOISE ZONES (IN ACRES)

Scenario	Land Off-station	Land On-station	Waterbody Off-station	Waterbody On-station	Grand Total
2007 Historical^a					
Noise Zone 1 (<55 to <65 dB DNL)	906	0	12,860	0	13,767
Noise Zone 2 (65 to <75 dB DNL)	1,391	583	11,218	380	13,572
Noise Zone 3 (>75 dB DNL)	603	2,100	2,090	855	5,647
Subtotal	2,900	2,683	26,168	1,235	
Total	5,583		27,403		32,986
2018 Projected (CY2028)^b					
Noise Zone 1 (<55 to <65 dB DNL)	791	0	7,980	0	8,771
Noise Zone 2 (65 to <75 dB DNL)	822	373	7,563	91	8,849
Noise Zone 3 (>75 dB DNL)	895	2,310	2,855	1,144	7,203
Subtotal	2,508	2,683	18,397	1,235	
Total	5,191		19,632		24,823

Sources:

^a Navy 2007

^b Wyle 2013 and Navy 2013

Notes:

Acreages shown in this table for Noise Zone 2 and Noise Zone 3 are slightly varied from those shown in the 2013 Airfield Operations EIS. This variation could be caused, in part, by updated data sets and methods for classifying water acreages. Total acreage amounts are higher because the 2013 Airfield Operations EIS did not include Noise Zone 1 acreages and this AICUZ Study includes the Noise Zone 1 acreages.

The total area within the projected noise contours (Noise Zones 1, 2, and 3 combined) is 24,823 acres. Approximately 16 percent (3,918 acres) of this total is on-station, with 84 percent (20,905 acres) located off-station. Because NAS Key West is surrounded by water, and due to the installation's course rules and flight tracks, over 90 percent of the area impacted by contours in Noise Zone 1 (<55 to <65 dB DNL) and 85 percent of the area impacted by contours in Noise Zone 2 (65 to <75 dB DNL) are over water. Approximately 39 percent of acres impacted by contours in Noise Zone 3 (>75 dB DNL) are over water. Chapter 7, Land Use Compatibility Analysis and Recommendations, presents land use within the off-station acres and the compatibility analysis.

NOISE GRADIENT AND PROPAGATION

The sound associated with aircraft operations extends beyond the plotted DNL contours. Figure 4-2 provides a DNL color gradient that illustrates how the noise originating at NAS Key West dissipates into the surrounding communities. The sequence of sound waves propagates through the air. During the propagation, sound waves are reflected, refracted, and attenuated (i.e., weakened) by the density of the air. Therefore, the highest noise levels are concentrated at the source within NAS Key West and decrease to lower levels farther out off-station and into Monroe County. Figure 4-2 also depicts the noise levels outside the 65 dB DNL noise contour.

4.4.2 COMPARISON OF NOISE CONTOURS

A comparison of the historical and projected noise contours shows some similarities in shape, general location, and DNL levels. The comparison also shows a decrease in overall size and coverage from the historical to the projected noise contours, as depicted on Figure 4-3. The changes between the historical and projected noise contours are attributed to several factors, including:

- ❑ Changes in aircraft types (historical noise contours modeled P-3 Orion and FA-18E/F Super Hornet aircraft operations, and projected noise contours modeled P-8 Poseidon and F-35C Lightning II operations);
- ❑ Changes in aircraft flight patterns;
- ❑ Changes in operational levels (the number of operations has increased from the historical to the projected scenarios); and
- ❑ Improved noise mapping techniques (discussed in Section 1.3.3, Changes that Necessitate this AICUZ Update).

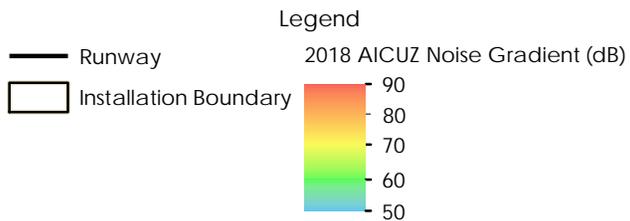
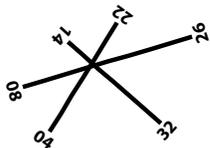
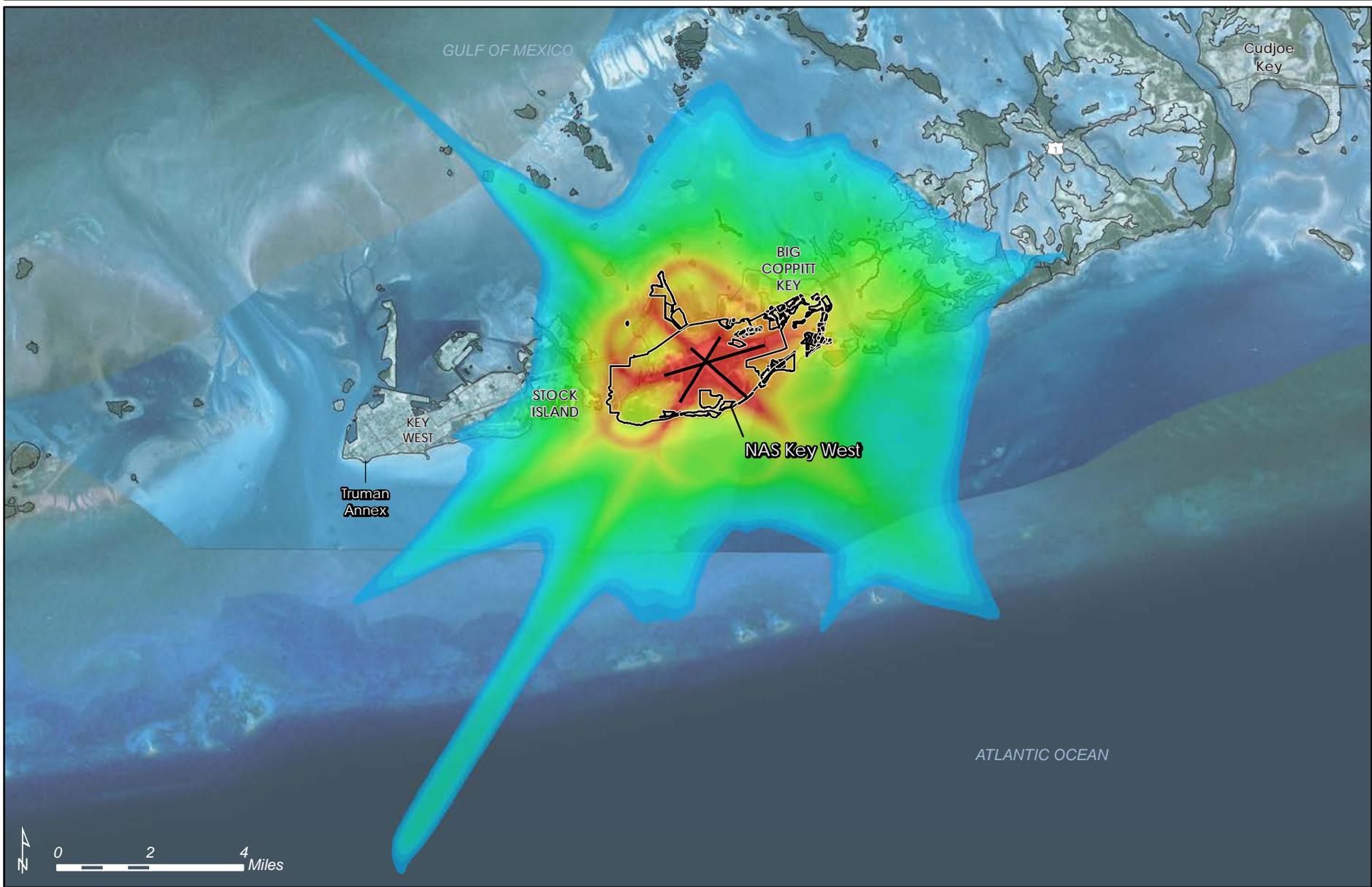
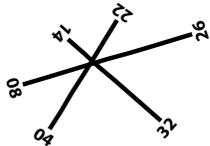
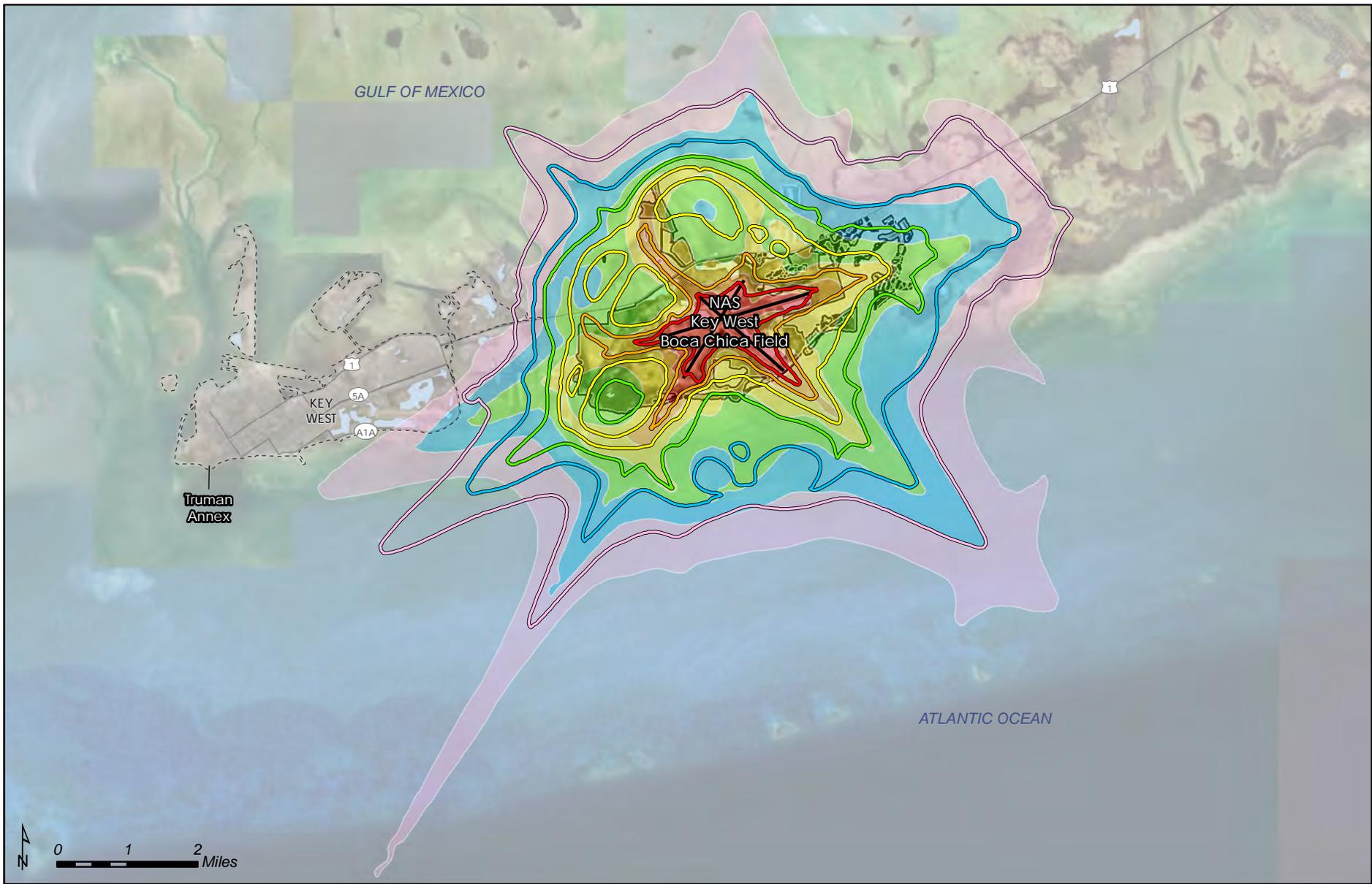


Figure 4-2
2018 AICUZ Noise Gradient
NAS Key West
Monroe County, Florida



-  Runway
-  Installation Boundary
-  City Boundary

Legend

2018 AICUZ Noise Contours		2007 AICUZ Noise Contours	
 60 dB	 75 dB	 60 dB	 75 dB
 65 dB	 80 dB	 65 dB	 80 dB
 70 dB	 85 dB	 70 dB	 85 dB

Figure 4-3
Comparison of 2007 AICUZ
and 2018 AICUZ Noise Contours
NAS Key West
Monroe County, Florida

As shown in Table 4-1, the historical noise contours (Noise Zones 1, 2, and 3) covered 32,986 acres as compared to 24,823 acres for the projected scenario (both on- and off-station), resulting in the total affected land area within the noise contours (Noise Zones 1, 2, and 3) decreasing by approximately 25 percent. There has been an overall decrease in off-station land area within Noise Zones 1 and 2, and while the total off-station area impacted within Noise Zone 3 has increased between the historical and the projected noise contours, 82 percent of off-station impacts are within Noise Zone 1 and Noise Zone 2. Over 90 percent of the area impacted by contours in Noise Zone 1 and 85 percent of the area impacted by contours in Noise Zone 2 are over water.

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5

AIRFIELD SAFETY

- 5.1 Accident Potential Zones
- 5.2 AICUZ Clear Zones and APZs
- 5.3 Imaginary Surfaces
- 5.4 Flight Safety

Community and airfield safety is paramount to the Navy. The Navy has established a flight safety program and areas of accident potential around NAS Key West to assist in planning for health, safety, and welfare in communities near the airfield. Cooperation between the Navy and local communities can improve land use planning and development surrounding naval airfields. APZs in this 2018 AICUZ Study were developed based on the projected annual aircraft operations presented in the 2013 Airfield Operations EIS and NAS Key West's unique training environment. The following sections present the 2018 AICUZ APZs for NAS Key West, including a detailed analysis of the impacted areas. Also provided are comparisons and figure overlays for the 2007 AICUZ Study and the 2018 AICUZ APZs. The comparison helps identify changes to the APZs based on projected aircraft operations and targets land use recommendations to mitigate incompatible development. Identifying safety issues assists the community in developing land uses compatible with airfield operations. These issues include areas of accident potential and hazards around the airfield that obstruct or interfere with aircraft arrivals and departures, pilot vision, communications, or aircraft electronics. While aircraft mishaps are rare, they do occur. Aircraft safety and mishaps at NAS Key West are discussed in detail in this chapter.

5.1 ACCIDENT POTENTIAL ZONES

Recognizing the need to identify areas of accident potential, in the 1960s, 1970s, and 1980s the military conducted studies of historical accidents 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 studies, the DOD identified APZs as areas where an aircraft accident would most likely occur.

APZs align with departure, arrival, and pattern flight tracks. While APZs are not a prediction of the number of accidents or the odds of an accident occurring, APZs reflect the most likely location of an accident and are designed to minimize potential harm if a mishap were to occur by limiting activities in these locations. The Navy and local planning authorities use APZs to ensure compatible development in proximity to runway ends and slightly beyond. Although the likelihood of an accident is remote, the Navy recommends that land uses that concentrate large numbers of people, such as apartments, churches, and schools, are not located within APZs.

5.1.1 CLEAR ZONE AND APZ REQUIREMENTS AND DIMENSIONS

APZ configurations and dimensions derive from AICUZ Instruction and are established for all runway classifications. There are three 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.

DOD fixed-wing runways are separated into two classes, Class A and Class B. 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 all other fixed-wing runways. The runways at NAS Key West are Class B. The AICUZ Instruction defines the components of standard APZs for Class B runways as shown on Figure 5-1 and described below:

- ❑ **Clear Zone.** The Clear Zone is a trapezoidal area located 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 that still has a measurable potential for aircraft accidents relative to the Clear Zone. APZ I is provided under flight tracks that 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) that 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

APZ I is provided under flight tracks that experience 5,000 or more annual operations (departures or approaches). An APZ II area is designated whenever APZ I is required.

Based on analysis of historic mishaps around military airfields, 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.

are typically 1,000 feet in width by 2,500 feet in length and, as with APZ I, may be curved to correspond with the predominant flight track.

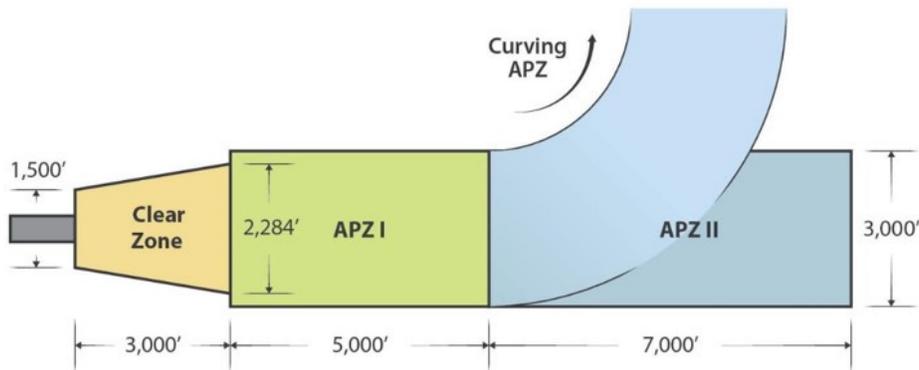


FIGURE 5-1 STANDARD CLASS B RUNWAY, FIXED-WING APZS

APZs extend from the end of the runway, but apply to the predominant arrival and/or 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 the flight track of an aircraft gets closer to the airfield, the potential for flight tracks to overlap or converge increases. When similar tracks align (e.g., straight-in arrival, overhead break arrival, arrival portion of a pattern operation), the operation counts are combined to determine if the number of annual operations requires the designation as APZ I. The AICUZ Instruction permits modification of APZ dimensions for safety purposes and specific operations. Per the AICUZ Instruction, if the APZ annual operations threshold is fulfilled due to FCLP operations, then APZ II shall extend the entire length of the FCLP track, resulting in a closed loop for the entire pattern.

Due to safety concerns, most land uses within the Clear Zone are incompatible with military aircraft operations. Within APZ I and APZ II, some land uses are compatible; however, people-intensive uses (e.g., schools, apartments, churches) should be restricted because of the greater risk. Chapter 7, Land Use Compatibility Analysis and Recommendations, further explains land use compatibility within Clear Zones and APZs.

5.2 AICUZ CLEAR ZONES AND APZS

The following sections present the 2018 APZs for NAS Key West, including a detailed analysis of their development and the areas impacted. This section also provides comparisons and figure overlays for the historical (2007 AICUZ) and projected APZs (CY2028) that can be used to identify changes resulting from projected aircraft operations. An analysis of land use and compatibility within

the APZs for NAS Key West are provided and discussed in Section 7.2, Land Use Compatibility Analysis.

5.2.1 PROJECTED CLEAR ZONES AND APZS

The NAS Key West 2018 AICUZ APZs were developed based on the projected annual aircraft operations presented in the 2013 Airfield Operations EIS as well as NAS Key West's unique training environment. Clear Zones and APZs that were developed as part of this AICUZ Study update are presented on Figure 5-2. The projected APZs shown on the figure represent the detailed aircraft operations counts, flight tracks, and runway utilization data presented in Chapter 3, Aircraft Operations, and the AICUZ Instruction APZ development guidance. The APZs off the approach and arrival ends of Runway 08 and Runway 26 are the result of multiple APZs off each runway end, resulting in a wider than usual APZ configuration due to the overlapping of APZs. Approximately 4,748 acres are impacted by the projected Clear Zones and APZs for NAS Key West (Table 5-1). About 25 percent of the impacted areas are within the installation boundary. The remaining 75 percent of impacted areas are off-station—with 88 percent (3,132 acres) of these off-station areas located over water, resulting in only 12 percent (440 acres) of the off-station areas located over land.

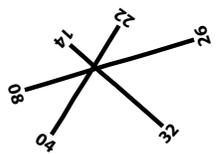
TABLE 5-1 COMPARISON OF LAND AND WATER AREAS IMPACTED WITHIN THE CLEAR ZONE AND APZS (IN ACRES)

Scenario	Land		Waterbody		Grand Total
	Off-station	On-station	Off-station	On-station	
2007 Historical					
Clear Zone	22	420	124	204	771
APZ I	285	152	356	242	1,035
APZ II	101	49	1,270	26	1,447
Subtotal	409	621	1,750	473	
Total	1,029		2,223		3,252
2018 Projected (CY2028)					
Clear Zone	22	419	124	205	771
APZ I	290	162	853	272	1,577
APZ II	127	86	2,155	32	2,400
Subtotal	440	667	3,132	508	
Total	1,107		3,641		4,748

Sources:

^a Navy 2007

^b Navy 2013



Legend

- Runway
- Installation Boundary
- Airfield Surface Area
- City Boundary
- Clear Zone
- APZ I
- APZ II

Figure 5-2
2018 AICUZ Clear Zones and APZs
NAS Key West
Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County 2015; NAVFAC SE 2015. © 2017 Ecology and Environment, Inc.

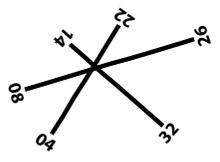
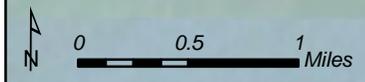
5.2.2 COMPARISON OF 2007 AICUZ APZS AND 2018 AICUZ APZS

Figure 5-3 compares NAS Key West's Clear Zones and APZs in the 2007 historical and 2018 projected scenarios. A comparison of acreages within the Clear Zones and APZs for both are provided as Table 5-1. The Clear Zones and APZs are organized by on-station, off-station, and over land or over water. When comparing acreage under the 2007 historical and the 2018 projected scenarios, the following should be noted:

- ❑ The 2007 historical Clear Zone and APZ footprints covered 3,252 acres, as compared to 4,748 acres for the 2018 projected scenario (on- and off-station);
- ❑ There was an increase of 1,496 acres when comparing off-station impacts for the historical scenario (2,158 acres) to the 2018 projected scenario (3,572 acres); and
- ❑ 3,132 acres of projected off-station Clear Zone and APZ areas are located over water, resulting in only 440 acres of impacted land off-station, as compared to 409 acres in the historical scenario—a net increase of 31 acres.

The operational data analyzed in the 2013 Airfield Operations EIS were used to develop the APZs for this AICUZ Study.

The acreage increases are attributed, in part, to the addition of APZ I and APZ II coverage over water off the approach end of Runway 32 (same location as Runway 14's departure end), which were not included in the 2007 AICUZ due to the Navy's practice of not showing APZs that only impact water. However, the Navy has changed their practice to now plot APZs over water, especially since more recreational activities (e.g., kite surfing, windsurfing, parasailing) and other developments (e.g., boat houses, wind turbines, cell towers) are occurring within waterways adjacent to active runways. Other factors that contribute to the increases in APZs include the widening of the approach end Runway 08 APZ due to a flight path adjustment to avoid, mitigate, and minimize noise impacts towards Stock Island and Key Haven. In addition, there was an expansion of the departure end of Runway 08's (same location as the approach end for Runway 26) APZ to the north due to a departure flight track adjustment to avoid/mitigate Geiger Key impacts. Therefore, the 2018 APZs off Runway 08 (approach end) and Runway 26 (approach end) are the result of the overlap of operational flight tracks off each runway end, resulting in a wider than usual standard APZ configuration.



Legend

Runway	2018 AICUZ APZs	2007 AICUZ APZs
Installation Boundary	Clear Zone	
Airfield Surface Area	APZ I	
City Boundary	APZ II	

Figure 5-3
Comparison of 2007 AICUZ
and 2018 AICUZ APZs
NAS Key West
Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County 2015;
NAS Key West 2007; NAVFAC SE 2015.
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The 2013 Airfield Operations EIS found that the runways at NAS Key West are compliant with all airfield safety and planning criteria, and the projected aircraft would not require that runway length or orientation be reconfigured to retain optimal safety and efficiency of the airfield. The APZs are based on Class B Runway APZ designation and predominant flight path. In addition, the projected aircraft are similar in operation to existing aircraft and would not result in a change to predominant flight paths (Navy 2013).

5.3 IMAGINARY SURFACES

The Navy and the 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 to 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. 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. As discussed previously, all runways at NAS Key West are Class B runways. An illustrations of the imaginary surfaces for fixed-wing Class B runways is provided as Figure 5-4, and Figure 5-5 illustrates the imaginary surface specific to NAS Key West.

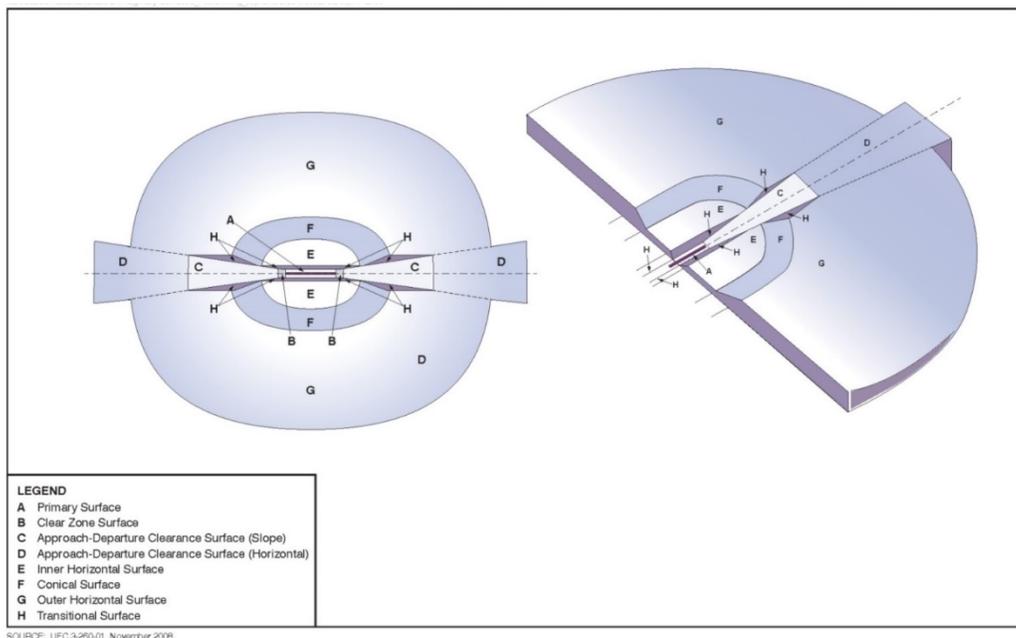
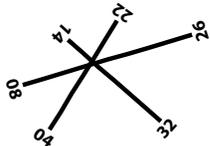
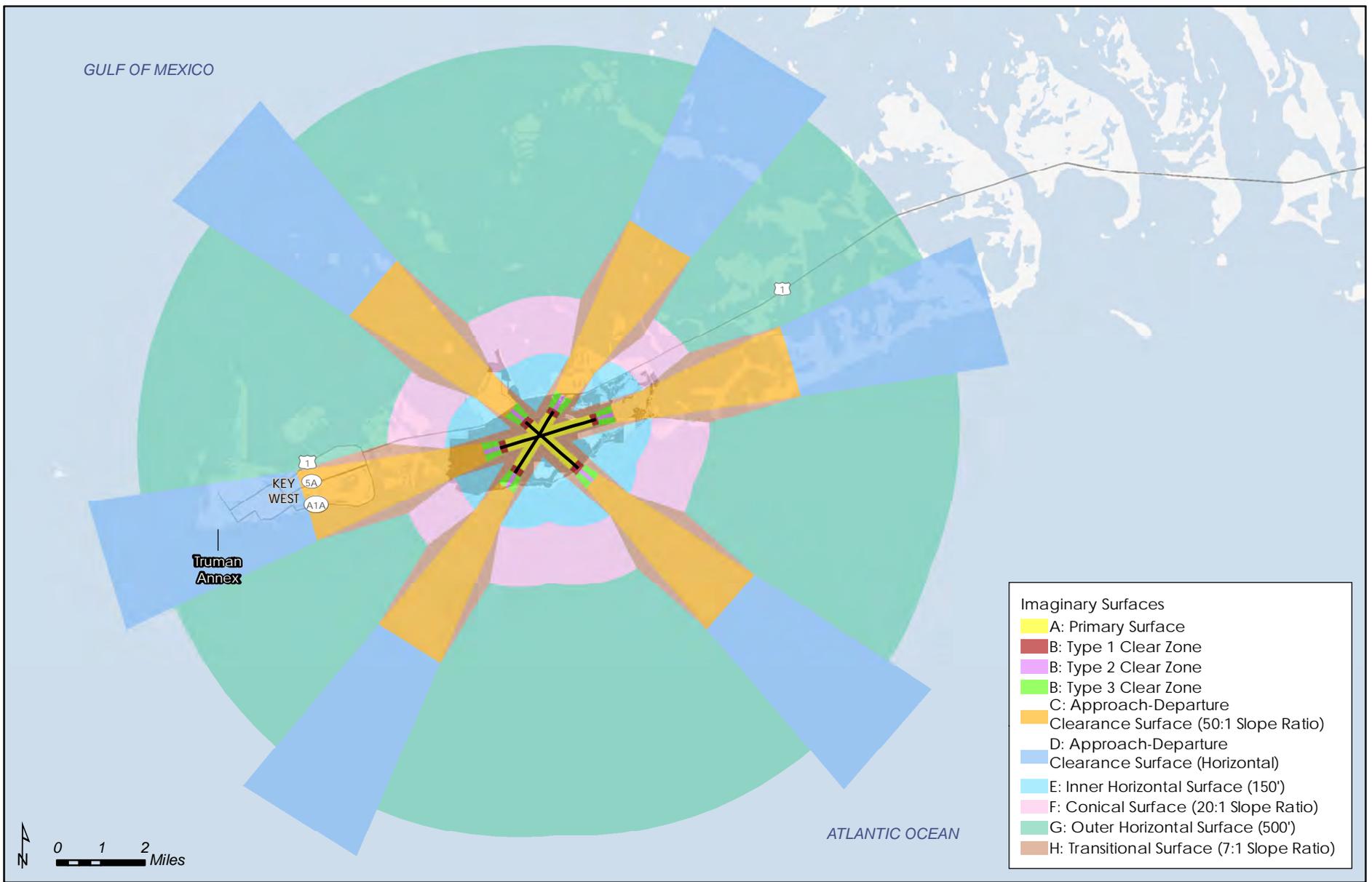


FIGURE 5-4 IMAGINARY SURFACES AND TRANSITION PLANES FOR CLASS B FIXED-WING RUNWAYS



- Legend
- Runway
 - Major Road
 - Installation Area

Figure 5-5
Imaginary Surfaces
NAS Key West
Monroe County, Florida

5.4 FLIGHT SAFETY

Flight safety programs are designed to reduce hazards that cause aircraft mishaps; APZs are designed to minimize harm if a mishap occurs. 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 airfields. 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 hazards that can cause an aircraft mishap. This section discusses aircraft mishaps at NAS Key West, hazards to flight safety that should be avoided in the airfield vicinity, and measures to avoid potential pilot interferences.

5.4.1 AIRCRAFT MISHAPS

The Navy categorizes aircraft mishaps into three primary groups: Class A, Class B, or Class C. The classification system is based on the severity of injury to the individuals involved and the total property damage. The most severe is Class A, and the least severe is Class C (for reportable mishaps).

Naval Safety Center records include 17 Class A mishaps in and around NAS Key West from January 1980 through August 2011 (Navy 2013). Of the 17 Class A mishaps, 14 occurred in the offshore training areas or other overwater areas. Three of the Class A mishaps occurred in the vicinity of NAS Key West. Two of those were in the same mishap event, in 1991, when an F-5E and an FA-18C had a midair collision in the overhead pattern at NAS Key West. The third Class A mishap was in 1994, when an error made in the landing of a touch-and-go pattern operation resulted in the pilot ejecting and the aircraft veering off the runway into a tidal pool. These data illustrate that most accidents in and around NAS Key West are associated with aircraft training operations. Since most of the aircraft training operations conducted at NAS Key West occur offshore, it is not surprising that most aircraft mishaps that result in aircraft crashes occur offshore, as well. In the 31+ years of Naval Safety Center data (January 1980 through August 2011), there were two mishaps resulting in three crashes in vicinity of the airfield. (Navy 2013)

5.4.2 BIRD/ANIMAL AIRCRAFT STRIKE HAZARDS

Bird/animal aircraft strike hazards (BASH) are another safety concern to aircraft operations. Birds and wildlife are drawn to different habitat types found in the airfield environment (e.g., edges, grass, brush, forest, water, and warm pavement). Due to the speed of the aircraft, collisions with wildlife can have considerable force and can cause substantial damage. 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. To reduce 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, and dredge disposal sites. Design modifications can reduce the appeal of these land uses for birds and other wildlife.

The Navy BASH program aims to minimize the risk of collisions involving birds/wildlife and aircraft and the subsequent loss of life and property. The BASH abatement program through awareness, avoidance, monitoring, and actively controlling bird and animal population movements. Some of the procedures outlined include monitoring the airfield for bird and other wildlife activity, issuing bird hazard warnings, installing and maintaining bird/wildlife avoidance measures, initiating bird/wildlife avoidance procedures when potentially hazardous bird/wildlife activities are reported, and submitting BASH reports for all incidents. NAS Key West has an effective BASH program that involves the distribution of information and active and passive measures to control how birds use the critical areas around the airfield. Methods outlined in the plan to reduce BASH risk at the airfield include habitat management, bird dispersal, depredation, and bird avoidance.

The United States Navy, Commander Navy Installations Command (CNIC) has entered into an agreement with the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (APHIS WS) to provide assistance to mitigate potential and realized wildlife hazards at Navy air stations. APHIS WS is recognized as the appropriate agency to conduct wildlife hazard management at military installations, as well as civilian airports, to reduce wildlife hazards. APHIS WS has assigned one full-time Wildlife Biologist at NAS Key West to conduct Wildlife Hazard Assessments and mitigate wildlife hazards on the airfield. Aircrews flying in and around NAS Key West will continue to adhere to the BASH program and flight operations standard operating procedures, using all available resources to minimize exposure during higher risk times of day and migration periods.

5.4.3 ELECTROMAGNETIC INTERFERENCE

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 activities that create EMI. The American National Standards Institute defines EMI as any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. EMI can be intentional, 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. For air operations, EMI is a concern because it can disrupt navigation and communications equipment. There also have been reports of EMI affecting aircraft fuel systems, warning lights, and propulsion. Any of these disruptions could lead to loss of aircraft and life.

5.4.4 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 pilot 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 can take 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 flash blindness, glare, disruptions, and distractions. These are most hazardous during critical phases of flight—landings, takeoffs, and emergency maneuvers. There is also concern about urban lighting that is not downward-directed, as well as the potential impacts of light-emitting diode, or "LED," lights on pilots who are training with night vision goggles.

5.4.5 SMOKE, STEAM, AND DUST

Land uses that generate sources of smoke, dust, and steam in the airfield vicinity could obstruct the pilot's vision during takeoff, landing, or other periods of low-altitude flight. Examples include dust from agricultural activities and thermal plumes from geothermal industries.

6

LAND USE PLANNING AUTHORITIES, POLICIES, REGULATIONS, AND PROGRAMS

6.1 Planning Authorities, Policies, Regulations, and Programs

6.2 Other Land Use Planning Programs and Tools

6.1 PLANNING AUTHORITIES, POLICIES, REGULATIONS, AND PROGRAMS

NAS Key West’s Boca Chica Field is located east of the City of Key West in an unincorporated area of Monroe County, Florida. The AICUZ footprint is located within the County and near the City of Key West’s jurisdiction (Navy 2007).

Development and control of land use outside the installation are beyond the jurisdiction of the Installation Commanding Officer. Therefore, this land is regulated by federal, state, and local land use planning programs, ordinances, and regulations.

These programs, ordinances, and regulations often have specific coordination efforts and considerations related to NAS Key West, as described in the following sections.

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

6.1.1 FEDERAL

The following are federal regulations and programs that provide NAS Key West the opportunity to guide development and land use within the vicinity of the installation and the AICUZ footprint.

NATIONAL ENVIRONMENTAL POLICY ACT

Under the National Environmental Policy Act (NEPA), federal agencies, including the Navy, are required to consider the impacts of any federal project that could significantly impact the environment. NEPA mandates full disclosure of the environmental effects resulting from proposed federal actions, approvals, or funding. Generally, an Environmental Assessment (EA) or EIS will document the impacts of the action. The environmental impact review process provides an opportunity for the public and the Navy to comment on federal agency projects that may affect land use decisions on NAS Key West or the surrounding area.

EXECUTIVE ORDER 12372, INTERGOVERNMENTAL REVIEW OF FEDERAL PROGRAMS (JULY 1982)

In accordance with the Intergovernmental Cooperation Act of 1968, the United States Office of Management and Budget requires federal agencies to coordinate and communicate with state, regional, and local officials in the early planning stages of any federal aid development projects. The Intergovernmental Review Program, Executive Order 12372, allows state governments, in consultation with local governments, to establish review periods and processes for federal projects. This provides the Navy with an early entry point to discuss AICUZ issues and introduce AICUZ concepts into the process.

HOUSING AND URBAN DEVELOPMENT

Under United States Department of Housing and Urban Development (HUD) Circular 1390.2, "Noise Abatement and Control," HUD established noise standards and polices for approving noise attenuation measures and HUD-assisted housing projects in high noise areas. The HUD regulations set forth a discretionary policy to withhold funds for housing projects when noise exposure exceeds prescribed levels. The HUD regulations allow for new housing construction assisted or supported by HUD within a noise area of 65 dB DNL or less. Construction within a 65- to 75-dB DNL noise area is subject to appropriate sound attenuation measures (e.g., dense wall material [concrete, brick], cavity partitions [airspace between two walls], acoustical blankets [insulation], double-paned windows, solid core wood doors), and construction within an area exceeding 75-dB DNL is not acceptable. Due to the discretionary framework of the HUD policy, variances may be permitted, depending on regional interpretation and local conditions. HUD regulations include policies that prohibit funding for HUD-assisted projects sited in Clear Zones and APZs unless the project is

compatible with the AICUZ. Additionally, the approval of all mortgage loans from the Federal Housing Administration or the Veterans Administration is subject to the standards and polices of HUD noise regulations (HUD 24 CFR 51, Subpart D).

NAVY

DOD Encroachment Partnering Program

Title 10 United States Code (U.S.C.) Section 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 for the purpose of limiting encroachment 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, or 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 simple, conservation, or other restrictive easements 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.

6.1.2 STATE OF FLORIDA

This section details state regulations and programs that provide NAS Key West the opportunity to guide development and land use within the vicinity of the installation and the AICUZ footprint.

The Florida Department of Economic Opportunity is the main agency responsible for oversight of the planning framework and growth management laws of Florida. The State of Florida institutes the State Comprehensive Plan that provides a framework for planning activities and guidance for the social, economic, and physical growth of the state. The State Comprehensive Plan is updated biennially by the Florida State Legislature. Additionally, Florida's Growth Management Act (Chapter 163, Part II, "Local Government Planning and Land Development

The Florida Department of Economic Opportunity is the main agency responsible for oversight of the planning framework and growth management laws of Florida.

Regulation Act”) was re-designated as the Community Planning Act in 2011. Under the Community Planning Act (163.3161, Florida Statutes [F.S.]), each city and county must adopt a comprehensive plan to guide future development, address issues associated with the use and development of land, promote public health and safety, and protect human, environmental, social, and economic resources. Development approval must be legally consistent with the plan. The Community Planning Act also calls for an Evaluation and Appraisal Review (163.3191, F.S.) where, at least every seven years, each local government must evaluate its comprehensive plan to determine if amendments or updates are needed in accordance with any State requirements since the last comprehensive plan update took place. After this evaluation, local governments submit Evaluation and Appraisal Review-related amendments to the Department of Economic Opportunity reflecting the necessary changes (Florida Department of Environmental Protection 2014).

Under the Community Planning Act, there are sections (e.g., Chapter 163, Part II, Sections 163.3175 and 163.3177) relating to military affairs and promoting the compatibility of land uses adjacent to or in proximity of military installations. These statutes require counties and municipalities where a military installation is located to send information that is necessary for determining potential land use compatibility issues directly to the Installation Commanding Officer, including those issues involving local or other non-military jurisdictions that affect the installation.

In addition, the Florida Keys Area Protection Act (380, F.S.) designates the Florida Keys as an area of critical state concern. The Act establishes a land management system that protects the natural environment and that conserves and protects the community character of the Florida Keys, which also includes details regarding military protection for NAS Key West. Under the principles for guiding development, the statute states that government plans should be consistent with principles that “protect the value, efficiency, cost-effectiveness, and amortized life of existing and proposed major public investments,” including NAS Key West and other military facilities [(380.0552(7)(h)4, F.S.).

6.1.3 REGIONAL PLANNING

The following are regional regulations and programs that provide NAS Key West the opportunity to guide development and land use within the vicinity of the installation and the AICUZ footprint.

REGIONAL PLANNING COUNCILS

The Florida Regional Councils Association is the statewide organization of the 10 regional planning councils (RPCs). The Florida Regional Councils Association collaborates with government and the business community to work towards enhancing the regional economy and ensuring consistency and quality of RPC programs. Each of the 10 RPCs are required to develop a Strategic Regional Policy Plan that is consistent with the State Comprehensive Plan and that provides guidance to local governments. NAS Key West is located in the South Florida RPC.



The South Florida RPC has a Council governed by a public/private sector board comprised of 18 voting members. Two-thirds of the board members are county and city elected officials. The remaining members are appointed by the Governor. The board also has four ex-officio members representing the Florida Departments of Economic Opportunity, Environmental Protection and Transportation, as well as the South Florida Water Management District. The Strategic Regional Policy Plan contains regional policies and strategies for improvement in each established goal area with targets and indicators to measure progress (South Florida RPC 2016).

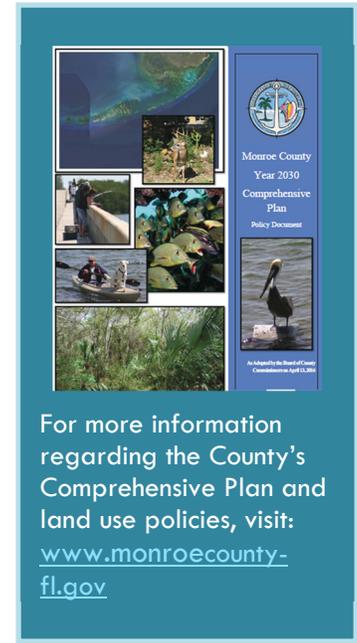
6.1.4 LOCAL PLANNING

MONROE COUNTY

The local planning authorities in Monroe County are the Board of County Commissioners, the Planning Commission, and the Monroe County Land Authority, among others. The Board of County Commissioners is comprised of five members representing the five districts in Monroe County. The Planning Commission consists of five members. Each member of the Board of County Commissioners appoints one member to the Planning Commission. Ex-officio or non-voting members also include a member from the Monroe County School District and a representative from NAS Key West (Monroe County 2016a). The Monroe County Land Authority acquires property for conservation, recreation, and affordable housing in Monroe County within the Florida Keys and Key West Areas of Critical State Concern. The Monroe County Land Authority was created to assist in the implementation of land use plans and to serve both landowners and government agencies that

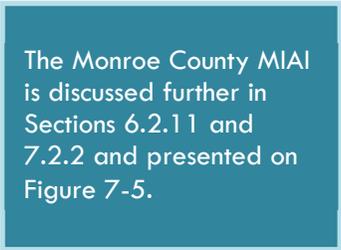
regulate land use. The Monroe County Board of County Commissioners serves as the Monroe County Land Authority's governing board.

Additionally, County departments help in the process of implementing planning initiatives, including the Monroe County Planning and Environmental Resources Department. The mission of the Monroe County Planning and Environmental Resources Department is to foster sustainable, quality development while conserving and promoting stewardship of the County's environment and the character of its communities. This department is responsible for administering and processing amendments to the Monroe County Comprehensive Plan and Land Development Regulations. Monroe County's 2030 Comprehensive Plan was adopted by the Board of County Commissioners in April 2016. Additionally, the department reviews development proposals to ensure compliance with the Comprehensive Plan and land development regulations. (Monroe County 2016b)



The Monroe County Comprehensive Plan was amended to meet the requirements of 163.3175, F.S., and 163.3177, F.S., which require cooperation and information exchange between the military and local governments for cities and counties adjacent or proximate to a military installation. The Monroe County Comprehensive Plan reflects these mandates:

- ❑ **Policies 108.1.1 and 108.1.5.** Direct that county plans affecting land adjacent or in proximity to a Military Installation Area of Impact (MIAI), as well as proposals scheduled for Development Review, must be transmitted to the Commanding Officer;
- ❑ **Policy 108.1.2.** Provides guidance for the Navy when working with the County on sound attenuation options for new construction and redevelopment within the MIAI;
- ❑ **Policy 108.1.4.** Requires the County's Planning Commission to include an ex officio, non-voting member who is a representative from NAS Key West; and
- ❑ **Policy 108.1.7.** Encourages the Navy to acquire noise-impacted lands with the 80+ dB DNL caused by Navy operations and noise. (Monroe County 2016c)



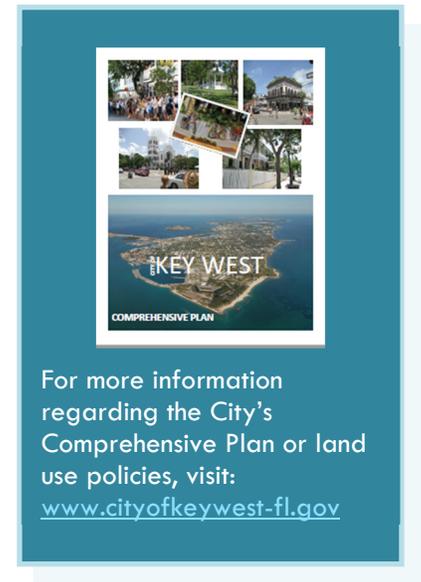
CITY OF KEY WEST

The local planning authorities for the City of Key West include entities such as the City Commission, the Planning Board and Department, and the Development Review Committee. There are six City Commissioners, each representing one of the six districts of Key West. The City of Key West Planning Board consists of seven members that address planning issues, from specific development approval requests to changes to the Comprehensive Plan and land development regulations (City of Key West 2016a). The Planning Board serves in an advisory role to the City Commission, or makes decisions to appeal either to the City Commission or court of law depending on the issue at hand. The Planning Board receives support and technical advice from both the City Planner and the Planning Department.

Additionally, the Planning Department works with the community to create policy documents that guide current and future development actions, such as the city's Comprehensive Plan (City of Key West 2016b). The City's 2013 Comprehensive Plan was adopted on March 5, 2013 and became effective May 2, 2013. Additionally, the Planning Department also works to create regulations to implement policy directives through the adopted land development regulations. Although NAS Key West's AICUZ footprint is not located within the city limit, the City of Key West has policies that relate to compatibility and can impact NAS Key West. The Comprehensive Plan for the City of Key West includes Military Compatibility and Coordination Criteria policies per 163.3175, F.S., as described below

- ❑ **Policy 1-1.13.2.** Requires the City to promote compatibility of lands adjacent or in proximity to military installations, as well as communicate with the Navy when changes are proposed to plans affecting these lands and consider resulting comments from the Navy; and
- ❑ **Policy 1-1.13.5.** Requires the City's Planning Board and Development Review Committee to include an ex officio, non-voting member who is a representative from NAS Key West. (City of Key West 2013)

The City also filed an amendment to the Comprehensive Plan (Ordinance No. 12-30) requiring coordination among the City of Key West, NAS Key West, and other government bodies for review of land development projects.



6.2 OTHER LAND USE PLANNING PROGRAMS AND TOOLS

The following are additional programs and tools that provide NAS Key West the opportunity to guide development and land use within the vicinity of the installation and the AICUZ footprint.

6.2.1 ZONING AND LAND USE

“Land use” describes the management of land and the extent to which it has been modified. Some typical uses found in communities include developed land, agricultural areas, and residential, commercial, open water, and forested areas. Land use is fundamental to the physical form of a county and its cities, and is a key component of the Comprehensive Plans, which are the primary policy documents that guide local land use and development.

“Zoning” is a term used in urban planning for a system of land use regulations. Zoning is the system local governments use to control the physical development and use of the land. The zoning ordinance is the principal tool for implementing a Comprehensive Plan. While the Comprehensive Plan provides broad policy direction on land use, the zoning ordinance provides the specific rules under which land can be developed and used. This includes standards for building setbacks, height restrictions, lot coverage, and design requirements. Zoning ordinances provide the regulatory framework to direct development and influence how the various uses interact with each other to prevent conflicts and incompatibility. The land surrounding NAS Key West has zoning classifications that mostly reflect the land uses. Establishing and/or enforcing zoning ordinances are the desired methods to address AICUZ guidelines and compatibility at NAS Key West.

More discussion regarding the land use and zoning regulations surrounding NAS Key West can be found in Section 7.2, Land Use Compatibility Analysis.

6.2.2 READINESS AND ENVIRONMENTAL PROTECTION INTEGRATION

The National Defense Authorization Act of 2004 granted the DOD the authority to enter into agreements (or partnerships) with private conservation organizations or state and local governments to establish buffers around military training and testing areas to restrict incompatible land use. Funding for the compatible land use efforts is provided to the DOD by Congress under the Readiness and Environmental Protection Integration (REPI) Program. REPI Program funding will support service agreements that, as authorized by 10 U.S.C. §2684a, seek to:

- (1) Limit any development or use of property that would be incompatible with the mission of the installations; or
- (2) Preserve off-installation habitat to relieve current or future environmental restrictions on military operations.

The REPI Program helps military installations sustain operational capabilities and ensure the future use of military training areas. Under the REPI Program, the DOD provides funding to military services in support of cost-sharing partnerships with non-federal organizations to purchase easements or acquire an interest in land. Land acquisition initiatives must be negotiated with a willing seller. Through partnerships, military services work with local and state agencies or conservation organizations to identify areas where land acquisition or conservation easements would be mutually beneficial for all parties. The partnership obtains property interest with the goal of controlling growth, preserving open space, and ultimately preventing future encroachment. The protected land obtained through REPI Program funding is not owned by the military or used for military training or testing.

6.2.3 PRACTICAL GUIDE TO COMPATIBLE CIVILIAN DEVELOPMENT NEAR MILITARY INSTALLATIONS

The DOD's Office of Economic Adjustment released a "Practical Guide to Compatible Civilian Development Near Military Installations" to highlight opportunities that local governments, states, and DOD representatives can take to promote compatible land use around military installations (DOD Office of Economic Adjustment 2005). The guide describes a variety of strategies that can be employed by military installation commanders, local government officials, planners, community members, and state officials to address encroachment by promoting the use of land surrounding a military installation in a way that is compatible with the military's mission. The guide focuses on approaches or best practices that an installation and surrounding communities can implement to initiate land use compatibility.

6.2.4 REAL ESTATE DISCLOSURE

Real estate disclosures can require that developers or landowners who own property within the AICUZ to notify any prospective purchaser of such property of associated noise and safety considerations. Real estate disclosures allow prospective buyers, lessees, or renters of property in the vicinity of military operations 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 locations of APZs, subsequently reducing

frustration and criticism by those who were not adequately informed prior to purchase of properties within impact areas.

6.2.5 TRANSFER OF DEVELOPMENT RIGHTS

Transfer of development rights (TDR) allows landowners in development-restricted areas to sell the rights to develop their property (sending property) and transfer those development rights to another landowner's property (receiving property) that can support development with greater densities. Transfers are generally administered through a local TDR program, which is typically established through local zoning ordinances. TDR programs are established to preserve environmentally sensitive areas, agricultural resources, historical properties, or valuable open space. A successful TDR program should identify the public purpose of the program, sending and receiving districts/areas, and the procedures to carry out the transaction. Development rights from the sending property are purchased as TDR credits. After development rights are transferred, the sending property is secured from future development under a conservation easement or deed restrictions, and the TDR credit is applied to the receiving property as a density bonus. The value of TDR credits should be defined in the local TDR program.

6.2.6 PURCHASE OF DEVELOPMENT RIGHTS

Local governments (or a land trust) can establish purchase of development rights programs to manage growth and to preserve open space. A local government or agency provides landowners with compensation for not developing their land (i.e., buying the development rights) and then obtains a legal easement (conservation easement) that further restricts development on the property. The landowner maintains ownership of the property and can use the land under conditions specified in the terms of the easement.

6.2.7 FEE-TITLE ACQUISITION

The Florida Legislature funds the acquisition of select sites identified as non-conservation buffers to protect military installations against encroachment through the Military Base Protection Program, as described in F.S. Section 288.980, "Military Base Retention; Legislative Intent; Grants Program." The Florida Department of Economic Opportunity annually solicits information on sites that encroach upon the mission of the military bases that do not qualify for acquisition under the Florida Forever Program. The Florida Department of Economic Opportunity ranks the sites and presents their recommendations to the Florida Defense Support Task Force prior to submitting a list to the Board of Trustees of the Internal Improvement Trust Fund for acquisition.

6.2.8 CAPITAL IMPROVEMENT PROGRAM

The Capital Improvement Program (CIP) is the multi-year scheduling of physical upgrades to public property. CIP projects, such as the extension of transmission lines, road paving and/or improvements, right-of-way acquisition, and school construction/renovation, can encourage new development to under-served areas. CIPs direct future growth patterns and ensure that the areas near military installations are developed in accordance with the AICUZ Program's recommended land use guidelines.

6.2.9 BUILDING PERMIT ALLOCATION SYSTEM AND RATE OF GROWTH ORDINANCE FOR MONROE COUNTY AND THE CITY OF KEY WEST

Statewide hurricane evacuation modeling and the Hurricane Evacuation Clearance Time Memorandum of Understanding was updated by the State of Florida and executed by Monroe County and its municipalities. Using the 2010 TIME Model, it was determined that there was additional capacity in the evacuation time to permit limited new residential growth, which allocated new residential units in Monroe County. Key West uses a Building Permit Allocation System (BPAS) to regulate residential development. As of development of this AICUZ Study, the City has approximately 910 BPAS units that can be developed for residential use. BPAS units have been distributed at a rate of 91 units per year from 2013 and will continue at this rate through 2023. This distribution only applies to new permanent and transient residential units, not the rebuilding of existing dwelling units. Different residence types have unique unit values based on the average number of vehicles associated with the residential structure type. Single-family and multi-family units, for example, have a value of "1," while transient units, such as motels and campgrounds, have a "0.86" equivalent single-family unit factor.

Per 2012 Updates to the Data and Analysis for EAR-Based Comprehensive Plan Amendments, if all land use districts were built to capacity, there could be 27,981 residential units in the City of Key West (City of Key West 2012).

To comply with the 24-hour hurricane evacuation time, new residential growth is controlled to ensure infrastructure can accommodate evacuees under a Rate of Growth Ordinance in Chapter 138 of the Monroe County Code of Ordinances. The Rate of Growth Ordinance was set in place to:

- (1) Facilitate implementation of goals, objectives, and policies set forth in the Comprehensive Plan relating to protection of residents, visitors, and property in the county from natural disasters, specifically hurricanes;

- (2) Limit the annual amount and rate of residential development commensurate with the County's ability to maintain a reasonable and safe hurricane evacuation clearance time;
- (3) Regulate the rate and location of growth in order to further deter deterioration of public facility service levels, environmental degradation, and potential land use conflicts;
- (4) Allocate the limited number of dwelling units available annually hereunder, based upon the goals, objectives, and policies set forth in the Comprehensive Plan; and
- (5) Implement Goal 105 of the Comprehensive Plan.

6.2.10 OVERLAY DISTRICTS

Through its Comprehensive Plan, Monroe County adopted military compatibility planning policies that promote and encourage compatible land uses in proximity to Boca Chica Field. This includes the creation of a future land use overlay known as the MIAI (Military Installation Area of Impact, as described previously in Section 6.1.4, Local Planning). The MIAI is the primary focus area in which development may currently or potentially be incompatible with NAS Key West and its training areas or where military activities may affect the surrounding communities. The MIAI includes a majority of the AICUZ footprint.

In accordance with Comprehensive Plan Policy 108.2.1, Monroe County adopted an overlay to the Future Land Use Map Series that identifies the MIAI as the zone of influence for the NAS Key West Complex. Growth management policies guide land use within this area, which experiences impacts from Navy operations. In addition, Policy 108.2.5 requires Monroe County to confer with the Navy on future land use designation changes within the MIAI overlay (see Figure 7-5).

The Comprehensive Plan also provides criteria that must be met in order for county residents to transfer development rights from within the MIAI overlay district to appropriate receiver sites located outside of the MIAI overlay district (Monroe County 2016a). In addition to the future land use overlay established as the MIAI, the Monroe County Land Development Code (Section 130, Article V) identifies several zoning designations in the vicinity of NAS Key West, including: Military Airport, Tier I Natural Area, and Tier III Infill Areas. (Note: There are no lands designated as Tier II Transition and Sprawl Area within the installation's immediate vicinity.) More details on Tier Overlays are discussed in 7.2.2, Zoning Surrounding Key West.

7

LAND USE COMPATIBILITY ANALYSIS AND RECOMMENDATIONS

- 7.1 Land Use Compatibility Guidelines and Classifications
- 7.2 Land Use Compatibility Analysis
- 7.3 NAS Key West AICUZ Study Recommendations

The information presented in this chapter of the AICUZ Study is intended for consideration by NAS Key West, government entities at the city, county, and state levels, surrounding communities, and other interested groups and stakeholders. The purpose of this chapter is to present the land use compatibility analysis that identifies any existing or planned land use, zoning, and development compatibility issues, as well as to provide recommendations to manage existing and future development within and around the AICUZ footprint to ensure long-term land use compatibility between local land development and the Navy's operational mission.

The AICUZ Study recommendations, when implemented, will continue to advance the goal, "to protect the health, safety, and welfare of those living near military airfields, while preserving the defense flying mission." Implementation of the recommendations is achieved over time through partnerships between NAS Key West and community stakeholders.

The "AICUZ footprint" is comprised of APZs and noise contours. The AICUZ footprint defines the minimum recommended area within which land use controls are needed to enhance the health, safety, and welfare of those living or working near a military airfield and to preserve the flying mission. The AICUZ footprint for NAS Key West is the basis for the land use compatibility analysis. The AICUZ, combined with the guidance and recommendations in this AICUZ Study, are the fundamental tools necessary for the planning process.

It should be noted that a similar compatibility analysis was performed in the 2013 Airfield Operations EIS; however, due to variations in land use datasets used in 2013 compared to those available and used for this AICUZ Study, as well as the categorization of compatibility, acreages and aspects in these analyses do not replicate acreages and aspects in the 2013 Airfield Operations EIS. The projected AICUZ footprint for NAS Key West (Figure 7-1) reflects DNL noise contours and APZs based on projected aircraft operations discussed earlier in this AICUZ Study. The AICUZ boundary shown is the area contained within Noise Zone 1 (<55 to <65 dB DNL), Noise Zone 2 (65 to <75 dB DNL), and Noise Zone 3 (>75 dB DNL), as well as APZs (Clear Zone, APZ I, and APZ II) of the air installation. The Navy recommends that the projected noise contours and APZs presented in this AICUZ Study be adopted into individual county and city planning studies, regulations, and processes to best guide compatible development around the installation.

7.1 LAND USE COMPATIBILITY GUIDELINES AND CLASSIFICATIONS

Certain land uses are incompatible with APZs and noise zones, while other land uses may be compatible or compatible under certain conditions (i.e., with restrictions). The Navy has developed land use compatibility recommendations for APZs and noise zones to foster land use compatibility. These recommendations, found in OPNAVINST 11010.36C, serve as guidelines for both the placement of APZs and noise zones and land use around military air installations. The guidelines recommend that noise-sensitive land uses (e.g., houses, churches, schools) be placed outside high noise zones, and that people-intensive uses (e.g., apartments, theaters, shopping centers, sports arenas) should not be placed in APZs. The land use compatibility analysis for NAS Key West is based on the Navy's land use compatibility recommendations, which are presented in Table 7-1, in Section 7.1.3, Standard Land Use Coding Manual. To determine land use compatibility within NAS Key West's projected noise zones and APZs, the Navy examined land use near the airfield.

7.1.1 SUGGESTED LAND USE COMPATIBILITY FOR NOISE

As discussed in Section 4.1, Sound Measurements and Guidance, DNL metrics present reliable measures of community sensitivity to aircraft noise. For land use planning purposes in AICUZ studies, noise exposure areas are divided into three noise zones, based on DNL measurements. Noise Zone 1 (<55 to <65 dB DNL) is an area of low or no impact. Noise Zone 2 (65 to <75 dB DNL) is an area of moderate impact where some land use controls are recommended. Noise Zone 3 (>75 dB DNL) is the most impacted area where the greatest degree of compatible land use controls are recommended.

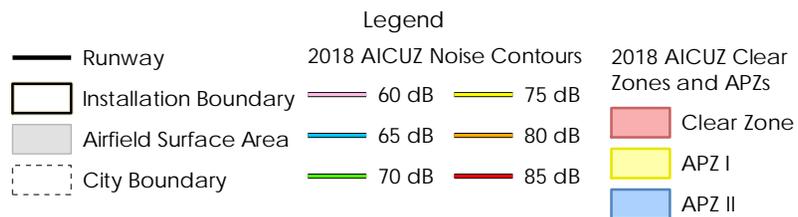
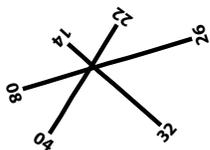
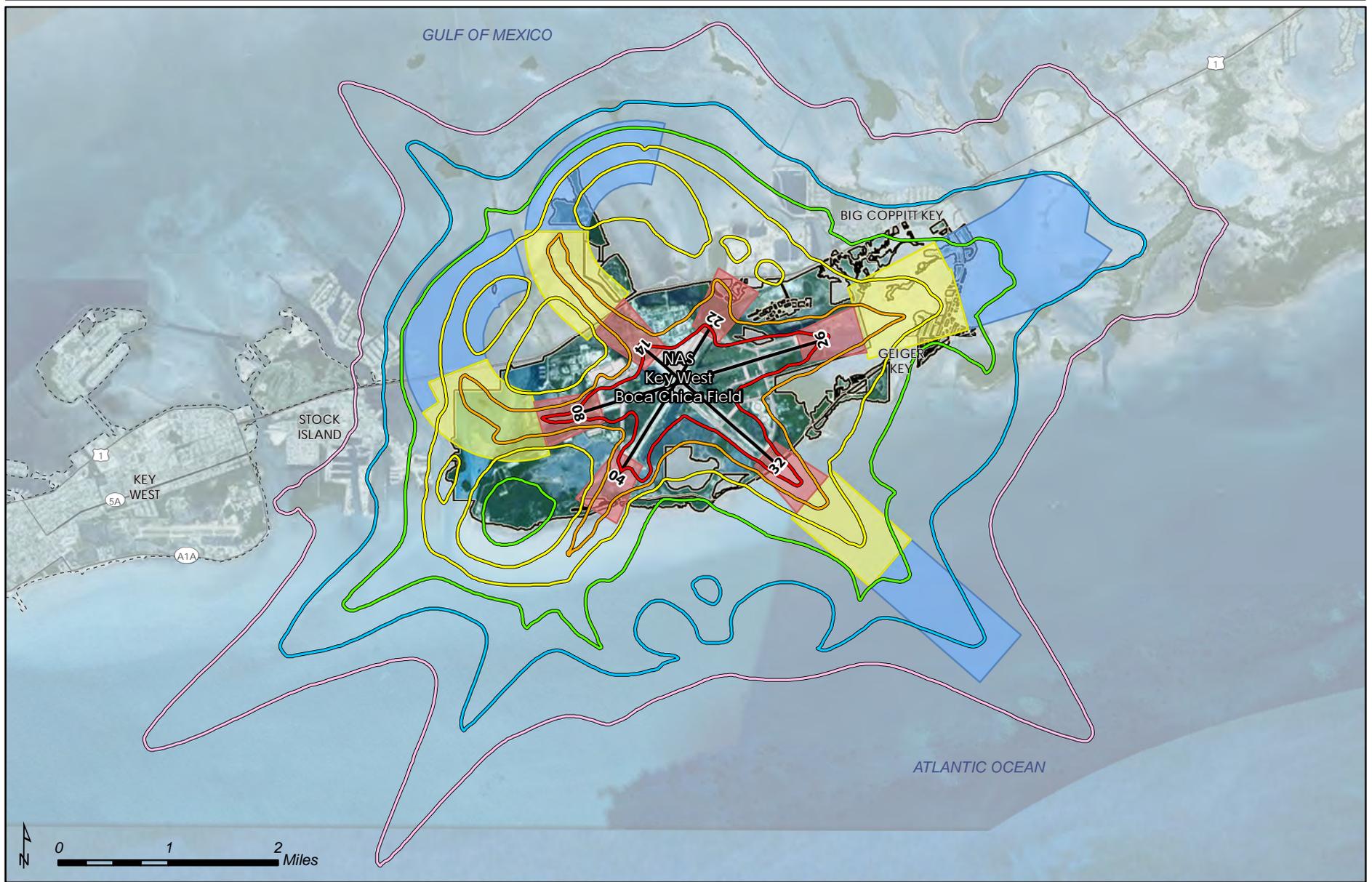


Figure 7-1
2018 AICUZ Footprint
NAS Key West
Monroe County, Florida

In addition to noise zones, areas of concern may be defined where noise levels are not normally considered to be objectionable (<65 dB DNL), but land use controls are recommended in that particular area. It is important to note that the noise contours described in Chapter 4, Aircraft Noise, are not precise representations of noise perceived by individuals. A number of factors can influence the propagation of and reaction to noise, including geographic features, weather, and the receiver's perception of the source. A portion of the population could be annoyed even by the lower levels of noise in Noise Zone 1.

7.1.2 SUGGESTED LAND USE COMPATIBILITY FOR ACCIDENT POTENTIAL ZONES

The Navy and local planning authorities use APZs to ensure compatible uses and development in proximity to runway ends and slightly beyond. Although the likelihood of an accident is remote, the Navy recommends that land uses that concentrate large numbers of people, such as apartments, churches, and schools, are not located within APZs.

7.1.3 STANDARD LAND USE CODING MANUAL

The Standard Land Use Coding Manual (SLUCM) reflects generic land use categories for illustrating a basic and high-level understanding of land use compatibility across some common land use types. Table 7-1 shows SLUCM generalized land use classifications and the associated land use compatibility with each land use designation for noise zones and APZs. However, it is important to note that the land uses provided in Table 7-1 do not represent the local community's land use designations. The local county and city land uses are different coding systems when compared to SLUCM's two- and four-digit coding system and draw different distinctions between land uses. With local coding systems, there may be multiple land use types per parcel (e.g., agricultural and residential use), whereas the SLUCM identifies parcels by a single type. Therefore, for the purposes of this analysis, each parcel within NAS Key West's noise zones or APZs was compared to the closest and most reasonable SLUCM classification. County and city land use and zoning are discussed later in this chapter.

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES ¹			NOISE LEVELS					
					NOISE ZONE 1		NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ I	APZ II	<55 DNL	55 TO 64 DNL	65 TO 69 DNL	70 TO <75 DNL	≥75 TO 79 DNL	80 TO 84 DNL
10	Residential									
11	Household units	NA	NA	NA	Y	Y ¹	N ²⁸	N ²⁸	N	N
11.11	Single units; detached	N	N	Y ²	Y	Y ¹	N ²⁸	N ²⁸	N	N
11.12	Single units; semidetached	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
11.13	Single units; attached row	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
11.21	Two units; side-by-side	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
11.22	Two units; one above the other	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
11.31	Apartments; walk up	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
11.32	Apartments; elevator	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
12	Group quarters	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
13	Residential hotels	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
14	Mobile home parks or courts	N	N	N	Y	Y ¹	N	N	N	N
15	Transient lodgings	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N ²⁸	N
16	Other residential	N	N	N	Y	Y ¹	N ²⁸	N ²⁸	N	N
20	Manufacturing³									
21	Food and kindred products; manufacturing	N	N	Y ⁴	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
22	Textile mill products; manufacturing	N	N	Y ⁴	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
23	Apparel and other finished products; products made from fabrics, leather and similar materials; manufacturing	N	N	N	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
24	Lumber and wood products (except furniture); manufacturing	N	Y ⁵	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
25	Furniture and fixtures; manufacturing	N	Y ⁵	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
26	Paper and allied products; manufacturing	N	Y ⁵	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
27	Printing, publishing, and allied industries	N	Y ⁵	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES ¹			NOISE LEVELS					
					NOISE ZONE 1		NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ I	APZ II	<55 DNL	55 TO 64 DNL	65 TO 69 DNL	70 TO <75 DNL	≥75 TO 79 DNL	80 TO 84 DNL
28	Chemicals and allied products; manufacturing	N	N	N	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
29	Petroleum refining and related industries	N	N	N	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
30	Manufacturing (continued) ³									
31	Rubber and misc. plastic products; manufacturing	N	N	N	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
32	Stone, clay, and glass products; manufacturing	N	N	Y ⁴	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
33	Primary metal products; manufacturing	N	N	Y ⁴	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
34	Fabricated metal products; manufacturing	N	N	Y ⁴	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks	N	N	N	Y	Y	Y	25	30	N
39	Miscellaneous manufacturing	N	Y ⁵	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
40	Transportation, communication and utilities ^{6,7}									
41	Railroad, rapid rail transit, and street railway transportation	N	Y ^{5,7}	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
42	Motor vehicle transportation	N	Y ^{5,7}	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
43	Aircraft transportation	N	Y ^{5,7}	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
44	Marine craft transportation	N	Y ^{5,7}	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
45	Highway and street right-of-way	N	Y ^{5,7}	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
46	Automobile parking	N	Y ^{5,7}	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
47	Communication	N	Y ^{5,7}	Y ⁵	Y	Y	Y	25 ³²	30 ³²	N
48	Utilities	N	Y ^{5,7}	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
485	Solid waste disposal (landfills, incineration, etc.)	N	N	N	Y	Y	NA	NA	NA	NA

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES ¹			NOISE LEVELS					
					NOISE ZONE 1		NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ I	APZ II	<55 DNL	55 TO 64 DNL	65 TO 69 DNL	70 TO <75 DNL	≥75 TO 79 DNL	80 TO 84 DNL
49	Other transportation, communication, and utilities	N	Y ⁷	Y ⁷	Y	Y	Y	25 ³²	30 ³²	N
50	Trade									
51	Wholesale trade	N	Y ⁵	Y ⁵	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
52	Retail trade – building materials, hardware, and farm equipment	N	Y ⁸	Y ⁸	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
53	Retail trade ¹⁰ – shopping centers, home improvement store, discount club, electronics superstore	N	N	Y ⁹	Y	Y	Y	25	30	N
54	Retail trade – food	N	N	Y ¹¹	Y	Y	Y	25	30	N
55	Retail trade – automotive, marine craft, aircraft, and accessories	N	Y ¹²	Y ¹²	Y	Y	Y	25	30	N
56	Retail trade – apparel and accessories	N	N	Y ¹³	Y	Y	Y	25	30	N
57	Retail trade – furniture, home furnishings, and equipment	N	N	Y ¹³	Y	Y	Y	25	30	N
58	Retail trade – eating and drinking establishments	N	N	N	Y	Y	Y	25	30	N
59	Other retail trade	N	N	Y ⁹	Y	Y	Y	25	30	N
60	Services¹⁴									
61	Finance, insurance, and real estate services	N	N	Y ¹⁵	Y	Y	Y	25	30	N
62	Personal services	N	N	Y ¹⁶	Y	Y	Y	25	30	N
62.4	Cemeteries	N	Y ¹⁷	Y ¹⁷	Y	Y	Y	Y ²⁹	Y ³⁰	Y ^{31,37}
63	Business services (credit reporting; mail, stenographic reproduction; advertising)	N	N	Y ¹⁸	Y	Y	Y	25	30	N
63.7	Warehousing and storage services	N	Y ¹⁹	Y ¹⁹	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
64	Repair services	N	Y ²⁰	Y ²⁰	Y	Y	Y	Y ²⁹	Y ³⁰	Y ³¹
65	Professional services	N	N	Y ¹⁸	Y	Y	Y	25	30	N

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES ¹			NOISE LEVELS					
					NOISE ZONE 1		NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ I	APZ II	<55 DNL	55 TO 64 DNL	65 TO 69 DNL	70 TO <75 DNL	≥75 TO 79 DNL	80 TO 84 DNL
65.1	Hospitals, other medical facilities	N	N	N	Y	Y ¹	25	30	N	N
65.16	Nursing homes	N	N	N	Y	Y	N ²⁸	N ²⁸	N	N
66	Contract construction services	N	Y ²⁰	Y ²⁰	Y	Y	Y	25	30	N
67	Governmental services	N	N	Y ¹¹	Y	Y ¹	Y ²⁸	25	30	N
68	Educational services	N	N	N	Y	Y ¹	25	30	N	N
69	Miscellaneous	N	N	Y ¹⁸	Y	Y	Y	25	30	N
70	Cultural, entertainment and recreational									
71	Cultural activities (& churches)	N	N	N	Y	Y ¹	25	30	N	N
71.2	Nature exhibits	N	Y ²¹	Y ²¹	Y	Y ¹	Y ²⁸	N	N	N
72	Public assembly	N	N	N	Y	Y ¹	Y	N	N	N
72.1	Auditoriums, concert halls	N	N	N	Y	Y	25	30	N	N
72.11	Outdoor music shells, amphitheaters	N	N	N	Y	Y ¹	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	N	N	N	Y	Y	Y ³³	Y ³³	N	N
73	Amusements- fairgrounds, miniature golf, driving ranges; amusement parks, etc.	N	N	Y	Y	Y	Y	Y	N	N
74	Recreational activities (including golf courses, riding stables, water recreation)	N	Y ^{20, 21}	Y ^{20, 21}	Y	Y ¹	Y ²⁸	25	30	N
75	Resorts and group camps	N	N	N	Y	Y ¹	Y ²⁸	Y ²⁸	N	N
76	Parks	N	Y ^{20, 21}	Y ^{20, 21}	Y	Y ¹	Y ²⁸	Y ²⁸	N	N
79	Other cultural, entertainment and recreation	N	Y ^{17, 20}	Y ^{17, 20}	Y	Y ¹	Y ²⁸	Y ²⁸	N	N
80	Resource production and extraction									
81	Agriculture (except livestock)	Y ⁶	Y ²²	Y ²²	Y	Y	Y ³⁴	Y ³⁵	Y ³⁶	Y ^{36, 37}
81.5, 81.7	Livestock farming and breeding	N	Y ^{22, 23}	Y ^{22, 23}	Y	Y	Y ³⁴	Y ³⁵	N	N
82	Agricultural related activities	N	Y ^{22, 24}	Y ^{22, 24}	Y	Y	Y ³⁴	Y ³⁵	Y ³⁶	Y ^{36, 37}

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES ¹			NOISE LEVELS					
					NOISE ZONE 1		NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ I	APZ II	<55 DNL	55 TO 64 DNL	65 TO 69 DNL	70 TO <75 DNL	≥75 TO 79 DNL	80 TO 84 DNL
83	Forestry activities ²⁵	N	Y ²⁴	Y ²⁴	Y	Y	Y ³⁴	Y ³⁵	Y ³⁶	Y ^{36, 37}
84	Fishing activities ²⁶	N ²⁶	Y ²⁴	Y ²⁴	Y	Y	Y	Y	Y	Y
85	Mining activities	N	Y ²⁴	Y ²⁴	Y	Y	Y	Y	Y	Y
89	Other resource production and extraction	N	Y ²⁴	Y ²⁴	Y	Y	Y	Y	Y	Y
90	Other									
91	Undeveloped Land	Y	Y	Y	NA	NA	NA	NA	NA	NA
93	Water areas	N ²⁷	N ²⁷	N ²⁷	NA	NA	NA	NA	NA	NA

Adapted from OPNAVINST 11010.36.C (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 Federal Aviation Regulations (FARs) are provided as a guide to densities in some categories. In general, land-use restrictions which limit commercial, services, or industrial buildings or structure occupants to 25 per acre in APZ 1 and 50 per acre in APZ 2 are the range of occupancy levels, including employees, considered to be low density. Outside events should normally be limited to assemblies of not more than 25 people per acre in APZ 1, and Maximum (MAX) assemblies of 50 people per acre in APZ 2.
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 to pilots.
4. Maximum FAR of 0.56 in APZ 2.
5. Maximum FAR of 0.28 in APZ 1 and 0.56 in APZ 2.
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 UFC 3-260-01 “Airfield and Heliport Planning & Design” dated 10 November 2001 for specific design details.
7. No passenger terminals and no major aboveground transmission lines in APZ 1.
8. Within SLUCM Code 52, Max FARs for lumber yards (SLUCM Code 521) are 0.20 in APZ 1 and 0.40 in APZ 2. For hardware/paint and farm equipment stores, SLUCM Code 525, the Max FARs are 0.12 in APZ 1 and 0.24 in APZ 2.
9. Maximum FAR of 0.16 in APZ 2.
10. A shopping center is an integrated group of commercial establishments that is planned, developed, owned, or managed as a unit. Shopping center types include strip, neighborhood, community, regional, and super regional facilities anchored by small businesses, supermarket or drug store, discount retailer, department store, or several department stores, respectively. Included in this category are such uses as big box discount and electronics superstores. The Max recommended FAR for SLUCM 53 should be applied to the gross leasable area of the shopping center rather than attempting to use other recommended FARs under “Retail” or “Trade.”
11. Maximum FAR of 0.24 in APZ 2.
12. Maximum FAR of 0.14 in APZ 1 and 0.28 in APZ 2.

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES ¹			NOISE LEVELS					
					NOISE ZONE 1		NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ I	APZ II	<55 DNL	55 TO 64 DNL	65 TO 69 DNL	70 TO <75 DNL	≥75 TO 79 DNL	80 TO 84 DNL

13. Maximum FAR of 0.28 in APZ 2.
14. Low intensity office uses only. Accessory uses such as meeting places, auditoriums, etc., are not recommended.
15. Maximum FAR of 0.22 for “General Office/Office park” In APZ 2.
16. Office uses only. Maximum FAR of 0.22 in APZ 2.
17. No chapels are allowed within APZ 1 or APZ 2.
18. Maximum FAR of 0.22 in APZ 2.
19. Maximum FAR of 1.0 in APZ 1 and 2.0 in APZ 2.
20. Maximum FAR of 0.11 in APZ 1 and 0.22 in APZ 2.
21. Facilities must be low intensity and provide no tot lots, etc. Facilities such as clubhouses, meeting places, auditoriums, large classes, etc., are not recommended.
22. 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.
23. Includes feedlots and intensive animal husbandry.
24. Maximum FAR of 0.28 in APZ 1 and 0.56 in APZ 2. No activity that produces smoke or glare or involves explosives.
25. 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.
26. Controlled hunting and fishing may be permitted for the purpose of wildlife management.
27. Naturally occurring water features (e.g., rivers, lakes, streams, wetlands) are compatible.
28. 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 locally 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 NLR of at least 25 dB in DNL 65-69 and NLR of 30 dB DNL 70-74 should be incorporated into building codes and be 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 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.
29. 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.
30. 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.
31. 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.
32. If the project or proposed development is noise sensitive, use indicated NLR; if not, land use is compatible without NLR.
33. Land use compatible provided special sound reinforcement systems are installed.
34. Residential buildings require an NLR of 25.
35. Residential buildings require an NLR of 30.
36. Residential buildings not permitted.

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES ¹			NOISE LEVELS					
					NOISE ZONE 1		NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ I	APZ II	<55 DNL	55 TO 64 DNL	65 TO 69 DNL	70 TO <75 DNL	≥75 TO 79 DNL	80 TO 84 DNL

37. Land-use not recommended, but if the community decides use is necessary, hearing protection devices should be worn.

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 exceptions) The land use and related structures are generally incompatible. However, see notes indicated by superscript.
- SLUCM = Standard Land Use Coding Manual, U.S. Department of Transportation.
- NA = Not Applicable (no data available for that category).
- FAR = (Floor Area Ratio) A floor area ratio is the ratio between the square feet of floor area of the building and the site area. It is customarily used to measure non-residential intensities.
- Du/Ac = (Dwelling Units per Acre) = This metric is customarily used to measure residential densities.
- DNL = Day-night average sound level.
- L_{dn} = Mathematical symbol for DNL.
- CNEL = Community Noise Equivalent Level (normally within a very small decibel difference of DNL).
- NLR = (Noise-Level Reduction) = NLR (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
- 25, 30, or 35 = The numbers refer to NLR levels. Land use and related structures generally compatible however, measures to achieve NLR of 25, 30, or 35 must be incorporated into design and construction of structure. However, measures to achieve an overall noise reduction do not necessarily solve noise difficulties outside the structure and additional evaluation is warranted. Also, see notes indicated by superscripts where they appear with one of these numbers.

7.2 LAND USE COMPATIBILITY ANALYSIS

This section addresses land use compatibility within aircraft noise zones and APZs by examining existing and planned land uses near NAS Key West. The AICUZ footprint for NAS Key West is the basis for the land use compatibility analysis. As previously noted, NAS Key West's AICUZ footprint is located in the unincorporated area of Monroe County and the City of Key West. Therefore, the land use within the off-installation AICUZ footprint is under the jurisdictions of the city and county. The land use compatibility analysis for this AICUZ Study is based on the Navy's land use compatibility guidelines, which are presented in Table 7-1. Land use patterns and zoning in the vicinity of NAS Key West, along with the land use compatibility assessment, are presented below.

7.2.1 LAND USE SURROUNDING NAS KEY WEST

NAS Key West is located within unincorporated areas of Monroe County (Boca Chica Key, Fleming Key, Demolition Key, Dredgers Key, Rockland Key, Geiger Key, Stock Island¹, Big Coppitt Key, and Saddlebunch Key). Land use classifications are consolidated into nine main categories, as shown on Figure 7-2. The lands surrounding the installation and within the AICUZ footprint (see Table 7-2) are varied and include mostly vacant, conservation, and residential existing land use types. Additionally, the area north of US Hwy 1 to the east of Boca Chica Field includes industrial and commercial land uses. The land uses west of the installation include mostly residential, commercial, and public lands uses within both Stock Island and Key West, as well as some institutional, industrial, and vacant land uses on Stock Island, specifically.

TABLE 7-2 LAND USES WITHIN THE NAS KEY WEST AICUZ FOOTPRINT (ACRES)

Land Use	Clear Zone	APZ I	APZ II	Noise Zone 1	Noise Zone 2	Noise Zone 3
Commercial				62.52	51.74	4.44
Conservation	2.03	6.02	30.14	160.95	132.34	47.88
Industrial	0.14			81.84	27.06	78.96
Institutional				11.71	4.86	
Military	231.30	456.54	65.05		106.23	1,346.72
Public	328.91	176.37	96.89	160.80	484.73	2,231.19
Recreation		5.72		0.40	4.71	1.73
Residential		11.96	1.32	88.10	204.33	12.67
Vacant or Undeveloped	1.60	99.83	59.37	301.30	258.72	214.05
TOTAL	563.99	756.43	252.77	867.61	1,274.72	3,937.64

Notes: Blank cells have a value of zero (0.0). Water is not included in the acreage totals.

¹ The area of Stock Island north of Overseas Highway (US Hwy 1) is located within the city of Key West, while the area south of US Hwy 1 is located within Monroe County.

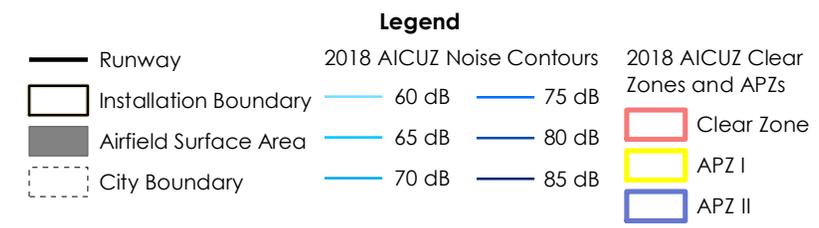
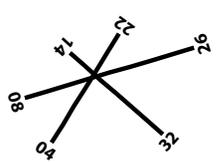
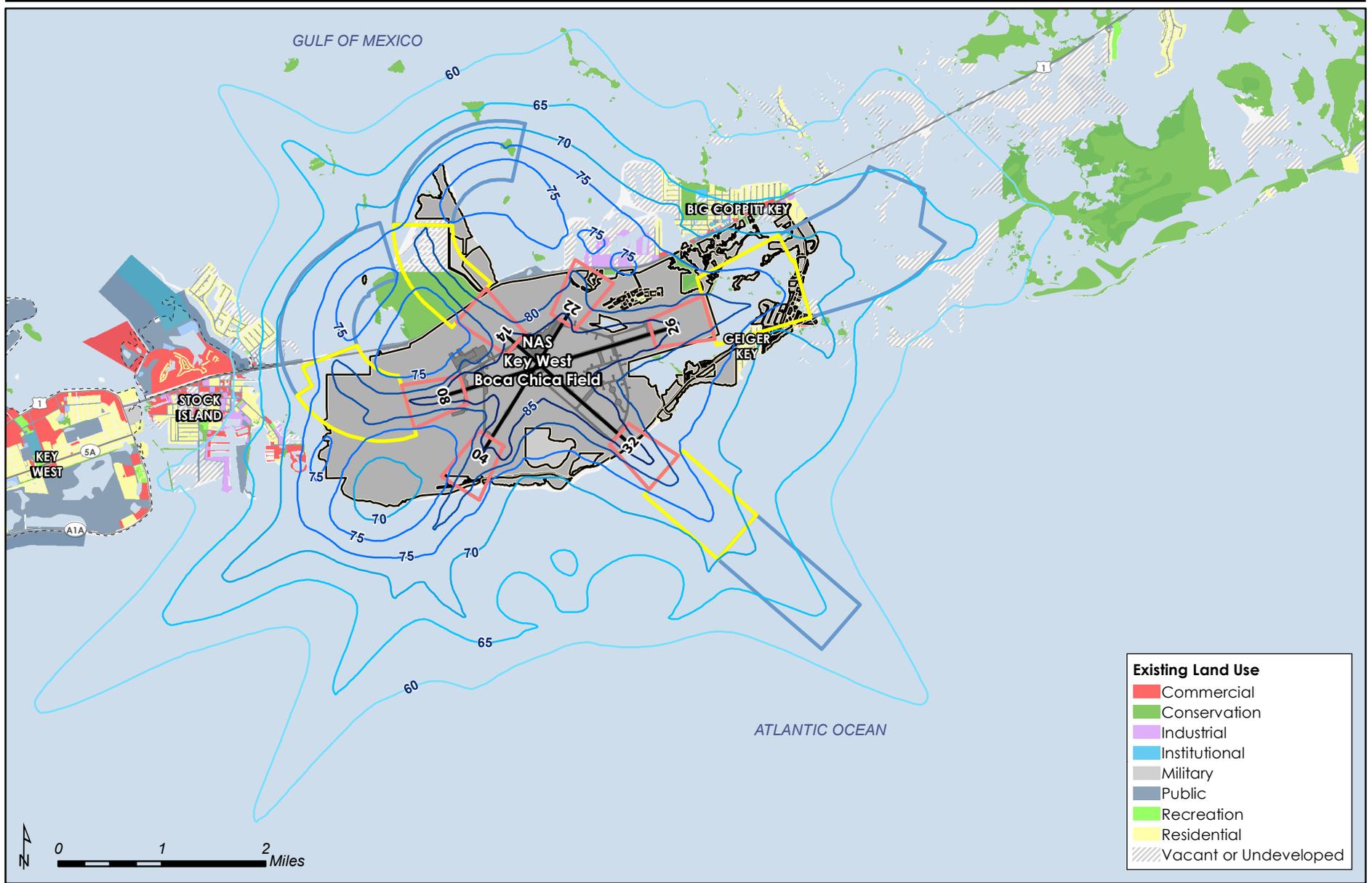


Figure 7-2
2018 AICUZ Footprint
with Existing Land Use
 NAS Key West
 Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County 2015; City of Key West 2004; NAVFAC SE 2014, 2015; Wyle 2013. © 2017 Ecology and Environment, Inc.

Future land use patterns are shown on Figure 7-3 and described in Table 7-3. Much of the land area east of the installation is categorized as residential conservation and conservation/recreation. Areas north of US Hwy 1 remain similar to the existing land uses of residential, commercial, and industrial. West of the installation on Stock Island, the future land uses north of US Hwy 1 are designated as public, recreation, and residential. To the west of the installation and south of US Hwy 1, future land uses are comprised of commercial, high-density residential, and industrial. In Key West, future land uses are classified as mostly low density residential, public uses, commercial, conservation, recreation, and some high residential.

TABLE 7-3 MONROE COUNTY FUTURE LAND USE DISTRICTS AROUND NAS KEY WEST

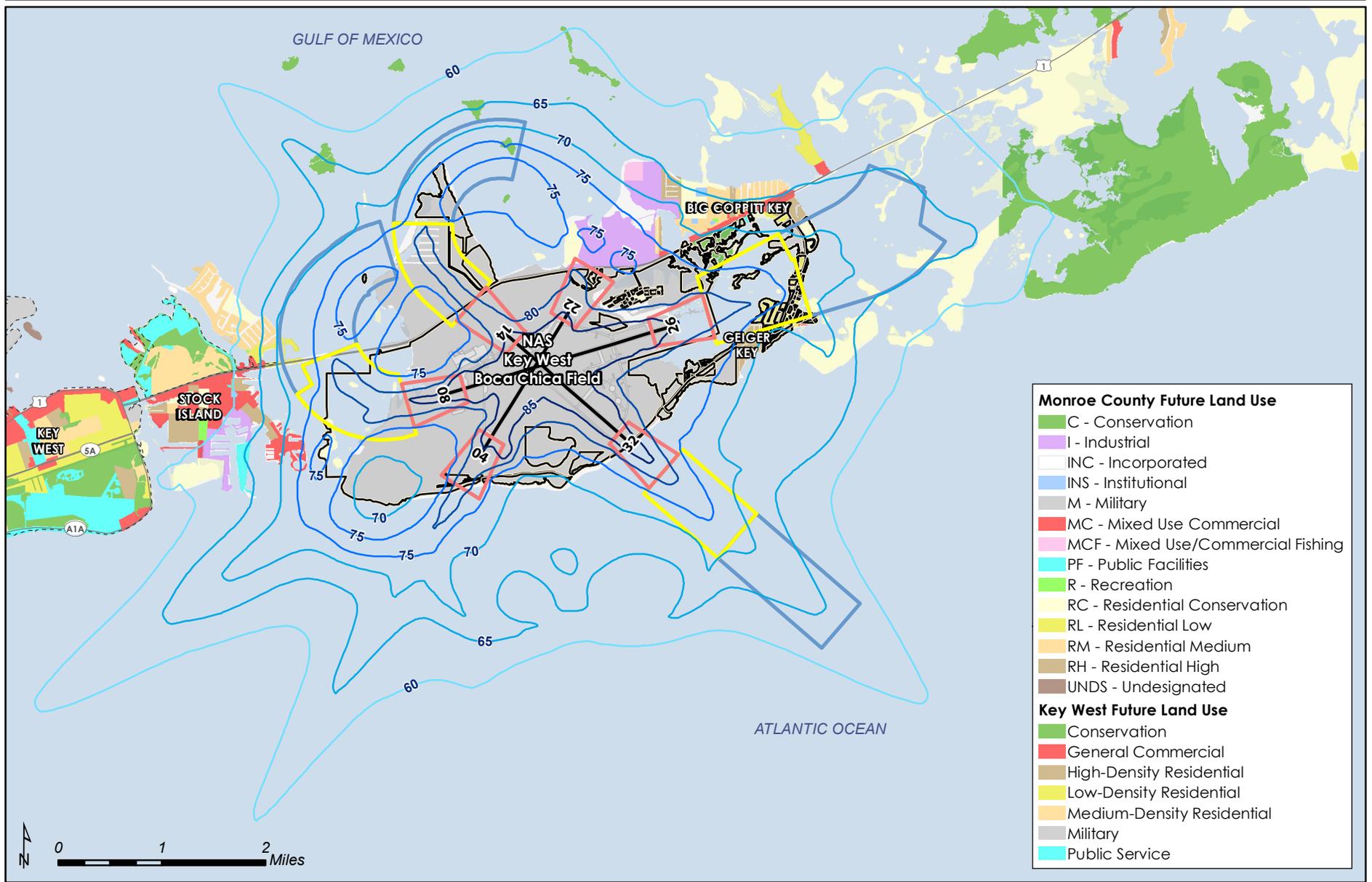
Future Land Use District		Uses and Limitations
C	Conservation	These are publically or privately owned lands to be preserved. Compatible passive recreational use is permitted.
I	Industrial	Industrial, manufacturing, warehouse, distribution, commercial, public, and employee or commercial apartment residential uses are permitted.
M	Military	Military use is permitted. Densities and intensities are not regulated by Monroe County.
MC	Mixed Use/Commercial	Compatible commercial retail, office, and residential uses are permitted with intensities consistent with the community character and natural environment.
MCF	Mixed Use/Commercial Fishing	Commercial fishing and water-related uses, as well as residential uses, are permitted.
R	Recreation	Public and private activity and resource-based recreational facilities are permitted.
RC	Residential Conservation	This area is for very low-density residential use in areas of predominantly undisturbed native vegetation.
RM	Residential Medium	Subdivisions, served by existing roadways, have an approved potable water supply, and sufficient uplands are permitted.
RH	Residential High	These are areas near employment centers where high-density residential use is permitted.

Source: Monroe County 2016c

Note: Only districts illustrated on Figure 7-3 that are adjacent or proximate to NAS Key West are included in this table.

7.2.2 ZONING SURROUNDING NAS KEY WEST

Zoning surrounding NAS Key West is varied and is shown on Figure 7-4 and described in Table 7-4. Table 7-5 provides the total composition of zoning within the AICUZ footprint. Zoning east of the installation includes conservation, native area, and research designations, as well as residential in Geiger Key. Northeast of the installation, along US Hwy 1, includes zoning designations of improved subdivision and residential, conservation, industrial, and commercial/commercial fishing. West of the installation includes mixed uses, planned redevelopment, residential, and public uses. Major zoning designation further west in Key West include conservation, commercial, single family residential and public services.

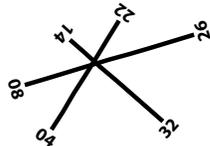


Monroe County Future Land Use

- C - Conservation
- I - Industrial
- INC - Incorporated
- INS - Institutional
- M - Military
- MC - Mixed Use Commercial
- MCF - Mixed Use/Commercial Fishing
- PF - Public Facilities
- R - Recreation
- RC - Residential Conservation
- RL - Residential Low
- RM - Residential Medium
- RH - Residential High
- UNDS - Undesignated

Key West Future Land Use

- Conservation
- General Commercial
- High-Density Residential
- Low-Density Residential
- Medium-Density Residential
- Military
- Public Service



Legend

- Runway
- Installation Boundary
- Airfield Surface Area
- City Boundary

2018 AICUZ Noise Contours

- 60 dB
- 65 dB
- 70 dB
- 75 dB
- 80 dB
- 85 dB

2018 AICUZ Clear Zones and APZs

- Clear Zone
- APZ I
- APZ II

Figure 7-3
2018 AICUZ Footprint
with Future Land Use
 NAS Key West
 Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County 2015; NAVFAC SE 2012, 2015; Wyle 2013. © 2017 Ecology and Environment, Inc.

TABLE 7-4 ZONING DISTRICTS AROUND NAS KEY WEST

Zoning District	Uses and Limitations
Suburban Commercial	<ul style="list-style-type: none"> ▪ The commercial uses in this district should be primarily for serving the immediate area. ▪ 3 dwelling units (du)/acre (allocated density); 6 du/buildable area (maximum net density).
Commercial Fishing Special District	<ul style="list-style-type: none"> ▪ This is a district traditionally used for commercial fishing. Additional commercial fishing uses must be consistent with the natural environment or community character. ▪ 3 du/acre (allocated density) to 12 du/buildable area (maximum net density).
Industrial	<ul style="list-style-type: none"> ▪ This district is for manufacturing, warehousing, and distribution. ▪ 1 du/acre (allocated density); 2 du/buildable area (maximum net density).
Native Area	<ul style="list-style-type: none"> ▪ This is an undisturbed area that should be preserved in its natural state. ▪ 0.25 du/acre (allocated density); 0 du/buildable area (maximum net density).
Sparsely Settled	<ul style="list-style-type: none"> ▪ This district is for low-density residential use with a predominant character of native or open space. ▪ 0.5 du/acre (allocated density); 0 du/buildable area (maximum net density).
Suburban Residential	<ul style="list-style-type: none"> ▪ This district is for low- to medium-density residential use. ▪ 0.5 du/acre (allocated density); 5 du/buildable area (maximum net density).
Urban Residential Mobile Home Limited	<ul style="list-style-type: none"> ▪ This district is for established mobile home parks below base flood elevation. ▪ 1 du/lot (allocated density; 0 du/building area (maximum net density).
Urban Residential Mobile Home	<ul style="list-style-type: none"> ▪ This district is for established mobile home parks. ▪ 1 du/lot (allocated density; 0 du/building area (maximum net density).
Improved Subdivision	<ul style="list-style-type: none"> ▪ This district is for established residential developments with existing roads and water supply. ▪ 1 du/lot (allocated density; 0 du/building area (maximum net density).

Source: Monroe County 2016d

Note: Only districts illustrated on Figure 7-4 that are adjacent or proximate to NAS Key West are included in this table.

TABLE 7-5 TOTAL COMPOSITION OF THE ZONING (ACRES) WITHIN THE NAS KEY WEST AICUZ FOOTPRINT

Zoning		Clear Zone	APZ I	APZ II	Noise Zone 1	Noise Zone 2	Noise Zone 3
City of Key West							
CM	Conservation - Mangrove				2.4		
C-OW	Conservation - Outstanding Waters of the State				0.9		
Monroe County							
	Commercial Fishing District		67.8	8.8		20.8	78.2
I	Industrial	3.6			0.3	94.6	198.5
IS	Improved Subdivision				80.1	95.0	2.4
MF	Military Facilities	454.6	120.1	71.0		304.6	2,871.3
MI	Maritime Industries				77.7	5.0	
MU	Mixed Use				20.2	43.0	5.1
NA	Native Area	106.3	198.7	68.6	149.4	222.3	751.2
OS	Offshore Island Area		21.7	31.7	177.2	162.6	63.4
PR	Park and Refuge				0.6	1.0	
	Research			44.5	263.0	53.7	
RV	Recreational Vehicle				10.7	1.6	
SC	Suburban Commercial				18.5	45.5	3.0
SR	Suburban Residential			13.5	41.3	35.8	
SS	Sparsely Settled		71.5	3.8		98.8	10.3
UR	Urban Residential		8.5		4.4		
URM	Urban Residential Mobile Home			0.1	19.3	96.6	0.6
URM-L	Urban Residential Mobile Home Limited				10.6	21.5	
TOTAL		564.4	488.3	241.9	876.6	1,302.5	3,984.1

Notes: Blank cells have a value of zero (0.0).
Water not included in the acreage totals.

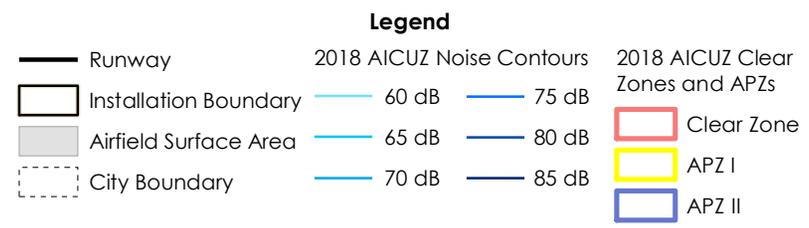
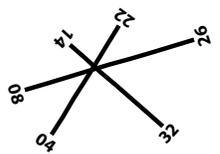
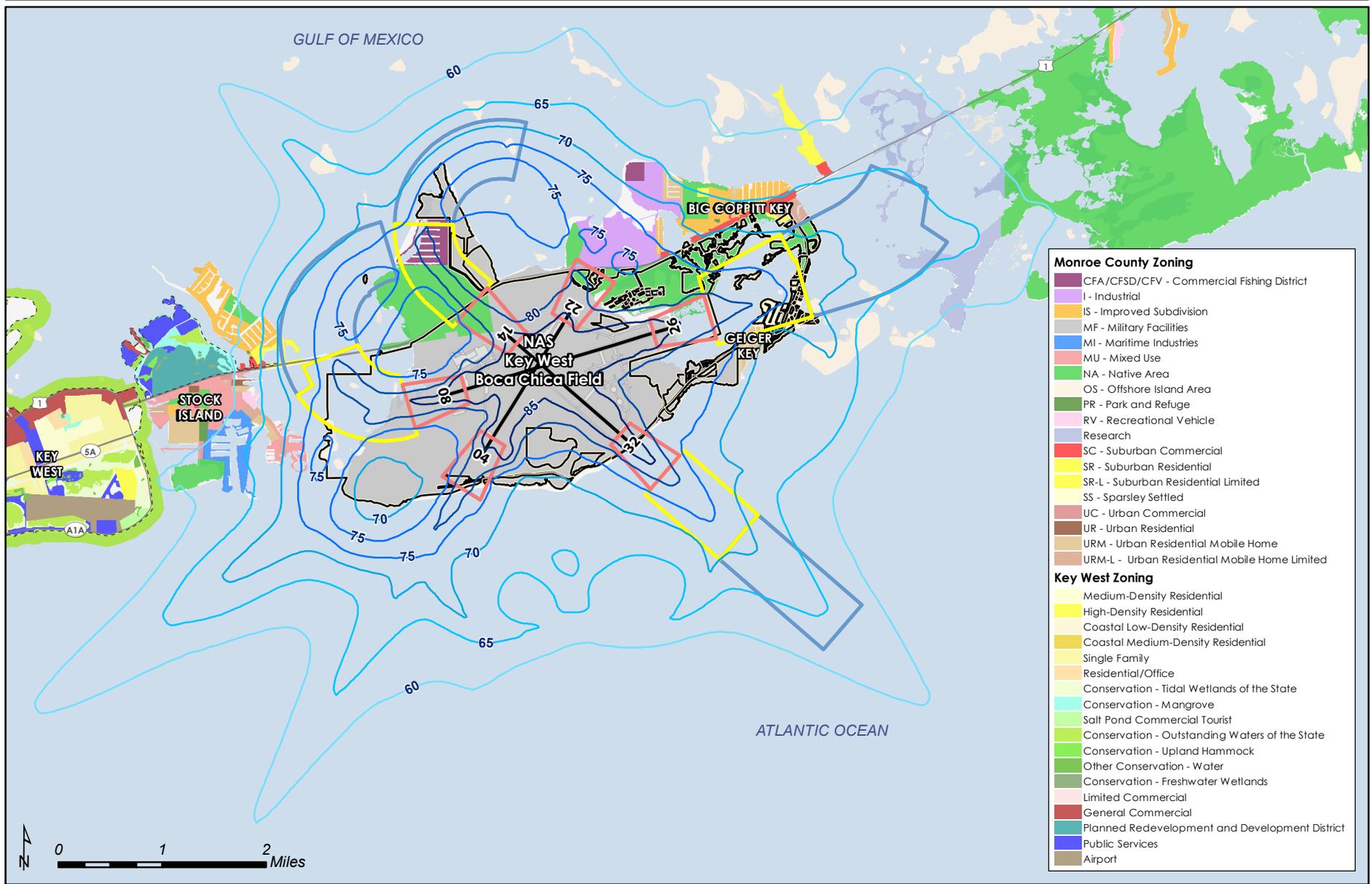


Figure 7-4
2018 AICUZ Footprint with Zoning
 NAS Key West
 Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County 2015; City of Key West 2004; NAVFAC SE 2012, 2015; Wyle 2013. © 2017 Ecology and Environment, Inc.

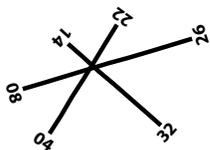
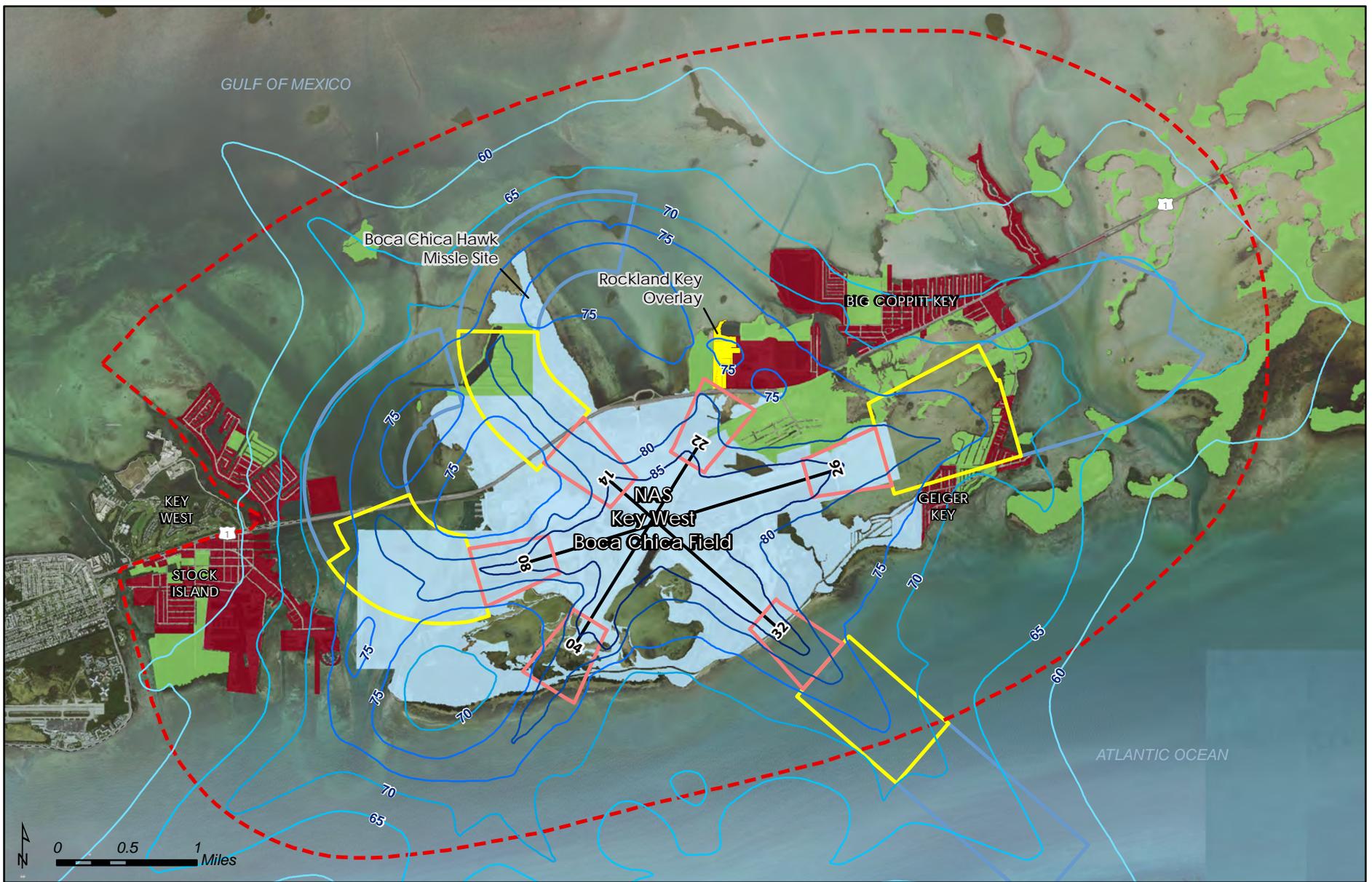
MONROE COUNTY TIER OVERLAY ZONING DISTRICT

The Monroe County Land Development Code, Section 130, Article IV, identifies several categories of special land use referred to as “overlay districts.” Tiers applied to NAS Key West and adjacent lands are Military Airport, Tier I, and Tier III (see Figure 7-5). The Military Airport District regulates land use around existing or future military airports. Structures that could affect navigable airspace are regulated. The purpose of the tier overlay district is to designate geographical areas outside of the mainland of the Monroe County, excluding the Ocean Reef planned development, into tiers to assign Rate of Growth restrictions, determine the amount of clearing of upland native vegetation that may be permitted, and to prioritize lands for public acquisition.

Tier I lands must include one or more of the following criteria from Section 130 of the Monroe County Land Development Code:

- (a) Vacant lands, which can be restored to connect upland native habitat patches and reduce further fragmentation of upland native habitat.
- (b) Lands required to provide an undeveloped buffer, up to 500 feet in depth, if indicated as appropriate by special species studies, between natural areas and development to reduce secondary impacts. Canals or roadways, depending on width, may form a boundary that removes the need for the buffer or reduces its depth.
- (c) Lands designated for acquisition by public agencies for conservation and natural resource protection.
- (d) Known locations of threatened and endangered species, as defined in Section 101-1, identified on the threatened and endangered plant and animal maps or the Florida Keys Carrying Capacity Study maps, or identified in on-site surveys.
- (e) Conservation, native area, sparsely settled, and offshore island land use districts.
- (f) Areas with minimal existing development and infrastructure.

Lands located outside of Big Pine Key and No Name Key that are not designated Tier I are designated Tier III.



- Runway
- - - City Boundary
- - - Monroe County Military Installation Area of Impact

- Legend
- 2018 AICUZ Noise Contours
- 60 dB
 - 65 dB
 - 70 dB
 - 75 dB
 - 80 dB
 - 85 dB

- 2018 AICUZ Clear Zones and APZs
- Clear Zone
 - APZ I
 - APZ II

- Tier Overlay District:
- Tier I - Natural Area
 - Tier III - Infill Area
 - Military
 - Rockland Key Commercial Retail Center Overlay District

Tier and Military Installation Area of Impact Overlay Districts
 NAS Key West
 Monroe County, Florida
 SOURCE: ESRI 2012; Monroe County, Florida 2014; NAVFAC SE 2015.
 © 2017 Ecology and Environment, Inc.

Figure 7-5

7.2.3 COMPATIBILITY CONCERNS

Identifying and minimizing potential incompatible land uses within the AICUZ footprint are objectives of this AICUZ Study. It is essential to NAS Key West's mission that incompatible land uses are identified and minimized, where possible, and that compatible land uses are promoted within the AICUZ footprint. In determining land use compatibility within the AICUZ footprint, the Navy examined existing and future land use patterns near NAS Key West.

Table 7-1, presented in Section 7.2, Land Use Compatibility Analysis, provides the Navy's complete land use compatibility classifications and the associated land use compatibility designations for noise zones and APZs from OPNAVINST 11011.36C.

Figures 4-3 and 5-3 in Chapters 4 and 5 of this AICUZ Study compare 2007 historical noise contours and APZs with the projected 2018 noise contours and APZs.

To analyze whether existing land uses are compatible with aircraft operations, the 2018 AICUZ noise contours and APZs were overlaid on parcel data and land use classification information. The land use compatibility analysis was performed on a case-by-case basis and at the land parcel level using the Navy's land use compatibility guidance and land use data from Monroe County. Table 7-6 presents the general land use compatibility designations around NAS Key West (see Appendix C for a more detailed list).

- ❑ **Compatible** means that land use and related structures are normally compatible without restrictions. However, this can also include land uses and related structures that are compatible with certain conditions and/or restrictions (e.g., density restrictions, NLR construction measures).
- ❑ **Incompatible** means that the designated land use is not compatible with the Navy's AICUZ Instruction recommendations and should be prohibited in that area.

Noise contours and/or APZs impact areas off the installation in all directions. While the majority of the areas impacted are military, conservation, and water, there are limited amounts of residential areas located within certain APZs and noise zones.

TABLE 7-6 GENERAL COMPATIBILITY DESIGNATIONS AROUND NAS KEY WEST

Land Use Analysis	Noise Zone 2		Noise Zone 3			Clear Zone	APZ I	APZ II
	65–69 DNL	70–74 DNL	75–79 DNL	80–84 DNL	85+ DNL			
Commercial	Y	Y*	Y*	N	N	N	N	Y
Conservation	Y	Y	Y	Y	Y	Y	Y	Y
Industrial	Y	Y*	Y*	Y*	N	N	Y	Y
Institutional	Y	Y*	Y*	N	N	N	N	Y
Military	Y	Y	Y	Y	Y	Y	Y	Y
Other Public - Utilities and Right-of-Ways	Y	Y*	Y*	Y*	N	N	Y*	Y
Public Buildings and Grounds	Y*	Y*	N	N	N	N	Y*	Y*
Recreational	Y*	Y*	N	N	N	N	Y*	Y*
Residential	Y*	Y*	N	N	N	N	N	Y*
Vacant or Undeveloped	Y	Y	Y	Y	Y	Y	Y	Y
General Commercial	Y	Y*	Y*	N	N	N	N	Y
Low Density Residential	Y*	Y*	N	N	N	N	N	Y*
Medium Density Residential	Y*	Y*	N	N	N	N	N	N
High Density Residential	Y*	Y*	N	N	N	N	N	N
Public Service	Y*	Y*	N	N	N	N	N	N

Key:

N = No (Not Compatible)

Y = Yes (Compatible)

Y* = Yes (Compatible with restrictions [see “Notes” in Table 7-1])

COMPATIBILITY CONCERNS WITHIN NOISE CONTOURS

Since noise contours and land use recommendations are based on average annoyance responses of a population, complaints can arise from outside the areas included in the noise contours. Noise concerns and complaints are inherent to airfield operations and occur periodically at NAS Key West. This is often due to a single, unusual event, such as a loud plane flying over an area not commonly overflown. Additionally, some people have greater noise sensitivity than others. An increase in aircraft operations and/or a change in aircraft type often results in additional noise exposure to the public, which, in turn, results in more frequent noise complaints.

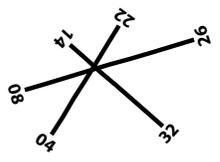
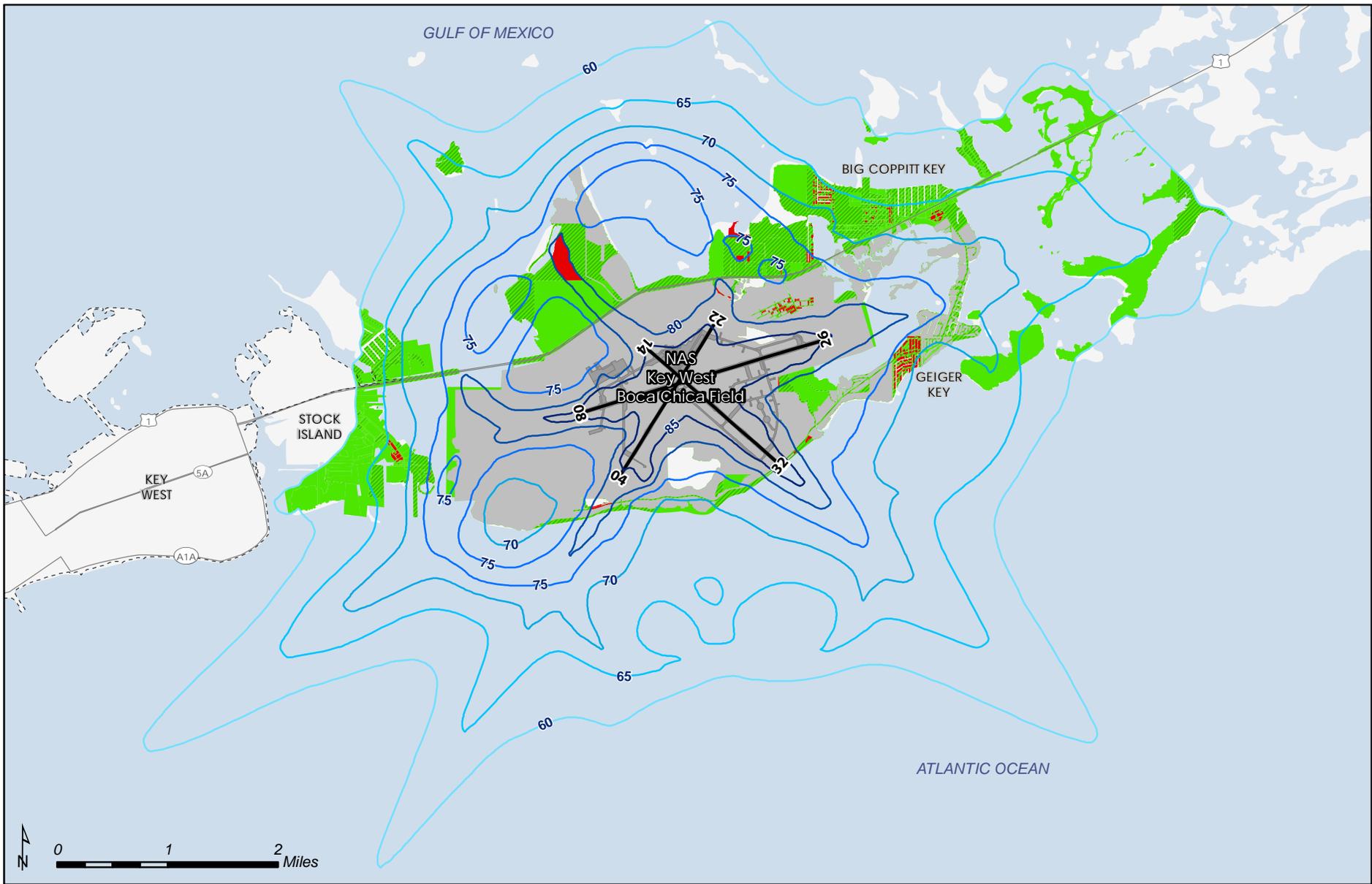
The 2018 AICUZ noise contours for NAS Key West that extend off the installation include 60-85 dB DNL noise contours (Noise Zones 1, 2, and 3), which pose a compatibility concern with certain types of land uses. To analyze whether existing land uses are compatible with aircraft operations, the Navy used parcel-based land uses to identify non-military lands that are either compatible or incompatible within the 2018 noise contours (i.e., 2013 Airfield Operations EIS).

As illustrated on Figure 7-6, the off-station land areas impacted by the 65+ dB DNL noise contours include Rockland Key, Big Coppitt Key, and Geiger Key to the east and Raccoon Key and Stock Island to the west. The areas identified as incompatible are mostly residential areas.

There are residential land uses located along Boca Chica Road on Geiger Key that are within the 70-75 dB DNL noise contour (Noise Zone 2). These structures include mostly manufactured mobile homes. Manufactured homes are important to identify because they are more sensitive to noise exposure due to fewer noise abatement construction standards and materials. The density of this residential development is 8 to 10 dwelling units per acre (du/acre). Residential uses, especially mobile homes, within Noise Zone 2 are incompatible with the Navy's AICUZ Instruction and should be discouraged through community outreach and education and the enforcement of zoning ordinances. However, residential uses may be considered compatible if they meet specific standards to achieve outdoor to indoor Noise-Level Reduction (NLR) by incorporating noise attenuation into the design and construction of the structures.

The land uses identified as incompatible on Big Coppitt Key (Figure 7-6) are residential developments along the north side of the Overseas Highway (US Hwy 1) and Boca Chica Road located within the 65-70 dB DNL noise contour (Noise Zone 2). These structures include both traditional "stick-built" homes and manufactured mobile homes. These areas are designated as medium-density single-family residential with +10 du/acre. Residential use within this area is incompatible with the Navy's AICUZ Instruction land use compatibility recommendations for Noise Zone 2. This area also includes multiple churches, which are deemed as gathering places and people-intensive land uses and are incompatible in Noise Zone 2 unless they meet a NLR level of at least 30 dB.

The land uses identified as incompatible on Rockland Key are associated with industrial and commercial uses within the 75-80 dB DNL noise contour (Noise Zone 3). The Monroe County Commission approved the Rockland Commercial Retail Center Overlay District in mid-2013. The development would be Monroe County's largest commercial center and anchored by a large-scale retailer. The scope of the project has gone through multiple revisions, with the latest calling for 175,000 square feet commercial, in addition to the 400 residential units, a two-story medical building, a 5,000-square-foot community center, and other smaller retail uses (Florida Keys News 2016). Residential uses within Noise Zone 3 are incompatible with the Navy's AICUZ Instruction and should be prohibited. However, commercial retail uses may be considered compatible if they meet specific standards to achieve outdoor to indoor NLR of at least 30 dB by incorporating noise attenuation into the design and construction of the structures.



Legend

Runway	2018 AICUZ Noise Contours 60 dB	75 dB	Land Use Compatibility Compatible
Installation Area	65 dB	80 dB	Compatible with Restrictions
Airfield Surface Area	70 dB	85 dB	Incompatible
City Boundary			

Figure 7-6
 Compatibility Concerns -
 2018 Noise Contours
 and Parcel-Based Land Use
 NAS Key West
 Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County 2015; City of Key West 2004; NAVFAC SE 2014, 2015; Wyle 2013. © 2017 Ecology and Environment, Inc.

The land uses on Stock Island identified as incompatible within the 2018 AICUZ noise contours are located along the southern end of Maloney Avenue. There are single-family residences, manufactured mobile homes, and multiple recreational vehicle (RV) parks within the 65-75 dB DNL noise contour (Noise Zone 2) in this area, which are incompatible with the Navy's AICUZ Instruction recommendations. In addition, there are multiple uses associated with resorts, marinas, and recreational activities (i.e., water recreation) within the 70-75 dB DNL noise contour (Noise Zone 2). These uses are compatible within Noise Zone 2 if they meet standards to achieve specific NLR levels.

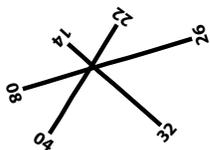
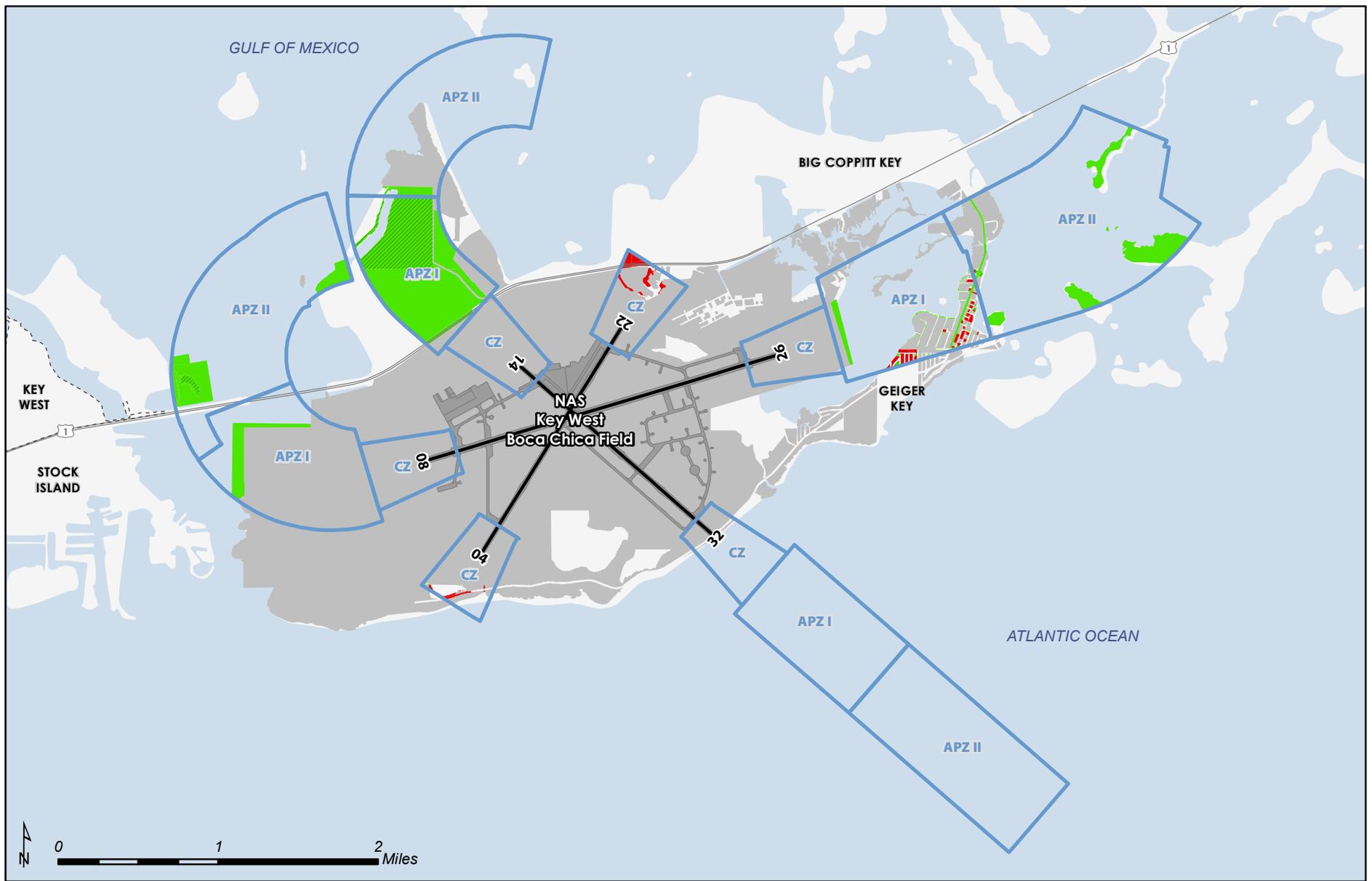
Others areas of concern include residential uses on Boca Chica Field in the Rockland Hammock area and Raccoon Key along Key Haven Road. The residential uses in Rockland Hammock fall within the 75-80 dB DNL noise contour (Noise Zone 3) and are incompatible per the Navy's land use recommendations. The Navy has taken steps to acquire some of the parcels within this development to safeguard the public and prevent any future incompatible development. The residential uses on Raccoon Key are within the 70-75 dB DNL noise contour (Noise Zone 2). Due to the age of the developments (1960s-1970s), it is unlikely that the structures meet the recommended NLR levels for Noise Zone 2. On Enchanted Island, there are vacant residential parcels along Enchanted Way within the 70-75 dB DNL noise contour (Noise Zone 2).

The Navy's AICUZ Instruction land use compatibility guidelines recommend residential uses within Noise Zone 2 and 3 be prohibited and discouraged through community outreach and education and the enforcement of zoning ordinances by the local jurisdictions. With the continued development of the lower keys, single-family and multi-family residential dwellings, as well as people-intensive land uses (e.g., shopping centers, public assembly areas, restaurants, churches, and schools) are the primary land uses of compatibility concern within the 2018 AICUZ noise contours.

COMPATIBILITY CONCERNS WITHIN APZs

The 2018 AICUZ APZs for NAS Key West extend off the installation and pose a compatibility concern with certain types of land uses. To analyze whether existing land use is compatible with aircraft operations, the Navy used parcel-based land uses to identify non-military lands that are incompatible within the 2018 APZs.

As illustrated on Figure 7-7, the 2018 AICUZ APZs for NAS Key West extend over areas associated with Big Coppitt Key and Geiger Key to the east, Raccoon Key to the west, and Northwest Boca Chica Key. The areas identified as incompatible are mostly residential uses with limited industrial/commercial use.



- Legend**
- Runway
 - Installation Area
 - Airfield Surface Area
 - City Boundary
 - 2018 AICUZ APZs
 - Land Use Compatibility
 - Compatible with Restrictions
 - Incompatible

Figure 7-7
Compatibility Concerns -
2018 APZs and
Parcel-Based Land Use
 NAS Key West
 Monroe County, Florida

SOURCE: ESRI 2012; FDOR/Monroe County 2015; City of Key West 2004; NAVFAC SE 2014, 2015. © 2017 Ecology and Environment, Inc.

Along Boca Chica Road and Geiger Road on Geiger Key, there are medium-density residential uses within APZ I for the departure end of Runway 08 (same location as Runway 26's approach end). These structures are mostly manufactured mobile homes with densities of 8 to 10 du/acre. Residential uses within APZ I are considered an incompatible land use per Navy's AICUZ Instruction recommendations and should be prohibited. The residential uses within APZ II for the departure end of Runway 08 (i.e., the approach end of Runway 26) do not appear to exceed the 1 to 2 du/acre maximum, per the AICUZ instruction.

Runway 22's Clear Zone extends over US Hwy 1 and encompasses approximately 1.75 acres of private property with an industrial land use designation as a garden center. The Clear Zone overlay portions of a major roadway, as well other structures on the property. Clear Zones have the highest potential for accidents and should be free of any structures.

Other areas of concern regarding compatibility within APZs include two areas identified as compatible with restrictions (Figure 7-7) with regard to APZ I for the approach end of Runway 14 and APZ II for the approach end of Runway 08. These areas were identified due to their potential future incompatibility regarding allowed uses within their residential and commercial designations. The land within APZ I for the approach end of Runway 14 is currently vacant, but is designated as a Commercial Fishing District, which allows commercial, retail, and recreational uses. These uses could include marinas and boat charting, restaurants, dive shops, and other commercial retail uses, and sales of goods and services, fuel, food, boating, diving, and sport fishing (see Appendix D). The allowed uses could also include mixed uses with attached residential dwellings. Residential uses, as well as commercial uses (e.g., restaurants and retail), could be deemed incompatible, per the Navy's AICUZ Instruction. The lands within APZ II for the approach end of Runway 08 are located at the end of Enchanted Way on Enchanted Island. The parcels are currently vacant, but are designated as residential and have been subdivided. If developed, this subdivision would exceed the 2 du/acre density recommended for APZ II in the Navy's land use recommendations.

The approach end of Runway 32's Clear Zone and APZs extend to the southeast over water and do not impact any land uses; however, there are safety concerns with certain water recreational activities that occur in that area. Recreational boaters and other water-based recreational activities, including kite/wind surfing, canoeing, kayaking, jet skiing, diving, and wildlife observation, are the primary concern for public and pilot safety related to the Navy's low-altitude flight paths (arrivals and departures) over that area. Kite surfers, in particular, pose a high safety concern because the kite can extend 30 to 75 feet from the water surface and extend up to another 30 feet higher over distances of a few hundred feet when the kite surfer is jumping. All recreational activities within the Clear Zone should be prohibited, per the Navy's AICUZ Instruction, to safeguard the public as well as the Navy pilots. Recreational activities should also be limited within APZ I to only those activities that do not

introduce vertical obstructions into the airspace. As discussed in Section 5.3, Imaginary Surfaces, obstruction-free imaginary surfaces help to ensure safe flight approaches, departures, and pattern operations.

The Navy's AICUZ Instruction land use compatibility guidelines recommend specific uses within APZ I and APZ II. Incompatible land uses should be prohibited and discouraged through community outreach and education and the enforcement of zoning ordinances by the local jurisdictions. The primary source of future compatibility concerns within the 2018 AICUZ APZ would most likely be from the in-fill of vacant parcels for single-family and multi-family residential dwellings, as well as other people-intensive land uses, such as shopping centers, public assembly areas, restaurants, churches, and schools.

7.3 NAS KEY WEST AICUZ STUDY RECOMMENDATIONS

Federal, state, and local governments, businesses, real estate professionals, and residents, along with the Navy, all play important roles in the successful implementation of the AICUZ land use compatibility study. To effectively accomplish the goal of the AICUZ Program, all involved parties must have active participation. The following sections provide specific recommendations for NAS Key West personnel, as well as local governments and agencies, businesses, and local residents, for implementation in order to meet the shared goals of the AICUZ Program. These AICUZ Study recommendations, when implemented, will continue to advance the goal, "to protect the health, safety, and welfare of those living near military airfields, while preserving the defense flying mission."

7.3.1 NAVY ACTION RECOMMENDATIONS

The Navy has the responsibility to communicate and collaborate with local governments on land use planning, zoning, and compatibility concerns that can impact its mission. Mutual cooperation between NAS Key West and their neighboring communities is key to the AICUZ Program's success. The following are both broad-based and site-specific recommendations for the Navy to consider.

CONTINUE TO ENGAGE IN THE LOCAL PLANNING PROCESS

The NAS Key West Commanding Officer (CO) has appointed the CPLO as the primary point of contact for maintaining routine communication with the local governments for Monroe County and the City of Key West. Routine communication will help the Navy stay informed of local land use plans and regulations and ensure the Navy's input is offered in the early stages of any long-range planning initiatives. NAS Key West representatives (i.e., CPLO, Public Affairs Officer [PAO], and CO) should:

- ❑ Continue to attend public hearings (meetings) and provide comments on actions that affect AICUZ planning for NAS Key West, including land use studies, CIP projects, Comprehensive Plan updates, and other land development regulation updates/amendments.

COMMUNITY OUTREACH

Outreach and information sharing helps educate the community about the Navy's mission and build alliances with the community and regional decision makers to ensure continuation of mission-essential operations. Additionally, NAS Key West should continue to provide community decision makers with the information necessary to make informed decisions regarding the impacts of their actions on mission readiness. NAS Key West representatives (i.e., CPLO, PAO, and CO) should consider the following:

- ❑ To encourage community interaction and to facilitate a better understanding of the Navy's scope of operations, NAS Key West should develop a package of AICUZ outreach materials, including community presentations and educational materials, on military training activities and the Navy's mission. Specifically, the Navy should create materials for a civilian audience, including the recreational boating and fishing community, local governments, and real estate brokers, to explain the basic elements of the AICUZ Program and how incompatible development within the AICUZ footprint can impact operations and the public. The materials should detail the significance of APZs and noise exposure contours to inform civilians.
- ❑ NAS Key West should prepare a presentation outlining elements of the AICUZ Program for community decision makers, including the Board of County Commissioners, City of Key West Commission, Economic Development Councils, Board of Realtors, and local civic organizations. The AICUZ Program presentation should also discuss how land uses and local policies (e.g., infrastructure siting, schools, rezoning) can influence Navy operations. Furthermore, one of the key goals of the presentations and meetings should be to encourage the local planning boards and Board of Commissioners to adopt the AICUZ footprint into the Land Use Plans and Zoning Ordinances, as recommend in Section 7.3.2, Local Government Recommendations.
- ❑ NAS Key West should post the 2018 AICUZ Study, presentation, and distribution materials, including AICUZ maps and other related educational materials, on their public website(s).
- ❑ NAS Key West should provide local real estate agencies with AICUZ-related materials and maps showing APZs and noise exposure contours. The CPLO should meet with the local Board of Realtors to discuss the importance of real estate disclosures when buying or selling property within or near the 2018 AICUZ footprint.

- ❑ NAS Key West should provide advanced notice of scheduled training events to the USCG for the posting of Notices to Mariners (NOTMARs). The Navy issues NOTMARs to advise the public of military activities that may impact commercial or recreational activities or access to commercial or recreational sites.

INCREASE PUBLIC SAFETY BY RESTRICTING CIVILIAN ACCESS

NAS Key West personnel currently exercise several procedures to safeguard the public during training exercises. These include signs, fencing, and sweeps of areas prior to operations. Civilian access into high-risk areas is a significant public safety concern. The Navy should pursue the process to establish “restricted areas” within the waters impacted by the approach end of Runway 32’s Clear Zone and APZs to both safeguard the public and gain legal enforcement to keep water-based recreational users out of high-risk areas during flight operations, pursuant to the conditions of 33 CFR 334, “Danger Zone and Restricted Area Regulations.”

NOISE COMPLAINT MONITORING AND RESPONSE PROGRAM

NAS Key West has a formalized noise complaint program. NAS Key West provides a dedicated noise complaint hotline for citizens who want to register a complaint. Information provided by each caller is recorded on a Community Concerns form to document the date and time of the incident, the nature of the complaint, and contact information of the caller. The complaint is then provided to the PAO and the CPLO for coordination and action.

NAS Key West will continue to record and assess noise complaints. Assessing noise complaints identifies noise-sensitive areas, determines which operational activities are responsible for the noise complaints, and ultimately helps abate future noise complaints. Through the noise complaint program, NAS Key West will monitor the need to adjust operational procedures in order to reduce aircraft noise exposure (noise abatement) and potential mishaps; no changes that compromise the mission of the installation should be instituted.

NAS Key West
Noise Complaint
Hotline Number

(305) 293-2166

FEE-TITLE ACQUISITION OF PARCELS WITHIN THE AICUZ FOOTPRINT

The Military Base Protection Program was instituted in 2012 to sustain military missions and to protect existing military installations. The Florida Department of Economic Opportunity, operating under the Military Base Protection Program (F.S. 288.980) considers land acquisitions under the provisions of the program that do not qualify for the Florida Forever Program. NAS Key West should continue to identify and submit sites to the Florida Department of Economic Opportunity for potential acquisition to address incompatible land uses and buffer the installation against encroachment.

7.3.2 LOCAL GOVERNMENT RECOMMENDATIONS

State and local governments have the authority to implement regulations and programs to control development and direct growth to ensure land use activity is compatible within the AICUZ footprint. Local governments should recognize their responsibility in providing land use controls in those areas encumbered by the AICUZ footprint by incorporating AICUZ information into their planning policies and regulations. The following recommendations will support compatible development practices within the vicinity of the installation.

COMMUNICATION AND PLANNING PARTNERSHIPS WITH NAS KEY WEST

NAS Key West is responsible for informing and educating community decision makers about the AICUZ Program; however, local governments (Monroe County and City of Key West) should continue to actively inform and request input from NAS Key West regarding land use decisions that could impact the readiness of the Navy. Before local governments make land use decisions for areas near the installation and the AICUZ footprint, they should consider the following:

- ❑ Their decisions may influence the capabilities of NAS Key West and potentially have a negative impact on military readiness and national security;
- ❑ Their decisions may decrease the capabilities of the airfield, thereby increasing the chances of the local commands having to relocate resources to ensure training is completed;
- ❑ Noise contours and APZs comprising the AICUZ footprint are dynamic and may change over time; and
- ❑ A proactive approach to planning with the Navy will serve the local population by mitigating, in advance, potential problems with noise and safety concerns.

The Navy recommends that local government websites include information about the AICUZ Program and provide a link to the NAS Key West website. Local governments are recommended to coordinate with NAS Key West on aircraft operations and work to ensure the safety of all parties.

ADOPT AICUZ GUIDELINES INTO LOCAL LAND USE PLANS AND REGULATIONS

The local planning authorities are encouraged to adopt and implement all or parts of the AICUZ Study, including amending their Comprehensive Plan and zoning ordinances to be consistent with the AICUZ footprint and recommended compatible land uses. The AICUZ Study is the Navy's defining statement regarding potential land use incompatibilities. The Navy recommends that, during the next Comprehensive Plan amendment cycle for each local government, language pertaining to local government's support of local military installations be updated. It is recommended that such

language be incorporated in the Administration chapter of the Comprehensive Plan and in the Future Land Use Element and Intergovernmental Coordination chapters as a Goal with Objectives and Policies.

The AICUZ Study is intended to support local government land use planning programs and processes by providing scientifically based technical information on military activities. Local governments should, to the extent possible, adhere to the land use recommendations in the AICUZ Instructions to mitigate noise impacts, safety, height obstructions, and incompatible development within AICUZ footprint.

REGULATE LAND USES WITHIN IDENTIFIED NOISE ZONES AND APZS BY UPDATING SPECIAL MILITARY PLANNING DISTRICT - MIAI

As discussed in Section 6.1.4, Local Planning, Monroe County adopted a military compatibility future land use overlay known as the MIAI as part of their Comprehensive Plan update in 2012. The current MIAI included all the 2007 APZs along with the 2013 Airfield Operations EIS noise contours.

General requirements for all MIAI areas are recommended to include:

- ❑ **Avigation Easements:** All applications for subdivision approval and/or building permits for any structure requiring plan approval shall include the dedication of an avigation easement to the County. If the parcel on which the structure is to be built has a dedicated avigation easement on record, this requirement is waived. The dedicated avigation easement allows property owners to develop land in accordance with the applicable zoning district and regulations. However, military installations receive a clear right to maintain flight operations over the parcel. The easement is recorded with the deed to a property and runs in perpetuity with the land.
- ❑ **Height Limitations:** The permitted uses within the APZs are based upon the underlying zoning along with recommended land uses and height restrictions.
- ❑ **Noise Zones:** Permitted uses in the noise zones that are outside of APZ areas are based upon the underlying zoning along with recommended land uses as contained in "Air Installations Compatible Use Zones, Suggested Land Use Compatibility in Noise Zones," OPNAVINST 11010.36C. The primary consideration for construction in the noise zones is noise level reduction/sound attenuation measures.
- ❑ **Rezoning:** Rezoning is allowed within MIAs, but density remains limited to the maximum density allowed by the MIAI, regardless of the zoning. The density limits should correspond to the recommend densities in "Air Installations Compatible Use Zones, Suggested Land Use Compatibility in Accident Potential Zones," OPNAVINST 11010.36C.

LOCAL INTERGOVERNMENTAL COORDINATION

The Navy recommends that local governments and commissions recognize the need to formalize each respective Comprehensive Plan and Land Development Code to incorporate a military official into the development review process and support the missions of local military installations. The Navy recommends that local governments and commissions continue to offer a NAS Key West official an ex officio seat on local planning/development boards. The Navy representative will continue to serve the local planning boards as a nonvoting member, with opportunities to voice comments and concerns more efficiently. As a member of the local planning board, NAS Key West should receive agenda items and meeting notifications directly from County and/or City staff.

The review process presents an opportunity for a military representative to work with a local government's development review team to identify issues and opportunities associated with the development application. As a major stakeholder in the community, the military is able to offer valuable insight to decision makers so that they can consider a development proposal's full impact on all stakeholders.

In addition, the local governments should ensure that adherence to the Principles for Guiding Development (380.0552(7)(h)4, F.S.) is in their plans to "protect the value, efficiency, cost-effectiveness, and amortized life of existing and proposed major public investments," including NAS Key West and other military facilities.

LOCAL DEVELOPMENT AND PERMIT REVIEW PROCESS

The Monroe County and City of Key West planning authorities should continue to invite NAS Key West representatives to participate in the local development review staff process as a way to integrate the military's missions with the local government's planning and development review processes. The Navy recommends that local governments amend their permitting criteria for permitted uses to include public safety, national defense, and compatibility considerations and provide increased public and Navy engagement in the project review process. Furthermore, the Navy recommends that local governments require delineation of all boundaries for Noise Zones, APZs and MIAs on subdivision and site plans submitted for development review. Monroe County and the City of Key West should continue to confer with the Navy on land use, zoning, and future land use designation changes within the AICUZ footprint.

The County is encouraged to continue communication with the installation regarding land use proposals, including a 30-day military review period on land use proposals within the MIAs.

REAL ESTATE DISCLOSURES

Monroe County and the City of Key West should continue exploring the implementation of ordinances for establishing real estate disclosures for areas around NAS Key West. These ordinances would require property owners and real estate professionals to provide written disclosures to prospective purchasers, renters, or lessees when a property is located within an APZ or high-noise zone (i.e., AICUZ footprint/MIAIs) (see Appendix B for a sample disclosure form).

The disclosure is intended to inform a potential property owner or occupant of the nearby range and alert them to possible incompatibilities of the intended property use with Navy operations. Further, the disclosure form would be attached to all listing agreements, sales and rental contracts, subdivision plats, and marketing materials provided to prospective buyers, renters, and lessees; however, the form would not need to be included in advertisements directed to the public at large. The disclosure should be required at a practicable stage in the real estate transaction and before making or accepting an offer to buy, rent, or lease.

BUILDING CODES

Monroe County and City of Key West should continue to monitor and/or amend their building codes to require noise attenuation techniques for new construction within the AICUZ footprint. Additional insulation and soundproofing should be included in the local building standards for new single- and multi-family residential and commercial service construction within the footprint. AIPDs can provide the means in which a realtor can reasonably identify apparent adverse factors and be obligated by Article 2, Standard of Practice 2-1, of the 2017 Code of Ethics and Standards of Practice of the National Association of Realtors to disclose said information.

7.3.3 COMMUNITY RECOMMENDATIONS

Private citizens, real estate professionals, and businesses should recognize their responsibility in adhering to and complying with land use controls in those areas encumbered by the AICUZ footprint. The list below provide actions, procedures, and recommendations that community groups can use or consider to help control development within the 2018 AICUZ footprint:

- ❑ Real estate professionals are encouraged to acknowledge the AICUZ Program for NAS Key West on their real estate websites and provide a link to the NAS Key West website for more information on aircraft operations and the AICUZ Program.
- ❑ Lending institutions should consider whether to limit financing for real estate purchases or construction that is incompatible with the AICUZ Program. This strategy encourages evaluation of noise and safety 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 compatible development of the area surrounding NAS Key West 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 and/or safety impacts on the mortgaged property.

- ❑ Residents considering purchasing, renting, or leasing properties near NAS Key West should ask local real estate professionals, lending institutions, city planning personnel, county appraisal personnel, and/or a Navy representative if the property is within an APZ and/or noise zone.
- ❑ Residents of the local communities 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.
- ❑ Residents should also provide sufficient and accurate information when registering a noise complaint with the Navy. NAS Key West personnel need accurate information to assess the potential causes resulting in the complaint and to assess any practical remedies for reducing future complaints.

7.4 SUMMARY OF IMPLEMENTING LAND USE TOOLS AND RECOMMENDATIONS FOR AREAS OF COMPATIBILITY CONCERN

The goal of the Navy AICUZ Program can most effectively be accomplished by the active participation of all interested parties. Federal, state, regional, and local governments, businesses, real estate professionals, and citizens, along with the Navy, all play key roles in successfully implementing the AICUZ land use compatibility study.

The Navy has the responsibility to communicate and collaborate with local governments on land use planning, zoning, and compatibility concerns that can affect its mission. NAS Key West is responsible for informing and educating community decision makers about the AICUZ Program; however, local governments should continue to actively inform and request input from NAS Key West regarding land use decisions that could impact the readiness of the installation. Local governments have the authority to implement regulations and programs to control development and direct growth to ensure land use activity is compatible with installation operations. Local governments should recognize their responsibility in providing land use control in areas encumbered by the AICUZ footprint by

incorporating AICUZ information into their planning policies and regulations. Mutual cooperation between NAS Key West and neighboring communities is key to the AICUZ Program’s success.

Table 7-7 provides a list of areas of compatibility concern related to NAS Key West as well as land use tools and recommendations that are available for stakeholders to implement, as noted in both Section 6.2, Other Land Use Planning Programs, and Section 7.3, NAS Key West AICUZ Recommendations. The table is effective in highlighting examples of compatibility concerns that have been raised throughout this AICUZ Study and provides a suite of cumulative tools and recommendations that can be used to address these areas of concern.

Table 7-7 illustrates how tools/recommendations and stakeholders can mitigate areas of compatibility concern. When combined, these tools and recommendations can have compounding effects on minimizing and addressing the concerns.

To use this overview effectively, it is important to first understand the compatibility criteria that were explained in detail in Section 4.4, AICUZ Noise Contours, and Section 5.2, AICUZ Clear Zones and APZs. The compatibility criteria, along with the land use compatibility guidelines for the AICUZ footprint explained in Section 7.1, Land Use Compatibility Guidelines and Classifications, provide a basis to then identify the compatibility concerns at NAS Key West. This section provides a reference of the tools and recommendations for various groups of stakeholders to use to then address the concerns that were identified throughout Section 7.2.3, Compatibility Concerns.

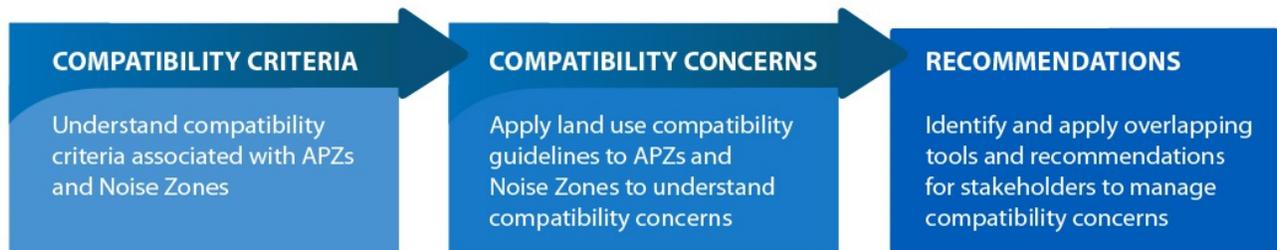


Table 7-7 is not a comprehensive list of compatibility concerns and recommendations but, rather, for reference purposes, it provides an abbreviated list of the issues and recommendations that could be implemented to address compatibility concerns holistically. Each land use tool and recommendation is linked with multiple or specific areas of compatibility concern and provides a summary of recommended actions and options that could reduce the overall compatibility concerns at NAS Key West. Minimizing current compatibility concerns and alleviating future concerns involves active participation from several stakeholders often implementing one or more of the recommendations that address a specific area or a broader area of concern. Managing compatibility concerns is an ongoing process that requires monitoring, maintenance, and targeted planning. To support the

ongoing implementation process that addresses compatibility concerns, the tools and recommendations listed in Table 7-7 can be applied to 11 areas and communities of concern within the AICUZ footprint. The numbers listed in the “Land Use Tools and Recommendations” column serve to link the tools and concerns more specifically.

TABLE 7-7 OVERVIEW OF INCOMPATIBLE LAND USE AND TOOLS AND RECOMMENDATIONS

Area of Compatibility Concern ¹	Land Use Tools and Recommendations	Stakeholder	AICUZ Section for Additional Information
<p>The areas and communities within the AICUZ footprint –</p> <p><u>Surrounding community may be exposed to high aircraft noise:</u></p> <ol style="list-style-type: none"> 2018 AICUZ noise contours extend off installation including 60-85 dB DNL (Noise Zones 1, 2, and 3); the vast majority of the higher noise contours are concentrated within the installation boundary. Over 90 percent of the area impacted by contours in Noise Zone 1 (<55 to <65 dB DNL) and 85 percent of the area impacted by contours in Noise Zone 2 (65 to <75 dB DNL) are over water. Approximately 39 percent of acres impacted by contours in Noise Zone 3 (>75 dB DNL) are over water. Off-station land areas impacted by the 65+ dB DNL noise contours include Rockland Key, Big Coppitt Key, and Geiger Key to the east, and Raccoon Key and Stock Island to the west, and are mostly residential areas. There are residential land uses located along Boca Chica Road on Geiger Key that are within the 70-75 dB DNL noise contour (Noise Zone 2). 	<p>Continue to engage in the local planning process by maintaining routine communication, attending public meetings, and providing input in the early stages of long-range planning items. (1-11)</p>	<p>Federal/Navy</p>	<p>Section 7.3.1</p>
	<p>Continue community outreach efforts with regional and local decision makers and the public. (1-11)</p>	<p>Federal/Navy</p>	<p>Section 7.3.1</p>
	<p>Develop a package of community outreach materials that can be provided to a civilian audience and community decision makers outlining various elements of the AICUZ Program. (1-11)</p>	<p>Federal/Navy</p>	<p>Section 7.3.1</p>
	<p>Provide local real estate agencies with AICUZ related materials and meet with the local Board of Realtors to discuss the importance of real estate disclosure when buying or selling property within or near the AICUZ footprint. (1-11)</p>	<p>Federal/Navy</p>	<p>Section 7.3.1</p>
	<p>Continue to maintain a noise complaint monitoring and response program. (1-6)</p>	<p>Federal/Navy</p>	<p>Section 7.3.1</p>
	<p>Continue to actively inform and request input from NAS Key West regarding land use decisions that could impact the readiness of the Navy. (1-11)</p>	<p>Local Government</p>	<p>Section 7.3.2</p>
	<p>Include information about the AICUZ Program on websites and provide a link to the NAS Key West website. (1-11)</p>	<p>Local Government</p>	<p>Section 7.3.2</p>
	<p>Adopt and implement all or parts of the AICUZ Study, including amending comprehensive plans and zoning ordinances to be consistent with the recommended land uses in the AICUZ Study. (1-11)</p>	<p>Local Government</p>	<p>Section 7.3.2</p>

TABLE 7-7 OVERVIEW OF INCOMPATIBLE LAND USE AND TOOLS AND RECOMMENDATIONS

Area of Compatibility Concern ¹	Land Use Tools and Recommendations	Stakeholder	AICUZ Section for Additional Information
<p>6. Continued development of the lower keys, single-family and multi-family residential dwellings, and people-intensive land uses (e.g., shopping centers, public assembly areas, churches, and schools) are the primary land uses of compatibility concern within the 2018 AICUZ noise contours.</p>	<p>Continue to have military representatives participate on the local planning/development boards as a way to integrate the military’s missions with the local government’s planning and development review processes. (1-11)</p>	<p>Local Government</p>	<p>Section 7.3.2</p>
<p>APZs:</p>	<p>Require delineation of all boundaries for Noise Zones, APZs and MIAs on subdivision and site plans submitted for development review. Monroe County and the City of Key West should continue to confer with the Navy on land use, zoning, and future land use designation changes within the AICUZ footprint. (1-11)</p>	<p>Local Government</p>	<p>Section 7.3.2</p>
<p>7. Approximately 4,748 acres are impacted by the projected Clear Zones and APZs for NAS Key West.</p>	<p>Monroe County and the City of Key West should continue exploring the implementation of ordinances for establishing real estate disclosures for areas around NAS Key West to require property owners and real estate professionals to provide written disclosure to prospective buyers and renters when property is located in an APZ or high-noise zone. (1-11)</p>	<p>Local Government</p>	<p>Section 7.3.2</p>
<p>8. About 25 percent of the impacted areas are within the installation boundary.</p>	<p>Monroe County and the City of Key West should continue to monitor and/or amend their building codes to require noise attenuation techniques for new construction within the AICUZ footprint.</p>	<p>Local Government</p>	<p>Section 7.3.2</p>
<p>9. The remaining 75 percent of impacted areas are off-station—with 88 percent (3,132 acres) of these off-station areas located over water, and only 12 percent (440 acres) of the off-station areas located over land.</p>	<p>Local banking and financial institutions should be encouraged to incorporate a “Due Diligence Review” of all loan applications to determine possible noise and/or safety impacts on the mortgaged property. (1-11)</p>	<p>Local Businesses</p>	<p>Section 7.3.3</p>
<p>10. The 2018 AICUZ APZs for NAS Key West extend over areas associated with Big Coppitt Key and Geiger Key to the east, Raccoon Key to the west, and Long Point key toward the northwest.</p>	<p>Acknowledge the AICUZ Program for NAS Key West on real estate websites and provide a link to the NAS Key West website for more information on aircraft operations and the AICUZ Program. (1-11)</p>	<p>Real Estate Professionals</p>	<p>Section 7.3.3</p>
<p>11. The areas identified as incompatible are mostly residential uses with limited industrial/commercial use.</p>	<p>Become informed about the AICUZ Program and how it could affect property owners/renters/lessees. (1-11)</p>	<p>Private Citizens/ Real Estate Professionals/ Businesses</p>	<p>Section 7.3.3</p>

TABLE 7-7 OVERVIEW OF INCOMPATIBLE LAND USE AND TOOLS AND RECOMMENDATIONS

Area of Compatibility Concern ¹	Land Use Tools and Recommendations	Stakeholder	AICUZ Section for Additional Information
	When purchasing, renting, or leasing properties near NAS Key West, ask real estate professionals and lending institution representatives if the property is within the AICUZ footprint. (1-11)	Private Citizens/ Real Estate Professionals/ Businesses	Section 7.3.3
	Provide sufficient and accurate information when registering a noise complaint to aid in determining the source of the noise and potential remedies for future actions. (1-6)	Private Citizens/ Real Estate Professionals/ Businesses	Section 7.3.3
Bird/animal aircraft strike hazard (BASH)	Continued progress of the full-time Wildlife Biologist at NAS Key West to conduct Wildlife Hazard Assessments and mitigate wildlife hazards on the airfield.	Federal/Navy	Section 5.4.2
NAS Key West and its training areas	Continue procedures to safeguard the public, such as signs and fencing, and pursue the process to establish "restricted areas" within the waters impacted by the approach end of Runway 32's Clear Zone and APZs to both safeguard the public and gain legal enforcement to keep water-based recreational users out of high-risk areas during flight operations, pursuant to the conditions of 33 CFR 334, "Danger Zone and Restricted Area Regulations."	Federal/Navy	Section 7.3.1
	Continue to provide advanced notice of scheduled training events to the USCG for the posting of Notices to Mariners to advise the public of military activities that may impact commercial or recreational activities or access to commercial or recreational sites.	Federal/Navy	Section 7.3.1
State of Florida	Continue implementing the Community Planning Act, particularly relating to military affairs and promoting compatibility of lands adjacent to or in proximity to military installations.	State/Regional	Section 6.1.2
	Continue to implement the Florida Keys Area Protection Act, including items regarding military protection for NAS Key West.	State/Regional	Section 6.1.2

Note:

1 = See Section 7.2 for a detailed analysis of land use compatibility.

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APPENDIX A

DISCUSSION OF NOISE AND ITS EFFECT ON THE ENVIRONMENT

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FINAL

APPENDIX A – Discussion of Noise and Its Effect on the Environment

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Acronyms & Abbreviations

ID	Definition
AAD	Annual Average Daily
AGL	Above Ground Level
ANSI	American National Standards Institute
ASHLA	American Speech-Language-Hearing Association
CHABA	Committee on Hearing, Bioacoustics, and Biomechanics
CNEL	Community Noise Equivalent Level
CNEL _{mr}	Onset-Rate Adjusted Monthly Community Noise Equivalent Level
dB	Decibel
dB(A)	A-Weighted Decibels
DLR	German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt e.V.)
DNL	Day-Night Average Sound Level
DOD	Department of Defense
FAA	Federal Aviation Administration (US)
FICAN	Federal Interagency Committee on Aviation Noise
FICON	Federal Interagency Committee on Noise
HA	Highly Annoyed
HYENA	Hypertension and Exposure to Noise near Airports
Hz	Hertz
ISO	International Organization for Standardization
L	Sound Level
L _{dn}	Day-Night Average Sound Level
L _{dnmr}	Onset-Rate Adjusted Monthly Day-Night Average Sound Level
L _{eq}	Equivalent Sound Level
L _{eq(16)}	Equivalent Sound Level over 16 hours
L _{eq(24)}	Equivalent Sound Level over 24 hours
L _{eq(30min)}	Equivalent Sound Level over 30 minutes
L _{eq(8)}	Equivalent Sound Level over 8 hours
L _{eq(h)}	Hourly Equivalent Sound Level
L _{max}	Maximum Sound Level
L _{pk}	Peak Sound Level

(Continued on next page)

ID	Definition
m	meter (distance unit)
mmHg	millimeters of mercury
MOA	Military Operations Area
MTR	Military Training Route
NA	Number of Events At or Above a Selected Threshold
NATO	North Atlantic Treaty Organization
NDI	Noise Depreciation Index
NIPTS	Noise-induced Permanent Threshold Shift
NSDI	Noise Sensitivity Depreciation Index
OR	Odd Ratio
POI	Point of Interest
PTS	Permanent Threshold Shift
RANCH	Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health
SEL	Sound Exposure Level
SIL	Speech Interference Level
SUA	Special Use Airspace
TA	Time Above
TTS	Temporary Threshold Shift
U.S.	United States
UKDfES	United Kingdom Department for Education and Skills
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WHO	World Health Organization

Appendix A

This appendix discusses sound and noise and their potential effects on the human and natural environment. Section A.1 provides an overview of the basics of sound and noise. Section A.2 defines and describes the different metrics used to describe noise. The largest section, Section A.3, reviews the potential effects of noise, focusing on effects on humans but also addressing effects on property values, terrain, structures, and animals. Section A.4 contains the list of references cited.

A.1 Basics of Sound

Section A.1.1 describes sound waves and decibels. Section A.1.2 review sounds levels and types of sounds.

A.1.1 Sound Waves and Decibels

Sound consists of minute vibrations in the air that travel through the air and are sensed by the human ear. Figure A-1 is a sketch of sound waves from a tuning fork. The waves move outward as a series of crests where the air is compressed and troughs where the air is expanded. The height of the crests and the depth of the troughs are the amplitude or sound pressure of the wave. The pressure determines its energy or intensity. The number of crests or troughs that pass a given point each second is called the frequency of the sound wave.

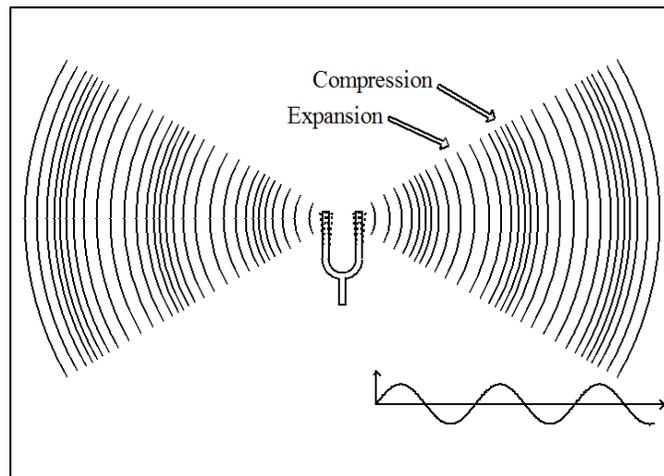


Figure A-1. Sound Waves from a Vibrating Tuning Fork

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration.

- Intensity is a measure of the acoustic energy of the sound and is related to sound pressure. The greater the sound pressure, the more energy carried by the sound and the louder the perception of that sound.
- Frequency determines how the pitch of the sound is perceived. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches.
- Duration or the length of time the sound can be detected.

As shown in Figure A-1, the sound from a tuning fork spreads out uniformly as it travels from the source. The spreading causes the sound's intensity to decrease with increasing distance from the source. For a source such as an aircraft in flight, the sound level will decrease by about 6 dB for every doubling of the distance. For a busy highway, the sound level will decrease by 3-4.5 dB for every doubling of distance.

As sound travels from the source it also gets absorbed by the air. The amount of absorption depends on the frequency composition of the sound, the temperature, and the humidity conditions. Sound with high frequency content gets absorbed by the air more than sound with low frequency content. More sound is absorbed in colder and drier conditions than in hot and wet conditions. Sound is also affected by wind and temperature gradients, terrain (elevation and ground cover) and structures.

The loudest sounds that can be comfortably heard by the human ear have intensities a trillion times higher than those of sounds barely heard. Because of this vast range, it is unwieldy to use a linear scale to represent the intensity of sound. 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 and 140 dB are felt as pain (Berglund and Lindvall 1995).

Because of the logarithmic nature of the decibel unit, sound levels cannot simply be 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:

$$60 \text{ dB} + 60 \text{ dB} = 63 \text{ dB, and}$$

$$80 \text{ dB} + 80 \text{ dB} = 83 \text{ dB.}$$

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:

$$60.0 \text{ dB} + 70.0 \text{ dB} = 70.4 \text{ dB.}$$

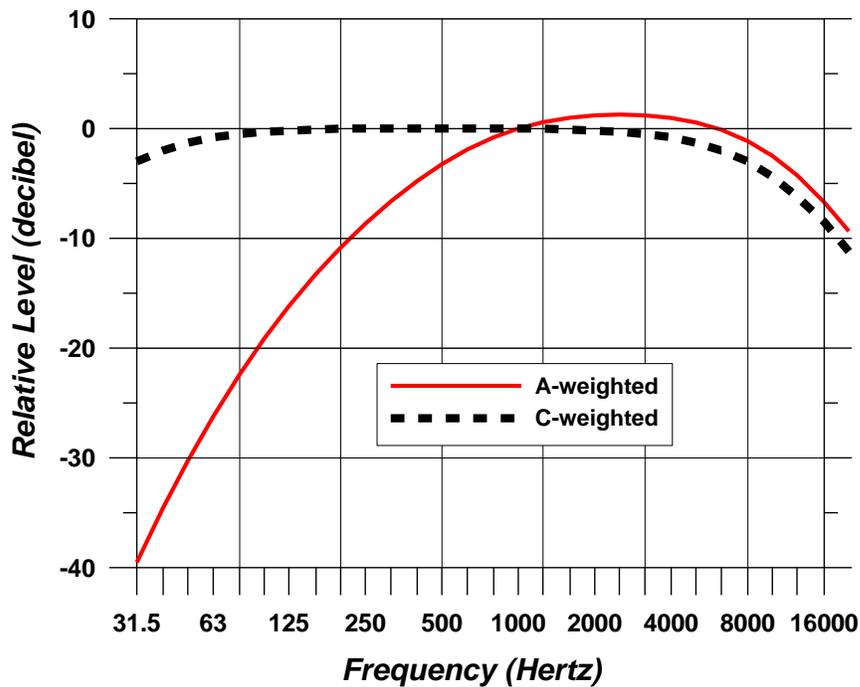
Because the addition of sound levels is different than that of ordinary numbers, this process is often referred to as "decibel addition."

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. This relation holds true for loud and quiet sounds. A decrease in sound level of 10 dB actually represents a 90% decrease in sound intensity but only a 50% decrease in perceived loudness because the human ear does not respond linearly.

Sound frequency is measured in terms of cycles per second or hertz (Hz). The normal ear of a young person can detect sounds that range in frequency from about 20 Hz to 20,000 Hz. As we get older, we lose the ability to hear high frequency sounds. Not all sounds in this wide range of frequencies are heard equally. Human hearing is most sensitive to frequencies in the 1,000 to 4,000 Hz range. The notes on a piano range from just over 27 Hz to 4,186 Hz, with middle C equal to 261.6 Hz. Most sounds (including a single note on a piano) are not simple pure tones like the tuning fork in Figure A-1, but contain a mix, or spectrum, of many frequencies.

Sounds with different spectra are perceived differently even if the sound levels are the same. 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. These two curves, shown in Figure A-2, are adequate to quantify most environmental noises. A-weighting puts emphasis on the 1,000 to 4,000 Hz range.

Very loud or impulsive sounds, such as explosions or sonic booms, can sometimes be felt, and can cause secondary effects, such as shaking of a structure or rattling of windows. These types of sounds can add to annoyance, and are best measured by C-weighted sound levels, denoted dBC. C-weighting is nearly flat throughout the audible frequency range, and includes low frequencies that may not be heard but cause shaking or rattling. C-weighting approximates the human ear's sensitivity to higher intensity sounds.



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

Figure A-2. Frequency Characteristics of A- and C-Weighting

A.1.2 Sound Levels and Types of Sounds

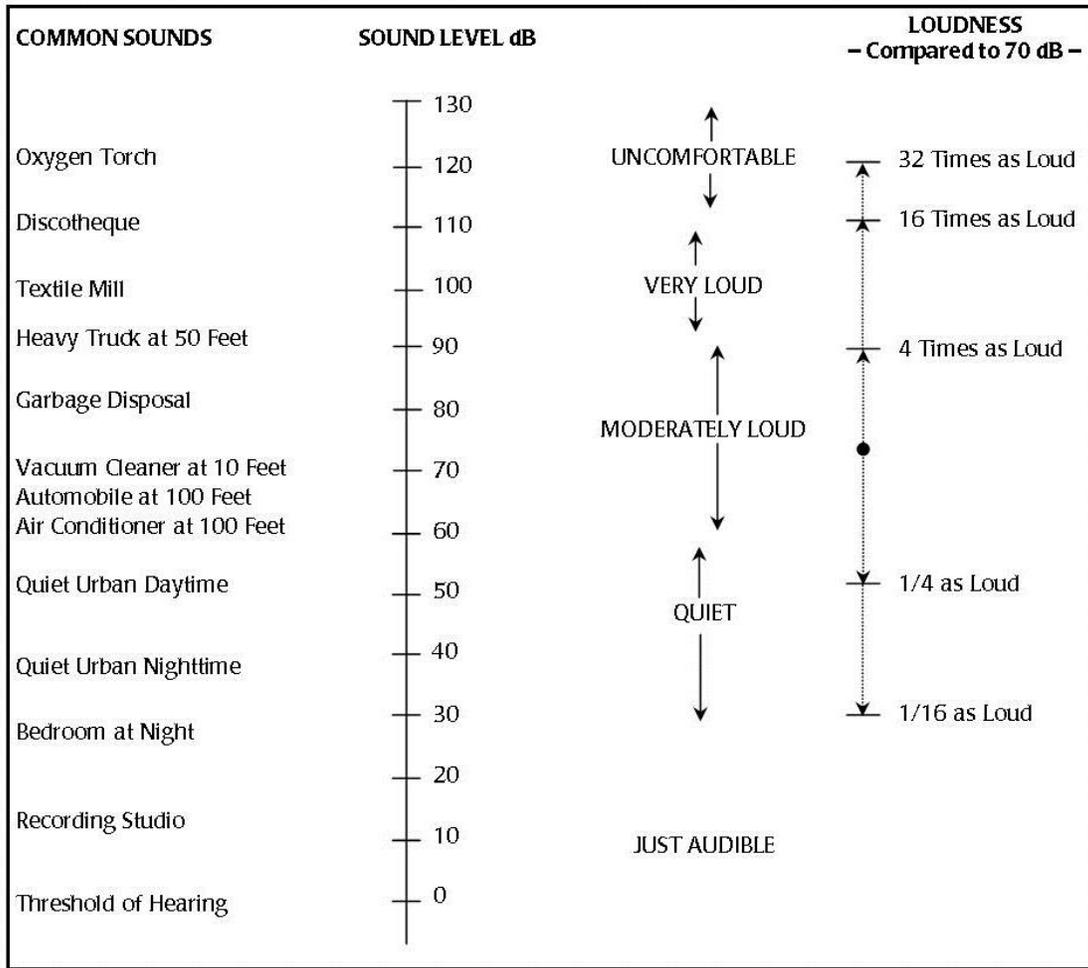
Most environmental sounds are measured using A-weighting. They're called A-weighted sound levels, and sometimes use the unit dBA or dB(A) rather than dB. When the use of A-weighting is understood, the term "A-weighted" is often omitted and the unit dB is used. Unless otherwise stated, dB units refer to A-weighted sound levels.

Sound becomes noise when it is unwelcome and interferes with normal activities, such as sleep or conversation. Noise is unwanted sound. Noise can become an issue when its level exceeds the ambient or background sound level. Ambient noise in urban areas typically varies from 60 to 70 dB, but can be as high as 80 dB in the center of a large city. Quiet suburban neighborhoods experience ambient noise levels around 45-50 dB (U.S. Environmental Protection Agency (USEPA) 1978).

Figure A-3 is a chart of A-weighted sound levels from common sources. Some sources, like the air conditioner and vacuum cleaner, are continuous sounds whose levels are constant for some time. Some sources, like the automobile and heavy truck, are the maximum sound during an intermittent event like a vehicle pass-by. Some sources like "urban daytime" and "urban nighttime" are averages over extended periods. A variety of noise metrics have been developed to describe noise over different time periods. These are discussed in detail in Section A.2.

Aircraft noise consists of two major types of sound events: flight (including takeoffs, landings and flyovers), and stationary, such as engine maintenance run-ups. The former are intermittent and the latter primarily continuous. Noise from aircraft overflights typically occurs beneath main approach and departure paths, in local air traffic patterns around the airfield, and in areas near aircraft parking ramps and staging areas. As aircraft climb, the noise received on the ground drops to lower levels, eventually fading into the background or ambient levels.

Impulsive noises are generally short, loud events. Their single-event duration is usually less than 1 second. Examples of impulsive noises are small-arms gunfire, hammering, pile driving, metal impacts during rail-yard shunting operations, and riveting. Examples of high-energy impulsive sounds are quarry/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, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams (American National Standards Institute [ANSI] 1996).

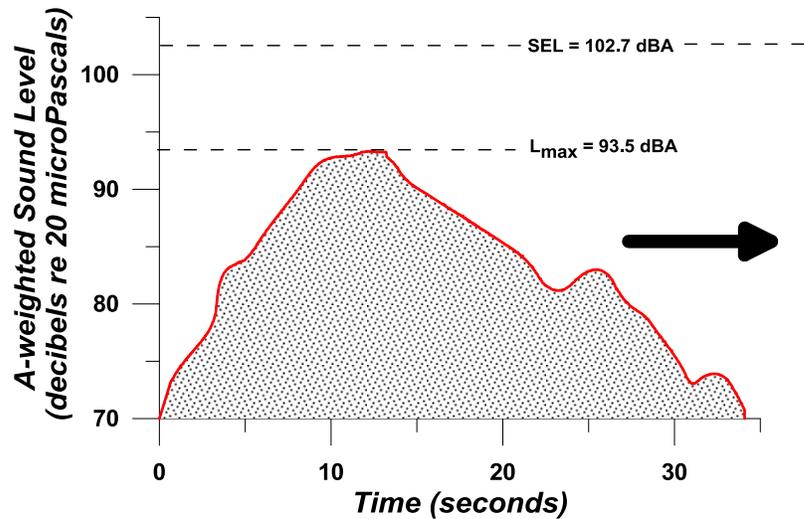


Sources: Harris 1979; Federal Interagency Committee on Aviation Noise (FICAN) 1997.

Figure A-3. Typical A-weighted Sound Levels of Common Sounds

A.2 Noise Metrics

Noise metrics quantify sounds so they can be compared with each other, and with their effects, in a standard way. The simplest metric is the A-weighted level, which is appropriate by itself for constant noise such as an air conditioner. Aircraft noise varies with time. During an aircraft overflight, noise starts at the background level, rises to a maximum level as the aircraft flies close to the observer, then returns to the background as the aircraft recedes into the distance. This is sketched in Figure A-4, which also indicates two metrics (L_{max} and SEL) that are described in Sections A.2.1 and A.2.3 below. Over time there can be a number of events, not all the same.



Source: Wyle Laboratories

Figure A-4. Example Time History of Aircraft Noise Flyover

There are a number of metrics that can be used to describe a range of situations, from a particular individual event to the cumulative effect of all noise events over a long time. This section describes the metrics relevant to environmental noise analysis.

A.2.1 Single-events

Maximum Sound Level (L_{max})

The highest A-weighted sound level measured during a single event in which the sound changes with time is called the maximum A-weighted sound level or Maximum Sound Level and is abbreviated L_{max} . The L_{max} is depicted for a sample event in Figure A-4.

L_{max} is the maximum level that occurs over a fraction of a second. For aircraft noise, the “fraction of a second” is one-eighth of a second, denoted as “fast” response on a sound level measuring meter (ANSI 1988). Slowly varying or steady sounds are generally measured over 1 second, denoted “slow” response. L_{max} is important in judging if a noise event will interfere with conversation, TV or radio listening, or other common activities. Although it provides some measure of the event, it does not fully describe the noise, because it does not account for how long the sound is heard.

Peak Sound Pressure Level (L_{pk})

The Peak Sound Pressure Level is the highest instantaneous level measured by a sound level measurement meter. L_{pk} is typically measured every 20 microseconds, and usually based on unweighted or linear response of the meter. It is used to describe individual impulsive events such as blast noise. Because blast noise varies from shot to shot and varies with meteorological (weather) conditions, the U.S. Department of Defense (DOD) usually characterizes L_{pk} by the metric PK 15(met), which is the L_{pk} exceeded 15% of the time. The “met” notation refers to the metric accounting for varied meteorological or weather conditions.

Sound Exposure Level (SEL)

Sound Exposure Level combines both the intensity of a sound and its duration. For an aircraft flyover, SEL includes the maximum and all lower noise levels produced as part of the overflight, together with how long each part lasts. It represents the total sound energy in the event. Figure A-4 indicates the SEL for an example event, representing it as if all the sound energy were contained within 1 second.

Because aircraft noise events last more than a few seconds, the SEL value is larger than L_{max} . It does not directly represent the sound level heard at any given time, but rather the entire event. SEL provides a much better measure of aircraft flyover noise exposure than L_{max} alone.

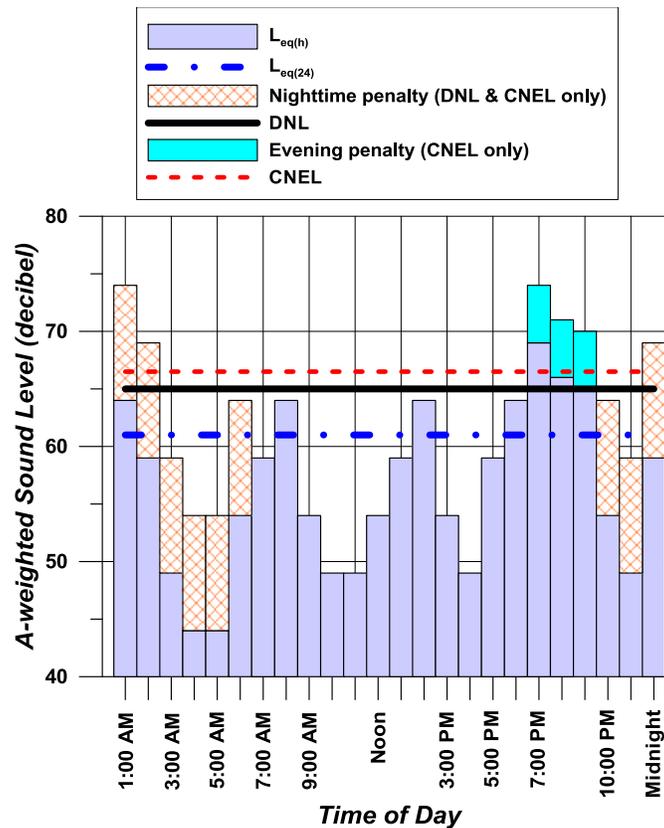
A.2.2 Cumulative Events

Equivalent Sound Level (L_{eq})

Equivalent Sound Level is a “cumulative” metric that combines a series of noise events over a period of time. L_{eq} is the sound level that represents the decibel average SEL of all sounds in the time period. Just as SEL has proven to be a good measure of a single event, L_{eq} has proven to be a good measure of series of events during a given time period.

The time period of an L_{eq} measurement is usually related to some activity, and is given along with the value. The time period is often shown in parenthesis (e.g., $L_{eq(24)}$ for 24 hours). The L_{eq} from 7 a.m. to 3 p.m. may give exposure of noise for a school day.

Figure A-5 gives an example of $L_{eq(24)}$ using notional hourly average noise levels ($L_{eq(h)}$) for each hour of the day as an example. The $L_{eq(24)}$ for this example is 61 dB.



Source: Wyle Laboratories

Figure A-5. Example of $L_{eq(24)}$, DNL and CNEL Computed from Hourly Equivalent Sound Levels

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

Day-Night Average Sound Level is a cumulative metric that accounts for all noise events in a 24-hour period. However, unlike $L_{eq(24)}$, DNL contains a nighttime noise penalty. To account for our increased sensitivity to noise at night, DNL applies a 10 dB penalty to events during the nighttime period, defined as 10:00 p.m. to 7:00 a.m. The notations DNL and L_{dn} are both used for Day-Night Average Sound Level and are equivalent.

CNEL is a variation of DNL specified by law in California (California Code of Regulations Title 21, *Public Works*) (Wyle Laboratories 1970). CNEL has the 10 dB nighttime penalty for events between 10:00 p.m. and 7:00 a.m. but also includes a 4.8 dB penalty for events during the evening period of 7:00 p.m. to 10:00 p.m. The evening penalty in CNEL accounts for the added intrusiveness of sounds during that period.

For airports and military airfields, DNL and CNEL represent the average sound level for annual average daily aircraft events.

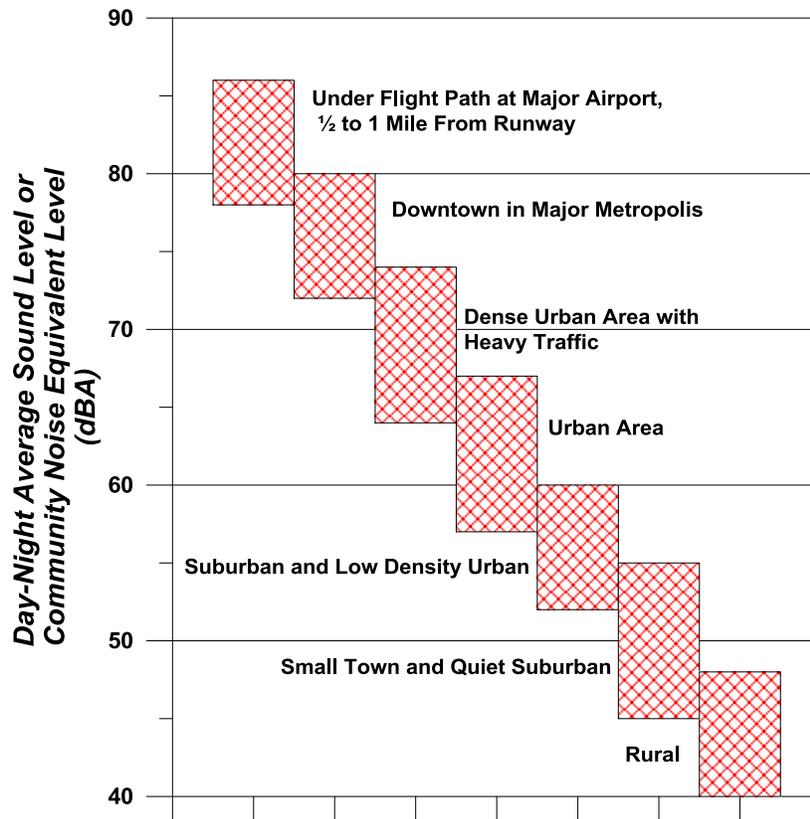
Figure A-5 gives an example of DNL and CNEL using notional hourly average noise levels ($L_{eq(h)}$) for each hour of the day as an example. Note the $L_{eq(h)}$ for the hours between 10 p.m. and 7 a.m. have a 10 dB penalty assigned. For CNEL the hours between 7 p.m. and 10 p.m. have a 4.8 dB penalty assigned. The DNL for this example is 65 dB. The CNEL for this example is 66 dB.

Figure A-6 shows the ranges of DNL or CNEL that occur in various types of communities. Under a flight path at a major airport the DNL may exceed 80 dB, while rural areas may experience DNL less than 45 dB.

The decibel summation nature of these metrics causes the noise levels of the loudest events to control the 24-hour average. As a simple example, 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.

A feature of the DNL metric is that a given DNL value could result from a very few noisy events or a large number of quieter events. For example, 1 overflight at 90 dB creates the same DNL as 10 overflights at 80 dB.

DNL or CNEL do not represent a level heard at any given time, but represent long term exposure. Scientific studies have found good correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL (Schultz 1978; USEPA 1978).



Source: DOD 1978.

Figure A-6. Typical DNL or CNEL Ranges in Various Types of Communities

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 Operations Areas (MOAs), and Restricted Areas/Ranges generate a noise environment that is somewhat different from that around airfields. Rather than regularly occurring operations like at airfields, activity in SUAs is highly sporadic. It is often seasonal, ranging from 10 per hour to less than 1 per week. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-air-speed flyover can have a rather sudden onset, with rates of up to 150 dB per second.

The cumulative daily noise metric devised to account for the “surprise” effect of the sudden onset of aircraft noise events on humans and the sporadic nature of SUA activity is the Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}). Onset rates between 15 and 150 dB per second require an adjustment of 0 to 11 dB to the event’s SEL, while onset rates below 15 dB per second require no adjustment to the event’s SEL (Stusnick et al. 1992). The term ‘monthly’ in L_{dnmr} refers to the noise assessment being conducted for the month with the most operations or sorties -- the so-called busiest month.

In California, a variant of the L_{dnmr} includes a penalty for evening operations (7 p.m. to 10 p.m.) and is denoted $CNEL_{mr}$.

A.2.3 Supplemental Metrics

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

The Number-of-Events Above (NA) metric gives the total number of events that exceed a noise level threshold (L) during a specified period of time. Combined with the selected threshold, the metric is denoted NAL. The threshold can be either SEL or L_{\max} , and it is important that this selection is shown in the nomenclature. When labeling a contour line or point of interest (POI), NAL is followed by the number of events in parentheses. For example, where 10 events exceed an SEL of 90 dB over a given period of time, the nomenclature would be NA90SEL(10). Similarly, for L_{\max} it would be NA90 L_{\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 is a supplemental metric. It is not supported by the amount of science behind DNL/CNEL, but it is valuable in helping to describe noise to the community. A threshold level and metric are selected that best meet the need for each situation. An L_{\max} threshold is normally selected to analyze speech interference, while an SEL threshold is normally selected for analysis of sleep disturbance.

The NA metric is the only supplemental metric 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.

Time Above (TA) a Specified Level (L)

The Time Above (TA) metric is the total time, in minutes, that the A-weighted noise level is at or above a threshold. Combined with the threshold level (L), it is denoted TAL. TA 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 for that time.

TA is a supplemental metric, used to help understand noise exposure. It is useful for describing the noise environment in schools, particularly when assessing classroom or other noise sensitive areas for various scenarios. TA can be shown as contours on a map similar to the way DNL contours are drawn.

TA helps describe the noise exposure of an individual event or many events occurring over a given 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, but also the total duration of those events above the threshold.

A.3 Noise Effects

Noise is of concern because of potential adverse effects. The following subsections describe how noise can affect communities and the environment, and how those effects are quantified. The specific topics discussed are:

- Annoyance;
- Speech interference;
- Sleep disturbance;
- Noise-induced hearing impairment;
- Non-auditory health effects;
- Performance effects;
- Noise effects on children;
- Property values;
- Noise-induced vibration effects on structures and humans;
- Noise effects on terrain;
- Noise effects on historical and archaeological sites; and
- Effects on domestic animals and wildlife.

A.3.1 Annoyance

With the introduction of jet aircraft in the 1950s, it became clear that aircraft noise annoyed people and was a significant problem around airports. Early studies, such as those of Rosenblith et al. (1953) and Stevens et al. (1953) showed that effects depended on the quality of the sound, its level, and the number of flights. Over the next 20 years considerable research was performed refining this understanding and setting guidelines for noise exposure. In the early 1970s, the USEPA published its “Levels Document” (USEPA 1974) that reviewed the factors that affected communities. DNL (still known as L_{dn} at the time) was identified as an appropriate noise metric, and threshold criteria were recommended.

Threshold criteria for annoyance were identified from social surveys, where people exposed to noise were asked how noise affects them. Surveys provide direct real-world data on how noise affects actual residents.

Surveys in the early years had a range of designs and formats, and needed some interpretation to find common ground. In 1978, Schultz showed that the common ground was the number of people “highly annoyed,” defined as the upper 28% range of whatever response scale a survey used (Schultz 1978). With that definition, he was able to show a remarkable consistency among the majority of the surveys for which data were available. Figure A-7 shows the result of his study relating DNL to individual annoyance measured by percent highly annoyed (%HA).

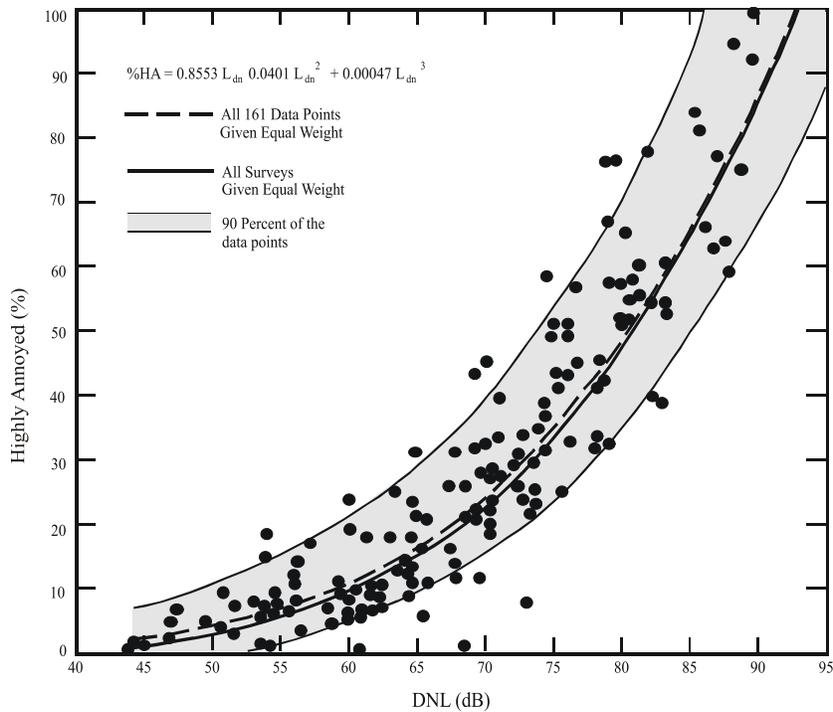


Figure A-7. Schultz Curve Relating Noise Annoyance to DNL (Schultz 1978)

Schultz’s original synthesis included 161 data points. Figure A-8 compares revised fits of the Schultz data set with an expanded set of 400 data points collected through 1989 (Finegold et al. 1994). The new form is the preferred form in the US, endorsed by the Federal Interagency Committee on Aviation Noise (FICAN 1997). Other forms have been proposed, such as that of Fidell and Silvati (2004), but have not gained widespread acceptance.

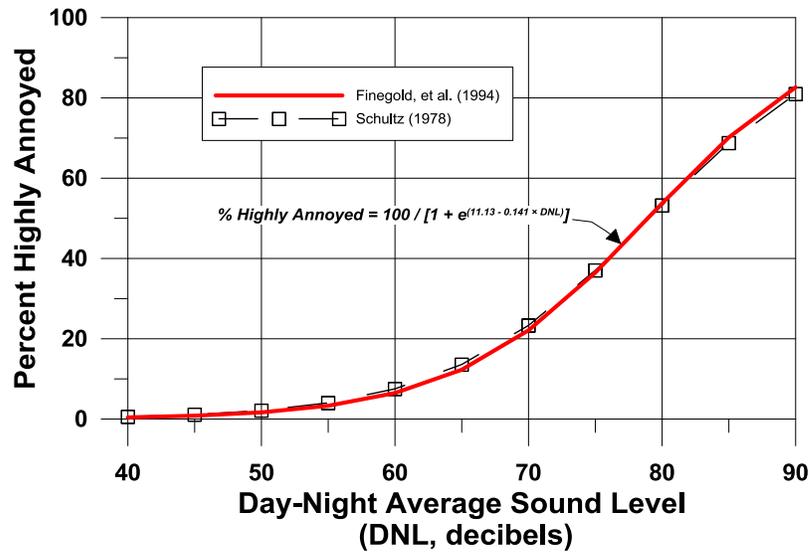


Figure A-8. Response of Communities to Noise; Comparison of Original Schultz (1978) with Finegold et al (1994)

When the goodness of fit of the Schultz curve is examined, the correlation between groups of people is high, in the range of 85-90%. The correlation between individuals is lower, 50% or less. This is not surprising, given the personal differences between individuals. The surveys underlying the Schultz curve include results that show that annoyance to noise is also affected by non-acoustical factors. Newman and Beattie (1985) divided the non-acoustic factors into the emotional and physical variables shown in Table A-1.

Table A-1. Non-Acoustic Variables Influencing Aircraft Noise Annoyance

Emotional Variables	Physical Variables
Feeling about the necessity or preventability of the noise;	Type of neighborhood;
Judgement of the importance and value of the activity that is producing the noise;	Time of day;
Activity at the time an individual hears the noise;	Season;
Attitude about the environment;	Predictability of the noise;
General sensitivity to noise;	Control over the noise source; and
Belief about the effect of noise on health; and	Length of time individual is exposed to a noise.
Feeling of fear associated with the noise.	

Schreckenber and Schuemer (2010) recently examined the importance of some of these factors on short term annoyance. Attitudinal factors were identified as having an effect on annoyance. In formal regression analysis, however, sound level (L_{eq}) was found to be more important than attitude.

A recent study by Plotkin et al. (2011) examined updating DNL to account for these factors. It was concluded that the data requirements for a general analysis were much greater than most existing studies. It was noted that the most significant issue with DNL is that it is not readily understood by the public, and that supplemental metrics such as TA and NA were valuable in addressing attitude when communicating noise analysis to communities (DOD 2009a).

A factor that is partially non-acoustical is the source of the noise. Miedema and Vos (1998) presented synthesis curves for the relationship between DNL and percentage “Annoyed” and percentage “Highly Annoyed” for three transportation noise sources. Different curves were found for aircraft, road traffic, and railway noise. Table A-2 summarizes their results. Comparing the updated Schultz curve suggests that the percentage of people highly annoyed by aircraft noise may be higher than previously thought.

Table A-2. Percent Highly Annoyed for Different Transportation Noise Sources

DNL (dB)	Percent Highly 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 and Vos 1998.

As noted by the World Health Organization (WHO), however, 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 1999).

Consistent with WHO's recommendations, the Federal Interagency Committee on Noise (FICON 1992) considered the Schultz curve to be the best source of dose information to predict community response to noise, but recommended further research to investigate the differences in perception of noise from different sources.

A.3.2 Speech Interference

Speech interference from noise is a primary cause of annoyance for communities. Disruption of routine activities such as radio or television listening, telephone use, or conversation leads to frustration and annoyance. The quality of speech communication is important in classrooms and offices. In the workplace, speech interference from noise can cause fatigue and vocal strain in those who attempt to talk over the noise. In schools it can impair learning.

There are two measures of speech comprehension:

1. *Word Intelligibility* - the percent of words spoken and understood. 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. *Sentence Intelligibility* - the percent of sentences spoken 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.

U.S. Federal Criteria for Interior Noise

In 1974, the USEPA identified a goal of an indoor $L_{eq(24)}$ of 45 dB to minimize speech interference based on sentence intelligibility and the presence of steady noise (USEPA 1974). Figure A-9 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 indoor sound levels of less than 45 dB L_{eq} are expected to allow 100% sentence intelligibility.

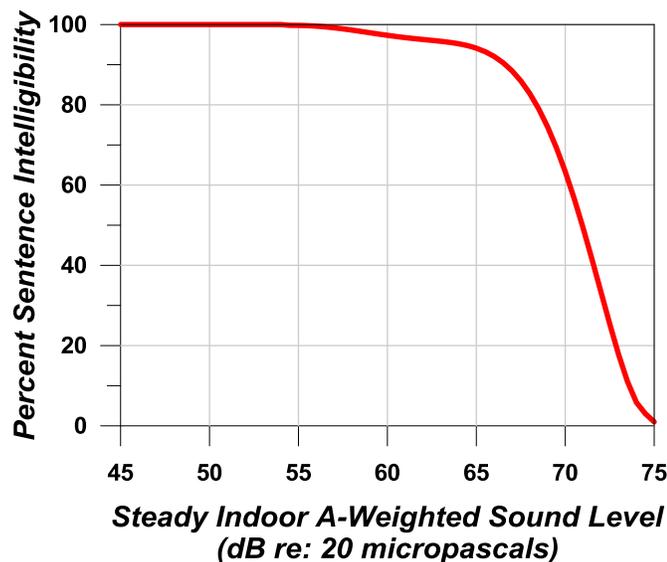


Figure A-9. Speech Intelligibility Curve (digitized from USEPA 1974)

The curve in Figure A-9 shows 99% intelligibility at L_{eq} below 54 dB, and less than 10% above 73 dB. Recalling that L_{eq} is dominated by louder noise events, the USEPA $L_{eq(24)}$ goal of 45 dB generally ensures that sentence intelligibility will be high most of the time.

Classroom Criteria

For teachers to be understood, their regular voice must be clear and uninterrupted. Background noise has to be below the teacher's voice level. Intermittent noise events that momentarily drown out the teacher's voice need to be kept to a minimum. 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.

Lazarus (1990) found that for listeners with normal hearing and fluency in the language, complete sentence intelligibility can be achieved when the signal-to-noise ratio (i.e., a comparison of the level of the sound to the level of background noise) is in the range of 15 to 18 dB. The initial ANSI classroom noise standard (ANSI 2002) and American Speech-Language-Hearing Association (ASLHA 1995) guidelines concur, recommending at least a 15 dB signal-to-noise ratio in classrooms. If the teacher's voice level is at least 50 dB, the background noise level must not exceed an average of 35 dB. The National Research Council of Canada (Bradley 1993) and WHO (1999) agree with this criterion for background noise.

For 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} during normal school hours (FAA 1985).

Most aircraft noise is not continuous. It consists of individual events like the one sketched in Figure A-4. Since speech interference in the presence of aircraft noise is caused by individual aircraft flyover events, a time-averaged metric alone, such as L_{eq} , is not necessarily appropriate. In addition to the background level criteria described above, single-event criteria that account for those noisy events are also needed.

A 1984 study by Wyle for the Port Authority of New York and New Jersey recommended using Speech Interference Level (SIL) for classroom noise criteria (Sharp and Plotkin 1984). SIL is based on the maximum sound levels in the frequency range that most affects speech communication (500-2,000 Hz). The study identified an SIL of 45 dB as the goal. This would provide 90% word intelligibility for the short time periods during aircraft overflights. While SIL is technically the best metric for speech interference, it can be approximated by an L_{max} value. An SIL of 45 dB is equivalent to an A-weighted L_{max} of 50 dB for aircraft noise (Wesler 1986).

Lind et al. (1998) also concluded that an L_{max} criterion of 50 dB would result in 90% word intelligibility. Bradley (1985) recommends SEL as a better indicator. His work indicates that 95% word intelligibility would be achieved when indoor SEL did not exceed 60 dB. For typical flyover noise this corresponds to an L_{max} of 50 dB. While WHO (1999) only specifies a background L_{max} criterion, they also note the SIL frequencies and that interference can begin at around 50 dB.

The United Kingdom Department for Education and Skills (UKDfES) established in its classroom acoustics guide a 30-minute time-averaged metric of $L_{eq(30min)}$ for background levels and the metric of $L_{A1,30min}$ for intermittent noises, at thresholds of 30-35 dB and 55 dB, respectively. $L_{A1,30min}$ represents the A-weighted sound level that is exceeded 1% of the time (in this case, during a 30-minute teaching session) and is generally equivalent to the L_{max} metric (UKDfES 2003).

Table A-3 summarizes the criteria discussed. Other than the FAA (1985) 45 dB L_{max} criterion, they are consistent with a limit on indoor background noise of 35-40 dB L_{eq} and a single event limit of 50 dB L_{max} . It should be noted that these limits were set based on students with normal hearing and no special needs. At-risk students may be adversely affected at lower sound levels.

Table A-3. Indoor Noise Level Criteria Based on Speech Intelligibility

Source	Metric/Level (dB)	Effects and Notes
U.S. FAA (1985)	$L_{eq}(\text{during school hours}) = 45 \text{ dB}$	Federal assistance criteria for school sound insulation; supplemental single-event criteria may be used.
Lind et al. (1998), Sharp and Plotkin (1984), Wesler (1986)	$L_{max} = 50 \text{ dB} / \text{SIL } 45$	Single event level permissible in the classroom.
WHO (1999)	$L_{eq} = 35 \text{ dB}$ $L_{max} = 50 \text{ dB}$	Assumes average speech level of 50 dB and recommends signal to noise ratio of 15 dB.
U.S. ANSI (2010)	$L_{eq} = 35 \text{ dB}$, based on Room Volume (e.g., cubic feet)	Acceptable background level for continuous and intermittent noise.
U.K. DFES (2003)	$L_{eq(30min)} = 30\text{-}35 \text{ dB}$ $L_{max} = 55 \text{ dB}$	Minimum acceptable in classroom and most other learning environs.

A.3.3 Sleep Disturbance

Sleep disturbance is a major concern for communities exposed to aircraft noise at night. A number of studies have attempted to quantify the effects of noise on sleep. This section provides an overview of the major noise-induced sleep disturbance studies. Emphasis is on 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 sleep observations performed under laboratory conditions.
2. Later studies performed in the 1990s up to the present, where the research was focused on field observations.

Initial Studies

The relation between noise and sleep disturbance is complex and not fully understood. The disturbance depends not only on the depth of sleep and the noise level, but also on the non-acoustic factors cited for annoyance. The easiest effect to measure is the number of arousals or awakenings from noise events. Much of the literature has therefore focused on predicting the percentage of the population that will be awakened at various noise levels.

FICON's 1992 review of airport noise issues (FICON 1992) included an overview of relevant research conducted through the 1970s. Literature reviews and analyses were conducted from 1978 through 1989 using existing data (Griefahn 1978; Lukas 1978; Pearsons et. al. 1989). Because of large variability in the data, FICON did not endorse the reliability of those results.

FICON did, however, recommend an interim dose-response curve, awaiting future research. That curve predicted the percent of the population expected to be awakened as a function of the exposure to SEL. This curve was based on research conducted for the U.S. Air Force (Finegold 1994). The data included most of the research performed up to that point, and predicted a 10% probability of awakening when exposed to an interior SEL of 58 dB. The data used to derive this curve were primarily from controlled laboratory studies.

Recent Sleep Disturbance Research – Field and Laboratory Studies

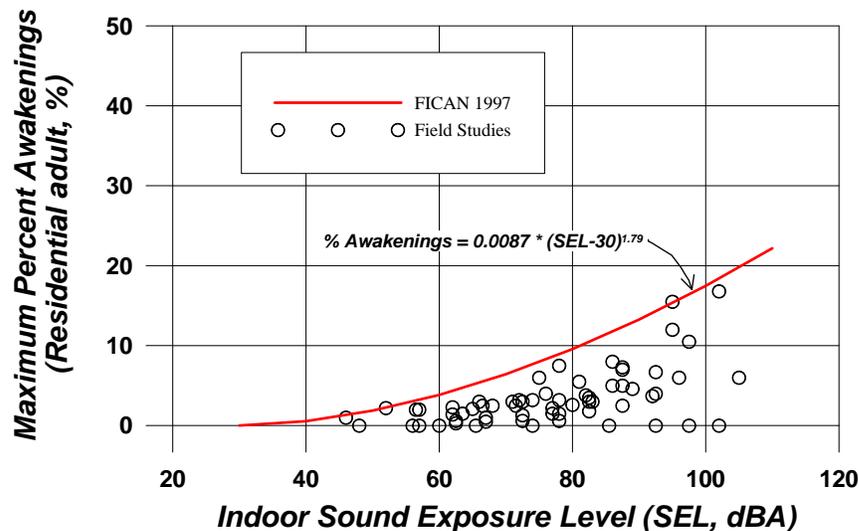
It was noted that early sleep laboratory studies did not account for some important factors. These included habituation to the laboratory, previous exposure to noise, and awakenings from noise other than aircraft. In the early 1990s, field studies in people's homes were conducted to validate the earlier laboratory work conducted in the 1960s and 1970s. The field studies of the 1990s found that 80-90% of

sleep disturbances were not related to outdoor noise events, but rather to indoor noises and non-noise factors. The results showed that, in real life conditions, there was less of an effect of noise on sleep than had been previously reported from laboratory studies. Laboratory sleep studies tend to show more sleep disturbance than field studies because people who sleep in their own homes are used to their environment and, therefore, do not wake up as easily (FICAN 1997).

FICAN

Based on this new information, in 1997 FICAN recommended a dose-response curve to use instead of the earlier 1992 FICAN curve (FICAN 1997). Figure A-10 shows FICAN's curve, the red line, which is based on the results of three field studies shown in the figure (Ollerhead et al. 1992; Fidell et al. 1994; Fidell et al. 1995a, 1995b), along with the data from six previous field studies.

The 1997 FICAN curve represents the upper envelope of the latest field data. It predicts the maximum percent awakened for a given residential population. According to this curve, a maximum of 3% of people would be awakened at an indoor SEL of 58 dB. An indoor SEL of 58 dB is equivalent to an outdoor SEL of 83 dB, with the windows closed (73 dB with windows open).



Source: FICAN 1997

Figure A-10. FICAN 1997 Recommended Sleep Disturbance Dose-Response Relationship

Number of Events and Awakenings

It is reasonable to expect that sleep disturbance is affected by the number of events. The German Aerospace Center (DLR Laboratory) conducted an extensive study focused on the effects of nighttime aircraft noise on sleep and related factors (Basner 2004). The DLR study was one of the largest studies to examine the link between aircraft noise and sleep disturbance. It involved both laboratory and in-home field research phases. The DLR investigators developed a dose-response 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.

A different approach was taken by an ANSI standards committee (ANSI 2008). The committee used the average of the data shown in Figure A-10 (i.e., the blue dashed line) rather than the upper envelope, to predict average awakening from one event. Probability theory is then used to project the awakening from multiple noise events.

Currently, there are no established criteria for evaluating sleep disturbance from aircraft noise, although recent studies have suggested a benchmark of an outdoor SEL of 90 dB as an appropriate tentative

criterion when comparing the effects of different operational alternatives. The corresponding indoor SEL would be approximately 25 dB lower (at 65 dB) with doors and windows closed, and approximately 15 dB lower (at 75 dB) with doors or windows open. According to the ANSI (2008) standard, the probability of awakening from a single aircraft event at this level is between 1 and 2% for people habituated to the noise sleeping in bedrooms with windows closed, and 2-3% with windows open. The probability of the exposed population awakening at least once from multiple aircraft events at noise levels of 90 dB SEL is shown in Table A-4.

Table A-4. Probability of Awakening from NA90SEL

Number of Aircraft Events at 90 dB SEL for Average 9-Hour Night	Minimum Probability of Awakening at Least Once	
	Windows Closed	Windows Open
1	1%	2%
3	4%	6%
5	7%	10%
9 (1 per hour)	12%	18%
18 (2 per hour)	22%	33%
27 (3 per hour)	32%	45%

Source: DOD 2009b.

In December 2008, FICAN recommended the use of this new standard. FICAN also recognized that more research is underway by various organizations, and that work may result in changes to FICAN's position. Until that time, FICAN recommends the use of the ANSI (2008) standard (FICAN 2008).

Summary

Sleep disturbance research still lacks the details to accurately estimate the population awakened for a given noise exposure. The procedure described in the ANSI (2008) Standard and endorsed by FICAN is based on probability calculations that have not yet been scientifically validated. While this procedure certainly provides a much better method for evaluating sleep awakenings from multiple aircraft noise events, the estimated probability of awakenings can only be considered approximate.

A.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 et al. 1995).

TTS can result from exposure to loud noise over a given amount of time. An example of TTS might be a person attending a loud music concert. After the concert is over, there can be a threshold shift that may last several hours. 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 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. A common example of PTS is the result of regularly working in a loud factory. A TTS can eventually become a PTS over time with repeated exposure to high noise levels. 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 TTS results in a PTS is difficult to identify and varies with a person's sensitivity.

Criteria for Permanent Hearing Loss

It has been well established that continuous exposure to high noise levels will damage human hearing (USEPA 1978). A large amount of data on hearing loss have been collected, largely for workers in manufacturing industries, and analyzed by the scientific/medical community. The Occupational Safety and Health Administration (OSHA) regulation of 1971 places the limit on workplace noise exposure at an average level of 90 dB over an 8-hour work period or 85 dB over a 16-hour period (U.S. Department of Labor 1971). Some hearing loss is still expected at those levels. The most protective criterion, with no measurable hearing loss after 40 years of exposure, is an average sound level of 70 dB over a 24-hour period.

The USEPA established 75 dB $L_{eq(8)}$ and 70 dB $L_{eq(24)}$ as the average noise level standard needed to protect 96% of the population from greater than a 5 dB PTS (USEPA 1978). The National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) identified 75 dB as the lowest level at which hearing loss may occur (CHABA 1977). WHO concluded that environmental and leisure-time noise below an $L_{eq(24)}$ value of 70 dB “will not cause hearing loss in the large majority of the population, even after a lifetime of exposure” (WHO 1999).

Hearing Loss and Aircraft Noise

The 1982 USEPA Guidelines report (USEPA 1982) addresses noise-induced hearing loss in terms of the “Noise-Induced Permanent Threshold Shift” (NIPTS). This defines the permanent change in hearing caused by exposure to noise. Numerically, the NIPITS is the change in threshold that can be expected from daily exposure to noise over a normal working lifetime of 40 years. A grand average of the NIPITS over time and hearing sensitivity is termed the Average NIPITS, or Ave. NIPITS for short. The Ave. NIPITS that can be expected for noise measured by the $L_{eq(24)}$ metric is given in Table A-5. Table A-5 assumes exposure to the full outdoor noise throughout the 24 hours. When inside a building, the exposure will be less (Eldred and von Gierke 1993).

The Ave. NIPITS is estimated as an average over all people exposed to the noise. The actual value of NIPITS for any given person will depend on their physical sensitivity to noise – some will experience more hearing loss than others. The USEPA Guidelines provide information on this variation in sensitivity in the form of the NIPITS exceeded by 10% of the population, which is included in the Table A-5 in the “10th Percentile NIPITS” column (USEPA 1982). For individuals exposed to $L_{eq(24)}$ of 80 dB, the most sensitive of the population would be expected to show degradation to their hearing of 7 dB over time.

To put these numbers in perspective, changes in hearing level of less than 5 dB are generally not considered noticeable or significant. Furthermore, there is no known evidence that a NIPITS of 5 dB is perceptible or has any practical significance for the individual. Lastly, the variability in audiometric testing is generally assumed to be ± 5 dB (USEPA 1974).

Table A-5. Ave. NIPTS and 10th Percentile NIPTS as a Function of L_{eq(24)}

L _{eq(24)}	Ave. NIPTS (dB)*	10 th 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
85-86	6.0	12.0
86-87	7.0	13.5
87-88	7.5	15.0
88-89	8.5	16.5
89-90	9.5	18.0

* rounded to the nearest 0.5 dB

Source: DOD 2012.

The scientific community has concluded that noise exposure from civil airports has little chance of causing permanent hearing loss (Newman and Beattie 1985). For military airbases, DOD policy requires that hearing risk loss be estimated for population exposed to L_{eq(24)} of 80 dB or higher (DOD 2012), including residents of on-base housing. Exposure of workers inside the base boundary is assessed using DOD regulations for occupational noise exposure.

Noise in low-altitude military airspace, especially along MTRs where L_{max} can exceed 115 dB, is of concern. That is the upper limit used for occupational noise exposure (e.g., U.S. Department of Labor 1971). One laboratory study (Ising et al. 1999) concluded that events with L_{max} above 114 dB have the potential to cause hearing loss. Another laboratory study of participants exposed to levels between 115 and 130 dB (Nixon et al. 1993), however, showed conflicting results. For an exposure to four events across that range, half the subjects showed no change in hearing, a quarter showed a temporary 5 dB decrease in sensitivity, and a quarter showed a temporary 5 dB increase in sensitivity. For exposure to eight events of 130 dB, subjects showed an increase in sensitivity of up to 10 dB (Nixon et al. 1993).

Summary

Aviation noise levels are not comparable to the occupational noise levels associated with hearing loss of workers in manufacturing industries. There is little chance of hearing loss at levels less than 75 dB DNL. Noise levels equal to or greater than 75 dB DNL can occur near military airbases, and DOD policy specifies that NIPTS be evaluated when exposure exceeds 80 dB L_{eq(24)} (DOD 2009c). There is some concern about L_{max} exceeding 115 dB in low altitude military airspace, but no research results to date have definitely related permanent hearing impairment to aviation noise.

A.3.5 Non-auditory Health Effects

Studies have been performed to see whether noise can cause health effects other than hearing loss. The premise is that annoyance causes stress. Prolonged stress is known to be a contributor to a number of health disorders. Cantrell (1974) confirmed that noise can provoke stress, but noted that results on cardiovascular health have been contradictory. Some studies have found a connection between aircraft noise and blood pressure (e.g., Michalak et al. 1990; Rosenlund et al. 2001), while others have not (e.g., Pulles et al. 1990).

Kryter and Poza (1980) noted, “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.”

The connection from annoyance to stress to health issues requires careful experimental design. Some highly publicized reports on health effects have, in fact, been rooted in poorly done science. Meecham and Shaw (1979) apparently found a relation between noise levels and mortality rates in neighborhoods under the approach path to Los Angeles International Airport. When the same data were analyzed by others (Frerichs et al. 1980) no relationship was found. Jones and Tauscher (1978) found a high rate of birth defects for the same neighborhood. But when the Centers For Disease Control performed a more thorough study near Atlanta’s Hartsfield International Airport, no relationships were found for levels above 65 dB (Edmonds et al. 1979).

A carefully designed study, Hypertension and Exposure to Noise near Airports (HYENA), was conducted around six European airports from 2002 through 2006 (Jarup et al. 2005, 2008). There were 4,861 subjects, aged between 45 and 70. Blood pressure was measured, and questionnaires administered for health, socioeconomic and lifestyle factors, including diet and physical exercise. Hypertension was defined by WHO blood pressure thresholds (WHO 2003). Noise from aircraft and highways was predicted from models.

HYENA results were presented as an odds ratio (OR). An OR of 1 means there is no added risk, while an OR of 2 would mean risk doubles. An OR of 1.14 was found for nighttime aircraft noise, measured by L_{night} , the L_{eq} for nighttime hours. For daytime aircraft noise, measured by $L_{\text{eq}(16)}$, the OR was 0.93. For road traffic noise, measured by the full day $L_{\text{eq}(24)}$, the OR was 1.1.

Note that OR is a statistical measure of change, not the actual risk. Risk itself and the measured effects were small, and not necessarily distinct from other events. Haralabidis et al. (2008) reported an increase in systolic blood pressure of 6.2 millimeters of mercury (mmHg) for aircraft noise, and an increase of 7.4 mmHg for other indoor noises such as snoring.

It is interesting that aircraft noise was a factor only at night, while traffic noise is a factor for the full day. Aircraft noise results varied among the six countries so that result is pooled across all data. Traffic noise results were consistent across the six countries.

One interesting conclusion from a 2013 study of the HYENA data (Babisch et al. 2013) states there is some indication that noise level is a stronger predictor of hypertension than annoyance. That is not consistent with the idea that annoyance is a link in the connection between noise and stress. Babisch et al. (2012) present interesting insights on the relationship of the results to various modifiers.

Two recent studies examined the correlation of aircraft noise with hospital admissions for cardiovascular disease. Hansell et al. (2013) examined neighborhoods around London’s Heathrow airport. Correia et al. (2013) examined neighborhoods around 89 airports in the United States. Both studies included areas of various noise levels. They found associations that were consistent with the HYENA results. The authors of these studies noted that further research is needed to refine the associations and the causal interpretation with noise or possible alternative explanations.

Summary

The current state of scientific knowledge cannot yet support inference of a causal or consistent relationship between aircraft noise exposure and non-auditory health consequences for exposed residents. The large scale HYENA study, and the recent studies by Hansell et al. (2013) and Correia et al. (2013) offer indications, but it is not yet possible to establish a quantitative cause and effect based on the currently available scientific evidence.

A.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 found links between continuous high noise levels and performance loss. Noise-induced performance losses are most frequently reported in studies where noise levels are above 85 dB. Little change has been found in low-noise cases. 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 workers.

A.3.7 Noise Effects on Children

Recent studies on school children indicate a potential link between aircraft noise and both reading comprehension and learning motivation. The effects may be small but may be of particular concern for children who are already scholastically challenged.

A.3.7.1 Effects on Learning and Cognitive Abilities

Early studies in several countries (Cohen et al. 1973, 1980, 1981; Bronzaft and McCarthy 1975; Green et al. 1982; Evans et al. 1998; Haines et al. 2002; Lercher et al. 2003) showed lower reading scores for children living or attending school in noisy areas than for children away from those areas. In some studies noise exposed children were less likely to solve difficult puzzles or more likely to give up.

More recently, the Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health (RANCH) study (Stansfeld et al. 2005; Clark et al. 2005) compared the effect of aircraft and road traffic noise on over 2,000 children in three countries. This was the first study to derive exposure-effect associations for a range of cognitive and health effects, and was the first to compare effects across countries.

The study found a linear relation between chronic aircraft noise exposure and impaired reading comprehension and recognition memory. No associations were found between chronic road traffic noise exposure and cognition. Conceptual recall and information recall surprisingly showed better performance in high road traffic noise areas. Neither aircraft noise nor road traffic noise affected attention or working memory (Stansfeld et al. 2005; Clark et al. 2006).

Figure A-11 shows RANCH's result relating noise to reading comprehension. It shows that reading falls below average (a z-score of 0) at L_{eq} greater than 55 dB. Because the relationship is linear, reducing exposure at any level should lead to improvements in reading comprehension.

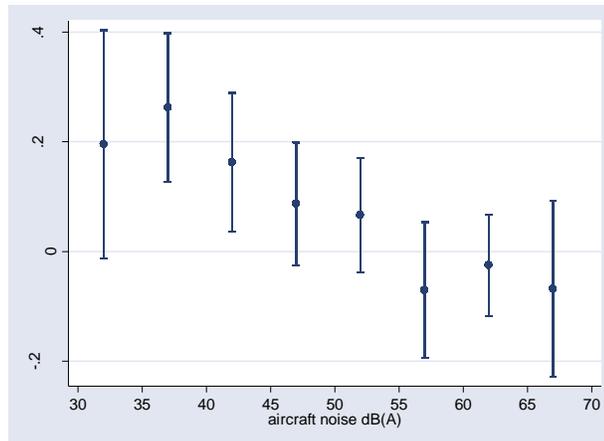


Figure A-11. RANCH Study Reading Scores Varying with L_{eq}
 Sources: Stansfeld et al. 2005; Clark et al. 2006

An observation of the RANCH study was that children may be exposed to aircraft noise for many of their childhood years and the consequences of long-term noise exposure were unknown. A follow-up study of the children in the RANCH project is being analyzed to examine the long-term effects on children’s reading comprehension (Clark et al. 2009). Preliminary analysis indicated a trend for reading comprehension to be poorer at 15-16 years of age for children who attended noise-exposed primary schools. There was also a trend for reading comprehension to be poorer in aircraft noise exposed secondary schools. Further analysis adjusting for confounding factors is ongoing, and is needed to confirm these initial conclusions.

FICAN funded a pilot study to assess the relationship between aircraft noise reduction and standardized test scores (Eagan et al. 2004; FICAN 2007). The study evaluated whether abrupt aircraft noise reduction within classrooms, from either airport closure or sound insulation, was associated with improvements in test scores. Data were collected in 35 public schools near three airports in Illinois and Texas. The study used several noise metrics. These were, however, all computed indoor levels, which makes it hard to compare with the outdoor levels used in most other studies.

The FICAN study found a significant association between noise reduction and a decrease in failure rates for high school students, but not middle or elementary school students. There were some weaker associations between noise reduction and an increase in failure rates for middle and elementary schools. Overall the study found that the associations observed were similar for children with or without learning difficulties, and between verbal and math/science tests. As a pilot study, it was not expected to obtain final answers, but provided useful indications (FICAN 2007).

While there are many factors that can 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 WHO and a North Atlantic Treaty Organization (NATO) 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 (NATO 2000; WHO 1999). The awareness has also led to the classroom noise standard discussed earlier (ANSI 2002).

A.3.7.2 Health Effects

A number of studies, including some of the cognitive studies discussed above, have examined the potential for effects on children’s health. Health effects include annoyance, psychological health, coronary risk, stress hormones, sleep disturbance and hearing loss.

Annoyance. Chronic noise exposure causes annoyance in children (Bronzaft and McCarthy 1975; Evans et al. 1995). Annoyance among children tends to be higher than for adults, and there is little habituation

(Haines et al. 2001a). The RANCH study found annoyance may play a role in how noise affects reading comprehension (Clark et al. 2005).

Psychological Health. Lercher et al. (2002) found an association between noise and teacher ratings of psychological health, but only for children with biological risk defined by low birth weight and/or premature birth. Haines et al. (2001b) found that children exposed to aircraft noise had higher levels of psychological distress and hyperactivity. Stansfeld et al. (2009) replicated the hyperactivity result, but not distress.

As with studies of adults, the evidence suggests that chronic noise exposure is probably not associated with serious psychological illness, but there may be effects on well-being and quality of life. Further research is needed, particularly on whether hyperactive children are more susceptible to stressors such as aircraft noise.

Coronary Risk. The HYENA study discussed earlier indicated a possible relation between noise and hypertension in older adults. Cohen et al. (1980, 1981) found some increase in blood pressure among school children, but within the normal range and not indicating hypertension. Hygge et al. (2002) found mixed effects. The RANCH study found some effect for children at home and at night, but not at school. Overall the evidence for noise effects on children's blood pressure is mixed, and less certain than for older adults.

Stress Hormones. Some studies investigated hormonal levels between groups of children exposed to aircraft noise compared to those in a control group. Two studies analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise (Haines et al. 2001a, 2001b). In both instances, there were no differences between the aircraft-noise-exposed children and the control groups.

Sleep Disturbance. A sub-study of RANCH in a Swedish sample used sleep logs and the monitoring of rest/activity cycles to compare the effect of road traffic noise on child and parent sleep (Ohrstrom et al. 2006). An exposure-response relationship was found for sleep quality and daytime sleepiness for children. While this suggests effects of noise on children's sleep disturbance, it is difficult to generalize from one study.

Hearing loss. A few studies have examined hearing loss from exposure to aircraft noise. Noise-induced hearing loss for children who attended a school located under a flight path near a Taiwan airport was greater than for 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 greater than 75 dB DNL and L_{max} were about 87 dB during overflights. Conversely, several other studies reported no difference in hearing ability between children exposed to high levels of airport noise and children located in quieter areas (Andrus et al. 1975; Fisch 1977; Wu et al. 1995). It is not clear from those results whether children are at higher risk than adults, but the levels involved are higher than those desirable for learning and quality of life.

Ludlow and Sixsmith (1999) conducted a cross-sectional pilot study to examine the hypothesis that military jet noise exposure early in life is associated with raised hearing thresholds. The authors concluded that there were no significant differences in audiometric test results between military personnel who as children had lived in or near stations where fast jet operations were based, and a similar group who had no such exposure as children.

A.3.8 Property Values

Noise can affect the value of homes. Economic studies of property values based on selling prices and noise have been conducted to find a direct relation.

The value-noise relation is usually presented as the Noise Depreciation Index (NDI) or Noise Sensitivity Depreciation Index (NSDI), the percent loss of value per dB (measured by the DNL metric). An early study by Nelson (1978) at three airports found an NDI of 1.8-2.3% per dB. Nelson also noted a decline in NDI over time which he theorized could be due to either a change in population or the increase in commercial value of the property near airports. Crowley (1978) reached a similar conclusion. A larger study by Nelson (1980) looking at 18 airports found an NDI from 0.5 to 0.6% per dB.

In a review of property value studies, Newman and Beattie (1985) found a range of NDI from 0.2 to 2% per dB. They noted that many factors other than noise affected values.

Fidell et al. (1996) studied the influence of aircraft noise on actual sale prices of residential properties in the vicinity of a military base in Virginia and one in Arizona. They found no meaningful effect on home values. Their results may have been due to non-noise factors, especially the wide differences in homes between the two study areas.

Recent studies of noise effects on property values have recognized the need to account for non-noise factors. Nelson (2004) analyzed data from 33 airports, and discussed the need to account for those factors and the need for careful statistics. His analysis showed NDI from 0.3 to 1.5% per dB, with an average of about 0.65% per dB. Nelson (2007) and Andersson et al. (2013) discuss statistical modeling in more detail.

Enough data is available to conclude that aircraft noise has a real effect on property values. This effect falls in the range of 0.2 to 2.0% per dB, with the average on the order of 0.5% per dB. The actual value varies from location to location, and is very often small compared to non-noise factors.

A.3.9 Noise-Induced Vibration Effects on Structures and Humans

High noise levels can cause buildings to vibrate. If high enough, building components can be damaged. The most sensitive components of a building are the windows, followed by plaster walls and ceilings. Possibility of damage depends on the peak sound pressures and the resonances of the building. In general, damage is possible only for sounds lasting more than one second above an unweighted sound level of 130 dB (CHABA 1977). That is higher than expected from normal aircraft operations. Even low altitude flyovers of heavy aircraft do not reach the potential for damage (Sutherland 1990).

Noise-induced structural vibration may cause annoyance to dwelling occupants because of induced secondary vibrations, or "rattle", of objects within the dwelling – hanging pictures, dishes, plaques, and bric-a-brac. Loose window panes may also vibrate noticeably when exposed to high levels of airborne noise, causing homeowners to fear breakage. In general, rattling occurs at peak unweighted sound levels that last for several seconds at levels above 110 dB, which is well above that considered normally compatible with residential land use. Thus, assessments of noise exposure levels for compatible land use will also be protective of noise-induced rattle.

The sound from an aircraft overflight travels from the exterior to the interior of the house in one of two ways: through the solid structural elements and directly through the air. Figure A-12 illustrates the sound transmission through a wall constructed with a brick exterior, stud framing, interior finish wall, and absorbent material in the cavity. The sound transmission starts with noise impinging on the wall exterior. Some of this sound energy will be reflected away and some will make the wall vibrate. The vibrating wall radiates sound into the airspace, which in turn sets the interior finish surface vibrating, with some energy lost in the airspace. This surface then radiates sound into the dwelling interior. As the figure shows, vibrational energy also bypasses the air cavity by traveling through the studs and edge connections.

Normally, the most sensitive components of a structure to airborne noise are the windows, followed by plastered walls and ceilings. An evaluation of the peak sound pressures impinging on the structure is normally sufficient to determine the possibility of damage. In general, at unweighted sound levels above 130 dB, there is the possibility of structural damage. While certain frequencies (such as 30 Hertz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than one second above a unweighted sound level of 130 dB are potentially damaging to structural components (von Gierke and Ward 1991).

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

1. Type of excitation: steady state, intermittent, or impulsive vibration.
2. Frequency of the excitation. International Organization for Standardization (ISO) standard 2631-2 (ISO 1989) recommends a frequency range of 1 to 80 Hz for the assessment of vibration on humans.
3. Orientation of the body with respect to the vibration.
4. The use of the occupied space (i.e., residential, workshop, hospital).
5. Time of day.

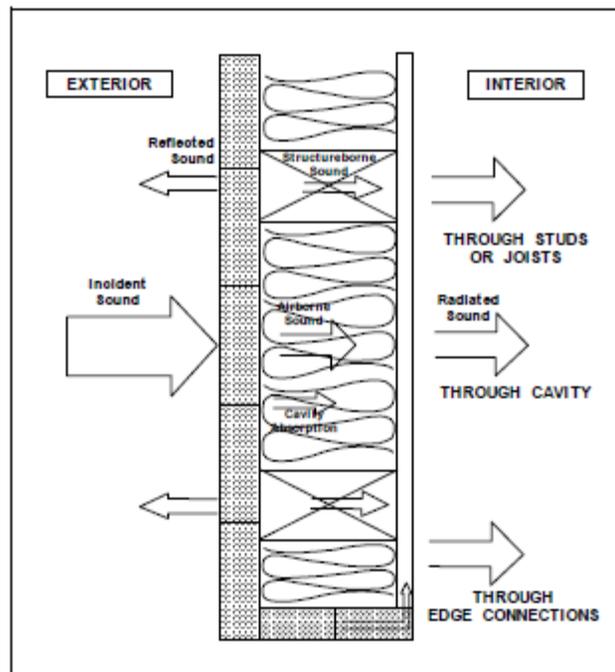


Figure A-12. Depiction of Sound Transmission through Built Construction

Table A-6 lists the whole-body vibration criteria from ISO 2631-2 for one-third octave frequency bands from 1 to 80 Hz.

Table A-6. Vibration Criteria for the Evaluation of Human Exposure to Whole-Body Vibration

Frequency (Hz)	RMS Acceleration (m/s/s)		
	Combined Criteria Base Curve	Residential Night	Residential Day
1.00	0.0036	0.0050	0.0072
1.25	0.0036	0.0050	0.0072
1.60	0.0036	0.0050	0.0072
2.00	0.0036	0.0050	0.0072
2.50	0.0037	0.0052	0.0074
3.15	0.0039	0.0054	0.0077
4.00	0.0041	0.0057	0.0081
5.00	0.0043	0.0060	0.0086
6.30	0.0046	0.0064	0.0092
8.00	0.0050	0.0070	0.0100
10.00	0.0063	0.0088	0.0126
12.50	0.0078	0.0109	0.0156
16.00	0.0100	0.0140	0.0200
20.00	0.0125	0.0175	0.0250
25.00	0.0156	0.0218	0.0312
31.50	0.0197	0.0276	0.0394
40.00	0.0250	0.0350	0.0500
50.00	0.0313	0.0438	0.0626
63.00	0.0394	0.0552	0.0788
80.00	0.0500	0.0700	0.1000

Source: ISO 1989.

A3.10 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 events. It is improbable that such effects would result from routine subsonic aircraft operations.

A3.11 Noise Effects on Historical and Archaeological Sites

Historical buildings and sites can have elements that are more fragile than conventional structures. Aircraft noise may affect such sites more severely than newer, modern structures. In older structures, seemingly insignificant surface cracks caused 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 measurements of noise and vibration in a restored plantation house, originally built in 1795. It is located 1,500 feet from the centerline at the departure end of Runway 19L at Washington Dulles International Airport. The aircraft measured was the Concorde. 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 (Wesler 1977).

As for conventional structures, noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites. Unique sites should, of course, be analyzed for specific exposure.

A.3.12 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. Mancini et al. (1988), assert that the consequences that physiological effects may have on behavioral patterns are 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 1960s and 1970s 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 Mancini 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 overflowed 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 (Mancini 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 (Mancini 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. 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 Mancini et al. (1988) 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. Mancini et al. (1988) reported that the literature indicated that avian species may be more sensitive to aircraft noise than mammals.

A.3.12.1 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 (Mancini 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 (Cottreau 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 summarized 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. A similar study reported abortions occurred in three out of five pregnant cattle after exposing them to flyovers by six different aircraft. Another study suggested that feedlot cattle could stampede and injure themselves when exposed to low-level overflights (U.S. Air Force 1994a).

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 1-year time period and none were associated with aircraft disturbances (U.S. Air Force 1993). In 1987, researchers contacted seven livestock operators for production data, and no effects of low-altitude and supersonic flights were noted. Of the 43 cattle previously exposed to low-altitude flights, 3 showed a startle response to an F/A-18 aircraft flying overhead at 500 feet above ground level (AGL) and 400 knots by running less than 10 meters (m). They resumed normal activity within 1 minute (U.S. Air Force 1994a). Beyer (1983) found that helicopters caused more reaction than other low-aircraft overflights, and that the helicopters at 30-60 feet overhead did not affect milk production and pregnancies of 44 cows in a 1964 study (U.S. Air Force 1994a).

Additionally, Beyer (1983) 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. 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 1994a).

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 50-100 m), as animals take care not to damage themselves (U.S. Forest Service 1992). If animals are overflown by aircraft at altitudes of 50-100 m, 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 1994a). 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 100-135 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 (Gladwin et al. 1988; Mancini 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 feet) on domestic fowl, overflight activity has negligible effects (U.S. Air Force 1994b). 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 1994b). 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 1994b). 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 120-130 dB.

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. 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 1994b).

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. 1990). 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 1994b).

A.3.12.2 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. 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 (Mancini et al. 1988).

Mammals

Terrestrial Mammals

Studies of terrestrial mammals have shown that noise levels of 120 dB can damage mammals' ears, and levels at 95 dB 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 AGL over important grizzly and polar bear habitat. Wolves have been frightened by low-altitude flights that were 25-1,000 feet AGL. 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, rising 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-kilogram 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 (Weisenberger et al. 1996).

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, are 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 Mancini 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 dB caused a greater intensity of startle reactions than lower-intensity booms at 72-79 dB. However, the duration of the startle responses to louder sonic booms was shorter (Jehl and Cooper 1980).

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 Park 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. 1993).

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 1,000 to 5,000 Hz, 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 (Ellis et al. 1991; Grubb and King 1991). Threshold noise levels for significant responses range from 62 dB for Pacific black brant to 85 dB for crested tern (Brown 1990; Ward and Stehn 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 Mancini et al. 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

Mancini 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 cooperative study between the DOD and the U.S. Fish and Wildlife Service (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 m away and SELs were 70 dB.

Lynch and Speake (1978) studied the effects of both real and simulated sonic booms on the nesting and brooding eastern wild turkey 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 10-20 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 4-8 m). Afterward, the poults resumed feeding activities while the hens remained alert for a short period of time (approximately 15-20 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.

Raptors

In a literature review of raptor responses to aircraft noise, Mancini 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 re-occupancy. 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 (Ellis et al. 1991).

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 dB) 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 m 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 m, 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 (USFWS 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 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 (9 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.

Migratory Waterfowl

Fleming et al. (1996) conducted a study of caged American black ducks found 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 (Fleming et al. 1996).

Another study by Conomy et al. (1998) exposed previously unexposed ducks to 71 noise events per day that equaled or exceeded 80 dB. It was determined that the proportion of time black ducks reacted to aircraft activity and noise decreased from 38% to 6% in 17 days and remained stable at 5.8% 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 less than 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).

Wading and Shorebirds

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 dB 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% of the 220 observations. Approximately 90% displayed no reaction or merely looked toward the direction of the noise source. Another 6% stood up, 3% walked from the nest, and 2% 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 85-100 dB on approach and 94-105 dB 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, sooty terns 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 tern hatch failure.

Subsequent laboratory tests of exposure of eggs to sonic booms and other impulsive noises (Cottureau 1972; Cogger and Zegarra 1980; Bowles et al. 1991, 1994) failed to show adverse effects on hatching of eggs. A structural analysis by 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.

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 spadefoot toads, may be affected by noise. Limited information is available on the effects of short-duration noise events on reptiles. Dufour (1980) and Mancini 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. Crocodylians 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 crocodylians (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 a DNL of 85 dB.

A.3.12.3 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.

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APPENDIX B

FLORIDA STATUTE CHAPTER 475 AND SAMPLE DISCLOSURE POLICY LANGUAGE

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Select Year:

The 2017 Florida Statutes

[Title XXXII](#)
REGULATION OF PROFESSIONS
AND OCCUPATIONS

[Chapter 475](#)
REAL ESTATE BROKERS, SALES
ASSOCIATES, SCHOOLS, AND APPRAISERS

[View Entire
Chapter](#)

475.278 Authorized brokerage relationships; presumption of transaction brokerage; required disclosures.—

(1) **BROKERAGE RELATIONSHIPS.**—

(a) *Authorized brokerage relationships.*—A real estate licensee in this state may enter into a brokerage relationship as either a transaction broker or as a single agent with potential buyers and sellers. A real estate licensee may not operate as a disclosed or nondisclosed dual agent. As used in this section, the term “dual agent” means a broker who represents as a fiduciary both the prospective buyer and the prospective seller in a real estate transaction. This part does not prevent a licensee from changing from one brokerage relationship to the other as long as the buyer or the seller, or both, gives consent as required by subparagraph (3)(c)2. before the change and the appropriate disclosure of duties as provided in this part is made to the buyer or seller. This part does not require a customer to enter into a brokerage relationship with any real estate licensee.

(b) *Presumption of transaction brokerage.*—It shall be presumed that all licensees are operating as transaction brokers unless a single agent or no brokerage relationship is established, in writing, with a customer.

(2) **TRANSACTION BROKER RELATIONSHIP.**—A transaction broker provides a limited form of representation to a buyer, a seller, or both in a real estate transaction but does not represent either in a fiduciary capacity or as a single agent. The duties of the real estate licensee in this limited form of representation include the following:

- (a) Dealing honestly and fairly;
- (b) Accounting for all funds;
- (c) Using skill, care, and diligence in the transaction;
- (d) Disclosing all known facts that materially affect the value of residential real property and are not readily observable to the buyer;

(e) Presenting all offers and counteroffers in a timely manner, unless a party has previously directed the licensee otherwise in writing;

(f) Limited confidentiality, unless waived in writing by a party. This limited confidentiality will prevent disclosure that the seller will accept a price less than the asking or listed price, that the buyer will pay a price greater than the price submitted in a written offer, of the motivation of any party for selling or buying property, that a seller or buyer will agree to financing terms other than those offered, or of any other information requested by a party to remain confidential; and

(g) Any additional duties that are mutually agreed to with a party.

(3) **SINGLE AGENT RELATIONSHIP.**—

(a) *Single agent-duties.*—The duties of a real estate licensee owed to a buyer or seller who engages the real estate licensee as a single agent include the following:

1. Dealing honestly and fairly;
2. Loyalty;
3. Confidentiality;
4. Obedience;
5. Full disclosure;
6. Accounting for all funds;
7. Skill, care, and diligence in the transaction;
8. Presenting all offers and counteroffers in a timely manner, unless a party has previously directed the licensee otherwise in writing; and
9. Disclosing all known facts that materially affect the value of residential real property and are not readily observable.

(b) *Disclosure requirements.*—

1. *Single agent disclosure.*—Duties of a single agent must be fully described and disclosed in writing to a buyer or seller either as a separate and distinct disclosure document or included as part of another document such as a listing agreement or other agreement for representation. The disclosure must be made before, or at the time of, entering into a listing agreement or an agreement for representation or before the showing of property, whichever occurs first. When incorporated into other documents, the required notice must be of the same size type, or larger, as other provisions of the document and must be conspicuous in its placement so as to advise customers of the duties of a single agent, except that the first sentence of the information identified in paragraph (c) must be printed in uppercase and bold type.

2. *Transition to transaction broker disclosure.*—A single agent relationship may be changed to a transaction broker relationship at any time during the relationship between an agent and principal, provided the agent first obtains the principal’s written consent to the change in relationship. This disclosure must be in writing to the principal either as a separate and distinct document or included as part of other documents such as a listing agreement or other agreements for representation. When incorporated into other documents, the required notice must be of the same size type, or larger, as other provisions of the document and must be conspicuous in its placement so as to advise customers of the duties of limited representation, except that the first sentence of the information identified in subparagraph (c)2. must be printed in uppercase and bold type.

(c) *Contents of disclosure.*—

1. *Single agent duties disclosure.*—The notice required under subparagraph (b)1. must include the following information in the following form:

SINGLE AGENT NOTICE

FLORIDA LAW REQUIRES THAT REAL ESTATE LICENSEES OPERATING AS SINGLE AGENTS DISCLOSE TO BUYERS AND SELLERS THEIR DUTIES.

As a single agent, (insert name of Real Estate Entity and its Associates) owe to you the following duties:

1. Dealing honestly and fairly;
2. Loyalty;
3. Confidentiality;
4. Obedience;

5. Full disclosure;
6. Accounting for all funds;
7. Skill, care, and diligence in the transaction;
8. Presenting all offers and counteroffers in a timely manner, unless a party has previously directed the licensee otherwise in writing; and
9. Disclosing all known facts that materially affect the value of residential real property and are not readily observable.

Date

Signature

2. Transition disclosure.—To gain the principal’s written consent to a change in relationship, a licensee must use the following disclosure:

CONSENT TO TRANSITION TO
TRANSACTION BROKER

FLORIDA LAW ALLOWS REAL ESTATE LICENSEES WHO REPRESENT A BUYER OR SELLER AS A SINGLE AGENT TO CHANGE FROM A SINGLE AGENT RELATIONSHIP TO A TRANSACTION BROKERAGE RELATIONSHIP IN ORDER FOR THE LICENSEE TO ASSIST BOTH PARTIES IN A REAL ESTATE TRANSACTION BY PROVIDING A LIMITED FORM OF REPRESENTATION TO BOTH THE BUYER AND THE SELLER. THIS CHANGE IN RELATIONSHIP CANNOT OCCUR WITHOUT YOUR PRIOR WRITTEN CONSENT.

As a transaction broker, (insert name of Real Estate Firm and its Associates), provides to you a limited form of representation that includes the following duties:

1. Dealing honestly and fairly;
2. Accounting for all funds;
3. Using skill, care, and diligence in the transaction;
4. Disclosing all known facts that materially affect the value of residential real property and are not readily observable to the buyer;
5. Presenting all offers and counteroffers in a timely manner, unless a party has previously directed the licensee otherwise in writing;
6. Limited confidentiality, unless waived in writing by a party. This limited confidentiality will prevent disclosure that the seller will accept a price less than the asking or listed price, that the buyer will pay a price greater than the price submitted in a written offer, of the motivation of any party for selling or buying property, that a seller or buyer will agree to financing terms other than those offered, or of any other information requested by a party to remain confidential; and
7. Any additional duties that are entered into by this or by separate written agreement.

Limited representation means that a buyer or seller is not responsible for the acts of the licensee. Additionally, parties are giving up their rights to the undivided loyalty of the licensee. This aspect of limited representation allows a licensee to facilitate a real estate transaction by assisting both the buyer and the seller, but a licensee will not work to represent one party to the detriment of the other party when acting as a transaction broker to both parties.

I agree that my agent may assume the role and duties of a transaction broker. [must be initialed or signed]

(4) NO BROKERAGE RELATIONSHIP.—

(a) *No brokerage relationship-duties.*—A real estate licensee owes to a potential seller or buyer with whom the licensee has no brokerage relationship the following duties:

1. Dealing honestly and fairly;
2. Disclosing all known facts that materially affect the value of the residential real property which are not readily observable to the buyer; and
3. Accounting for all funds entrusted to the licensee.

(b) *Disclosure requirements.*—Duties of a licensee who has no brokerage relationship with a buyer or seller must be fully described and disclosed in writing to the buyer or seller. The disclosure must be made before the showing of property. When incorporated into other documents, the required notice must be of the same size type, or larger, as other provisions of the document and must be conspicuous in its placement so as to advise customers of the duties of a licensee that has no brokerage relationship with a buyer or seller, except that the first sentence of the information identified in paragraph (c) must be printed in uppercase bold type.

(c) *Contents of disclosure.*—The notice required under paragraph (b) must include the following information in the following form:

NO BROKERAGE RELATIONSHIP NOTICE

FLORIDA LAW REQUIRES THAT REAL ESTATE LICENSEES WHO HAVE NO BROKERAGE RELATIONSHIP WITH A POTENTIAL SELLER OR BUYER DISCLOSE THEIR DUTIES TO SELLERS AND BUYERS.

As a real estate licensee who has no brokerage relationship with you, (insert name of Real Estate Entity and its Associates) owe to you the following duties:

1. Dealing honestly and fairly;
2. Disclosing all known facts that materially affect the value of residential real property which are not readily observable to the buyer.
3. Accounting for all funds entrusted to the licensee.

(Date)

(Signature)

(5) APPLICABILITY.—

(a) *Residential sales.*—The real estate licensee disclosure requirements of this section apply to all residential sales. As used in this subsection, the term “residential sale” means the sale of improved residential property of four units or fewer, the sale of unimproved residential property intended for use of four units or fewer, or the sale of agricultural property of 10 acres or fewer.

(b) *Disclosure limitations.*—

1. The real estate disclosure requirements of this section do not apply when a licensee knows that the potential seller or buyer is represented by a single agent or a transaction broker; or when an owner is selling new residential units built by the owner and the circumstances or setting should reasonably inform the potential buyer that the owner’s employee or single agent is acting on behalf of the owner, whether because of the location of the sales office or because of office signage or placards or identification badges worn by the owner’s employee or single agent.

2. The real estate licensee disclosure requirements of this section do not apply to: nonresidential transactions; the rental or leasing of real property, unless an option to purchase all or a portion of the property improved with four or fewer residential units is given; a bona fide “open house” or model home

showing that does not involve eliciting confidential information, the execution of a contractual offer or an agreement for representation, or negotiations concerning price, terms, or conditions of a potential sale; unanticipated casual conversations between a licensee and a seller or buyer which do not involve eliciting confidential information, the execution of a contractual offer or agreement for representation, or negotiations concerning price, terms, or conditions of a potential sale; responding to general factual questions from a potential buyer or seller concerning properties that have been advertised for sale; situations in which a licensee's communications with a potential buyer or seller are limited to providing general factual information, oral or written, about the qualifications, background, and services of the licensee or the licensee's brokerage firm; auctions; appraisals; and dispositions of any interest in business enterprises or business opportunities, except for property with four or fewer residential units.

History.—s. 3, ch. 97-42; s. 12, ch. 98-250; s. 9, ch. 99-384; s. 2, ch. 2000-198; s. 36, ch. 2003-164; s. 79, ch. 2004-5; s. 5, ch. 2006-210; s. 13, ch. 2009-20.

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Sample Disclosure Policy Language

Note: The sample policy language may be drafted to recognize, or not recognize, the AICUZ and its associated noise contours and accident potential zones (APZs).

At all real estate closings involving a property in an accident potential zone (APZ) or noise zone (or Military Installation Area of Impact), the buyer, seller, and witnesses shall sign the following form, which shall be filed with the deed and/or plat at the County Register of Deeds Office.

Military Installation Area of Impact Disclosure Form

The property at _____ (address/location) is located in proximity to Naval Air Station Key West, Monroe County, Florida. Monroe County (County) determined that persons on the premises may be exposed to accident potentials and/or significant noise levels as a result of military air operations. The County has established certain noise zones and APZs (or a Military Installation Area of Impact Overlay) within its land development regulations.

The above property is located in Noise Zone _____ and in Accident Potential Zone _____.

The County has placed certain restrictions on the development and use of property within these areas. Before purchasing the above property, you should consult the County Growth Management Division to determine the restrictions that have been placed on the subject property.

Certification

A. Property Owner

As the owner of the subject property, I hereby certify that I have informed _____, as a prospective purchaser, that the subject property is located in the Monroe County Military Installation Area of Impact Overlay district.

Dated this _____ day of _____, _____.

Witness _____ Owner _____

As a prospective purchaser of the subject property, I hereby certify that I have been informed that the subject property is in a Military Installation Area of Impact Overlay district, and I have consulted with the County to determine the restrictions that have been placed on the subject property.

Dated this _____ day of _____, _____.

Witness _____ Purchaser _____

B. Lessee

All prospective renters signing a commercial or residential lease shall be notified by the property owner through a written provision contained in the lease agreement if

the leased property is located within the Military Installation Area of Impact Overlay district.

C. Subdivision Plats, Planned Unit Development Plats, Townhouse Plats and/or Condominium Documents

All subdivision plats, planned unit development plats, townhouse plats, and /or condominium documents shall contain the following disclosure statement:

Military Installation Area of Impact Overlay Disclosure Statement

This property lies within a Military Installation Area of Impact Overlay District, which applies to property in proximity to the Naval Air Station Key West, Monroe County, Florida. Monroe County has determined that persons on the premises may be exposed to accident potentials and/or significant noise levels as a result of the airport operations. Purchasers are required to sign a Disclosure Form and file the form with the deed and/or plat at the Monroe County Register of Deeds Office. All or a portion of this property lies within:

Accident Potential Zone: _____

Noise Zone: _____ DNL (Day-Night Average Sound Level): _____

D. New Construction

In the case of new construction, a signed Military Installation Area of Impact Overlay Disclosure Statement shall accompany the building permit application.

(Ord. No. XXXXXXXXXXXXX)

APPENDIX C

FLORIDA STATUTE CHAPTER 163.3175 LEGISLATIVE FINDINGS ON COMPATIBILITY OF DEVELOPMENT WITH MILITARY INSTALLATIONS

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Select Year:

The 2017 Florida Statutes

[Title XI](#)

COUNTY ORGANIZATION AND INTERGOVERNMENTAL RELATIONS

[Chapter 163](#)

INTERGOVERNMENTAL PROGRAMS

[View Entire Chapter](#)

163.3175 Legislative findings on compatibility of development with military installations; exchange of information between local governments and military installations.—

(1) The Legislature finds that incompatible development of land close to military installations can adversely affect the ability of such an installation to carry out its mission. The Legislature further finds that such development also threatens the public safety because of the possibility of accidents occurring within the areas surrounding a military installation. In addition, the economic vitality of a community is affected when military operations and missions must relocate because of incompatible urban encroachment. Therefore, the Legislature finds it desirable for the local governments in the state to cooperate with military installations to encourage compatible land use, help prevent incompatible encroachment, and facilitate the continued presence of major military installations in this state.

(2) Certain major military installations, due to their mission and activities, have a greater potential for experiencing compatibility and coordination issues than others. Consequently, this section and the provisions in s. [163.3177\(6\)\(a\)](#), relating to compatibility of land development with military installations, apply to specific affected local governments in proximity to and in association with specific military installations, as follows:

- (a) Avon Park Air Force Range, associated with Highlands, Okeechobee, Osceola, and Polk Counties and Avon Park, Sebring, and Frostproof.
 - (b) Camp Blanding, associated with Clay, Bradford, and Putnam Counties.
 - (c) Eglin Air Force Base and Hurlburt Field, associated with Gulf, Okaloosa, Santa Rosa, and Walton Counties and Cinco Bayou, Crestview, Destin, DeFuniak Springs, Fort Walton Beach, Freeport, Laurel Hill, Mary Esther, Niceville, Shalimar, and Valparaiso.
 - (d) Homestead Air Reserve Base, associated with Miami-Dade County and Homestead.
 - (e) Jacksonville Training Range Complex, associated with Lake, Marion, Putnam, and Volusia Counties.
 - (f) MacDill Air Force Base, associated with Tampa.
 - (g) Naval Air Station Jacksonville, Marine Corps Support Facility-Blount Island, and outlying landing field Whitehouse, associated with Jacksonville.
 - (h) Naval Air Station Key West, associated with Monroe County and Key West.
 - (i) Naval Support Activity Panama City, associated with Bay County, Panama City, and Panama City Beach.
 - (j) Naval Air Station Pensacola, associated with Escambia County.
 - (k) Naval Air Station Whiting Field and its outlying landing fields, associated with Santa Rosa and Escambia Counties.
 - (l) Naval Station Mayport, associated with Atlantic Beach and Jacksonville.
 - (m) Patrick Air Force Base and Cape Canaveral Air Force Station, associated with Brevard County and Satellite Beach.
 - (n) Tyndall Air Force Base, associated with Bay County and Mexico Beach and Parker.
- (3) The Florida Defense Support Task Force may recommend to the Legislature changes to the military installations and local governments specified in subsection (2) based on a military base's potential for impacts from encroachment, and incompatible land uses and development.
- (4) Each affected local government must transmit to the commanding officer of the relevant associated installation or installations information relating to proposed changes to comprehensive plans, plan amendments, and proposed changes to land development regulations which, if approved, would affect the intensity, density, or use of the land adjacent to or in close proximity to the military installation. At the request of the commanding officer, affected local governments must also transmit to the commanding officer copies of applications for development orders requesting a variance or waiver from height or lighting restrictions or noise attenuation reduction requirements within areas defined in the local government's comprehensive plan as being in a zone of influence of the military installation. Each affected local government shall provide the military installation an opportunity to review and comment on the proposed changes.
- (5) The commanding officer or his or her designee may provide advisory comments to the affected local government on the impact such proposed changes may have on the mission of the military installation. Such advisory comments shall be based on appropriate data and analyses provided with the comments and may include:
- (a) If the installation has an airfield, whether such proposed changes will be incompatible with the safety and noise standards contained in the Air Installation Compatible Use Zone (AICUZ) adopted by the military installation for that airfield;
 - (b) Whether such changes are incompatible with the Installation Environmental Noise Management Program (IENMP) of the United States Army;
 - (c) Whether such changes are incompatible with the findings of a Joint Land Use Study (JLUS) for the area if one has been completed; and
 - (d) Whether the military installation's mission will be adversely affected by the proposed actions of the county or affected local government.

The commanding officer's comments, underlying studies, and reports shall be considered by the local government in the same manner as the comments received from other reviewing agencies pursuant to s. [163.3184](#).

(6) The affected local government shall take into consideration any comments and accompanying data and analyses provided by the commanding officer or his or her designee pursuant to subsection (4) as they relate to the strategic mission of the base, public safety, and the economic vitality associated with the base's operations, while also respecting private property rights and not being unduly restrictive on those rights. The affected local government shall forward a copy of any comments regarding comprehensive plan amendments to the state land planning agency.

(7) To facilitate the exchange of information provided for in this section, a representative of a military installation acting on behalf of all military installations within that jurisdiction shall serve ex officio as a nonvoting member of the county's or affected local government's land planning or zoning board. The representative is not required to file a statement of financial interest pursuant to s. [112.3145](#) solely due to his or her service on the county's or affected local government's land planning or zoning board.

(8) The commanding officer is encouraged to provide information about any community planning assistance grants that may be available to a county or affected local government through programs such as those of the federal Office of Economic Adjustment as an incentive for communities to participate in a joint planning process that would facilitate the compatibility of community planning and the activities and mission of the military installation.

History.—s. 1, ch. 2004-230; s. 1, ch. 2010-182; s. 11, ch. 2011-139; s. 1, ch. 2012-98; s. 3, ch. 2012-99; s. 2, ch. 2012-159; s. 1, ch. 2015-30; s. 2, ch. 2016-148.

APPENDIX D

REAL ESTATE EASEMENTS BOCA CHICA KEY

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275154

REC 856-1529

EASEMENT DEED

KNOW ALL MEN BY THESE PRESENTS:

THAT L. E. Davis of _____

Longwood, Florida

M, hereinafter called the Grantor, for and in consideration of the sum of One Dollar (\$1.00), the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed and by these presents does grant, bargain, sell and convey unto the United States of America and its assigns, hereinafter called the Government, an easement in perpetuity for the establishment, maintenance, operation and use of a compatible use zone in connection with the operation of the Naval Air Station, Key West, Florida in, upon, over and across that parcel of land situate in Monroe County, Florida, hereinafter called the Premises, more particularly described as follows:

A parcel of land lying and being in the County of Monroe, State of Florida, as recorded in Official Records Book 93 at Page 407 of the Public Boards of Monroe County, Florida, being more particularly described as follows:

DS Paid 45¢ Date 6-22-82

MONROE COUNTY

RALPH WHITE, CLERK OF CIR. CT.,

By Marie Bethel D.C.

All of Government Lots 2 and 3 of Section 19, Township 67 South, Range 26 East, Monroe County, Florida;

Containing 122.75 acres more or less.

BY THIS GRANT OF EASEMENT the Grantor, for itself, (its heirs, successors, and assigns, as appropriate) covenants, as a covenant running with the Premises, that:

I. It will not use or permit use of the premises for the construction of dwellings or habitable facilities or for any purpose that is not included in the following list of Compatible Land Uses:

- Food and Kindred Product Manufacturing
- Textile Mill Products Manufacturing
- Apparel and other finished products made from Fabrics
- Leather and Simulated Materials Manufacturing
- Lumber and Wood products Manufacturing
- Furniture and Fixtures Manufacturing
- Paper and Allied Products Manufacturing
- Printing and Publishing Industry
- Chemicals and Allied Products Manufacturing
- Rubber and Miscellaneous Plastic Products Manufacturing
- Stone, Clay and Glass Products Manufacturing
- Primary Metal Industries
- Fabricated Metal Product Manufacturing
- Railroad and Rapid Rail Transit
- Motor Vehicle Transportation
- Marine Craft Transportation
- Highway and Street Right of Way
- Automobile Parking
- Transportation and Utilities
- Agricultural and Agricultural Related Activities
- Forestry Activities and Related Services
- Fishing Activities and Related Services

MONROE COUNTY FLORIDA

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- Mining Activities and Related Services
- Noncommercial Forest Development
- Wholesale Trade
- Retail Trade of Building Materials, General Merchandise,
Goods, Autos, Marine, Aircraft, Apparel and Accessories,
Furniture, Home Furnishings and Equipment, Eating and
Drinking
- Finance, Insurance & Real Estate Services
- Personal Services
- Business Services
- Repair Services
- Professional Services
- Contract Construction Services
- Outdoor Amusements
- Sports Activities
- Water Based Activities
- Playgrounds and Neighborhood Parks
- Community Parks

2. No man made or natural obstructions, including structures and trees, shall be constructed or permitted to grow so as to extend more than 116 feet above mean sea level and any such obstructions which extend above 116 feet above mean sea level shall be altered, trimmed, cut or otherwise removed by the Grantor. Provided, however, if the Grantor should fail to do so, the Government may in behalf of and at the expense of the Grantor effect such removal by the use of the Government forces or by contract, and in doing so shall have the right to salvage, sell, dispose of, or abandon in place any and all of the man made or natural obstructions so removed without liability to the Government.

3. All buildings on the premises will be designed, constructed, and equipped to reduce the noise level in the interior of the building 25 db below the external noise levels during aircraft operations.

4. The Government shall have the right of ingress and egress to, from and across the Premises at reasonable times and upon reasonable notice, to determine and insure compliance with the above covenant.

5. The easement herein granted is subject to all existing easements and rights of way for public roads and highways, public utilities, railroads and pipelines.

6. The Grantor reserves to itself, (its heirs, successors and assigns, as appropriate) all such rights and privileges in the Premises that do not interfere with, limit, or abridge the rights granted the Government and its assigns, hereunder, specifically reserving to the Grantor (its heirs, successors and assigns, as appropriate) the right and privilege to use, construct upon, and develop the Premises for those purposes, and those purposes only, which are specified in paragraph 1. above and within the height restrictions as set forth in paragraph 2. above.

This easement is granted subject to the condition that this easement shall cease and be terminated upon the written determination by the Government that it is no longer required for Government purposes.

IN WITNESS WHEREOF, the Grantor has caused this Easement Deed to be duly executed this 26th day of March, 1982

WITNESS:

GRANTOR

Suzy Sowinski
Christine Cantell

Lyman Eugene Davis

STATE OF Florida)
COUNTY OF Seminole)

PERSONALLY appeared before me LYMAN EUGENE DAVIS and made oath that he/she saw the within named LYMAN EUGENE DAVIS, sign, seal, and as their act and deed deliver the within written Easement and that he/she along with SUZY SOWINSKY witnessed the execution thereof.

Christine Cantell

SWORN TO before me this

26th day of March, 1982

Christine Cantell
Notary Public

Notary Public, State of Florida at Large
My Commission Expires: My Commission Expires February 12, 1984

This instrument was prepared by Kelly S. Hodge, Assistant Counsel for the Southern Division, Naval Facilities Engineering Command, P.O. Box 10068, Charleston, S.C. 29411

RECORDED IN OFFICIAL RECORDS BOOK OF SEMINOLE COUNTY, FLORIDA. REC'D VERIFIED RALPH W. WHITE CLERK CIRCUIT COURT

275155

EASEMENT DEED

KNOW ALL MEN BY THESE PRESENTS:

THAT Charleston Capital Corporation, by Henry Yaschik, President of _____
Charleston, South Carolina

_____, hereinafter called the Grantor, for and in consideration of the sum of One Dollar (\$1.00), the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed and by these presents does grant, bargain, sell and convey unto the United States of America and its assigns, hereinafter called the Government, an easement in perpetuity for the establishment, maintenance, operation and use of a compatible use zone in connection with the operation of the Naval Air Station, Key West, Florida in, upon, over and across that parcel of land situate in Monroe County, Florida, hereinafter called the Premises, more particularly described as follows:

A parcel of land lying and being in the County of Monroe, State of Florida, as recorded in Official Records Book 93 at Page 407 of the Public Boards of Monroe County, Florida, being more particularly described as follows:

DS Paid 45¢ Date 6-22-82
MONROE COUNTY

RALPH WHITE, CLERK OF CIR. CT.,
By Maria Bethel D.C.

All of Government Lots 2 and 3 of Section 19, Township 67 South, Range 26 East, Monroe County, Florida;

Containing 122.75 acres more or less.

BY THIS GRANT OF EASEMENT the Grantor, for itself, (its heirs, successors, and assigns, as appropriate) covenants, as a covenant running with the Premises, that:

1. It will not use or permit use of the premises for the construction of dwellings or habitable facilities or for any purpose that is not included in the following list of Compatible Land Uses:

- Food and Kindred Product Manufacturing
- Textile Mill Products Manufacturing
- Apparel and other finished products made from Fabrics, Leather and Simulated Materials Manufacturing
- Lumber and Wood products Manufacturing
- Furniture and Fixtures Manufacturing
- Paper and Allied Products Manufacturing
- Printing and Publishing Industry
- Chemicals and Allied Products Manufacturing
- Rubber and Miscellaneous Plastic Products Manufacturing
- Stone, Clay and Glass Products Manufacturing
- Primary Metal Industries
- Fabricated Metal Product Manufacturing
- Railroad and Rapid Rail Transit
- Motor Vehicle Transportation
- Marine Craft Transportation
- Highway and Street Right of Way
- Automobile Parking
- Transportation and Utilities
- Agricultural and Agricultural Related Activities
- Forestry Activities and Related Services
- Fishing Activities and Related Services

FILED FOR RECORD
MONROE COUNTY FLORIDA

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FILED FOR RECORD

OFF REC. 856-1533

- Mining Activities and Related Services
- Noncommercial Forest Development
- Wholesale Trade
- Retail Trade of Building Materials, General Merchandise,
Goods, Autos, Marine, Aircraft, Apparel and Accessories,
Furniture, Home Furnishings and Equipment, Eating and
Drinking
- Finance, Insurance & Real Estate Services
- Personal Services
- Business Services
- Repair Services
- Professional Services
- Contract Construction Services
- Outdoor Amusements
- Sports Activities
- Water Based Activities
- Playgrounds and Neighborhood Parks
- Community Parks

2. No man made or natural obstructions, including structures and trees, shall be constructed or permitted to grow so as to extend more than 116 feet above mean sea level and any such obstructions which extend above 116 feet above mean sea level shall be altered, trimmed, cut or otherwise removed by the Grantor. Provided, however, if the Grantor should fail to do so, the Government may in behalf of and at the expense of the Grantor effect such removal by the use of the Government forces or by contract, and in doing so shall have the right to salvage, sell, dispose of, or abandon in place any and all of the man made or natural obstructions so removed without liability to the Government.

3. All buildings on the premises will be designed, constructed, and equipped to reduce the noise level in the interior of the building 25 db below the external noise levels during aircraft operations.

4. The Government shall have the right of ingress and egress to, from and across the Premises at reasonable times and upon reasonable notice, to determine and insure compliance with the above covenant.

5. The easement herein granted is subject to all existing easements and rights of way for public roads and highways, public utilities, railroads and pipelines.

6. The Grantor reserves to itself, (its heirs, successors and assigns, as appropriate) all such rights and privileges in the Premises that do not interfere with, limit, or abridge the rights granted the Government and its assigns, hereunder, specifically reserving to the Grantor (its heirs, successors and assigns, as appropriate) the right and privilege to use, construct upon, and develop the Premises for those purposes, and those purposes only, which are specified in paragraph 1. above and within the height restrictions as set forth in paragraph 2. above.

This easement is granted subject to the condition that this easement shall cease and be terminated upon the written determination by the Government that it is no longer required for Government purposes.

IN WITNESS WHEREOF, the Grantor has caused this Easement Deed to be duly executed this 30th day of March, 1982

WITNESS:

GRANTOR

Nancy Schnebelen
Mary Harman

Henry Yaschik
President, Charleston Capital Corp.

STATE OF South Carolina)
COUNTY OF Charleston)

PERSONALLY appeared before me Nancy Schnebelen and made oath that ~~he~~/she saw the within named Henry Yaschik, President of Charleston Capital Corp., sign, seal, and as their act and deed deliver the within written Easement and that he/she along with Mary Harman witnessed the execution thereof.

Nancy Schnebelen

SWORN TO before me this 30 day of March, 1982

Mary Harman
Notary Public
MY COMMISSION EXPIRES MAY 27, 1990.
My Commission Expires: _____

RECORDED IN OFFICIAL RECORDS BOOK
OF BAYSIDE COUNTY, FLORIDA.
RECORD VERIFIED
RALPH W. WHITE
CLERK CIRCUIT COURT

This instrument was prepared by Kelly S. Hodge, Assistant Counsel for the Southern Division, Naval Facilities Engineering Command, P.O. Box 10068, Charleston, S.C. 29411

EASEMENT DEED

KNOW ALL MEN BY THESE PRESENTS:

275156

THAT Edward D. Soady of _____

Jacksonville, Florida

_____, hereinafter called the Grantor, for and in consideration of the sum of One Dollar (\$1.00), the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed and by these presents does grant, bargain, sell and convey unto the United States of America and its assigns, hereinafter called the Government, an easement in perpetuity for the establishment, maintenance, operation and use of a compatible use zone in connection with the operation of the Naval Air Station, Key West, Florida in, upon, over and across that parcel of land situate in Monroe County, Florida, hereinafter called the Premises, more particularly described as follows:

A parcel of land lying and being in the County of Monroe, State of Florida, as recorded in Official Records Book 93 at Page 407 of the Public Boards of Monroe County, Florida, being more particularly described as follows:

DS Paid 454 Date 6-22-82
MONROE COUNTY
RALPH WHITE, CLERK OF CIR. CT.
BY [Signature]

All of Government Lots 2 and 3 of Section 19, Township 67 South, Range 26 East, Monroe County, Florida;

Containing 122.75 acres more or less.

BY THIS GRANT OF EASEMENT the Grantor, for itself, (its heirs, successors, and assigns, as appropriate) covenants, as a covenant running with the Premises, that:

1. It will not use or permit use of the premises for the construction of dwellings or habitable facilities or for any purpose that is not included in the following list of Compatible Land Uses:

- Food and Kindred Product Manufacturing
- Textile Mill Products Manufacturing
- Apparel and other finished products made from Fabrics, Leather and Simulated Materials Manufacturing
- Lumber and Wood products Manufacturing
- Furniture and Fixtures Manufacturing
- Paper and Allied Products Manufacturing
- Printing and Publishing Industry
- Chemicals and Allied Products Manufacturing
- Rubber and Miscellaneous Plastic Products Manufacturing
- Stone, Clay and Glass Products Manufacturing
- Primary Metal Industries
- Fabricated Metal Product Manufacturing
- Railroad and Rapid Rail Transit
- Motor Vehicle Transportation
- Marine Craft Transportation
- Highway and Street Right of Way
- Automobile Parking
- Transportation and Utilities
- Agricultural and Agricultural Related Activities
- Forestry Activities and Related Services
- Fishing Activities and Related Services

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JUL 22 1982
MONROE COUNTY, FLORIDA

Mining Activities and Related Services
 Noncommercial Forest Development
 Wholesale Trade
 Retail Trade of Building Materials, General Merchandise,
 Goods, Autos, Marine, Aircraft, Apparel and Accessories,
 Furniture, Home Furnishings and Equipment, Eating and
 Drinking
 Finance, Insurance & Real Estate Services
 Personal Services
 Business Services
 Repair Services
 Professional Services
 Contract Construction Services
 Outdoor Amusements
 Sports Activities
 Water Based Activities
 Playgrounds and Neighborhood Parks
 Community Parks

2. No man made or natural obstructions, including structures and trees, shall be constructed or permitted to grow so as to extend more than 116 feet above mean sea level and any such obstructions which extend above 116 feet above mean sea level shall be altered, trimmed, cut or otherwise removed by the Grantor. Provided, however, if the Grantor should fail to do so, the Government may in behalf of and at the expense of the Grantor effect such removal by the use of the Government forces or by contract, and in doing so shall have the right to salvage, sell, dispose of, or abandon in place any and all of the man made or natural obstructions so removed without liability to the Government.

3. All buildings on the premises will be designed, constructed, and equipped to reduce the noise level in the interior of the building 25 db below the external noise levels during aircraft operations.

4. The Government shall have the right of ingress and egress to, from and across the Premises at reasonable times and upon reasonable notice, to determine and insure compliance with the above covenant.

5. The easement herein granted is subject to all existing easements and rights of way for public roads and highways, public utilities, railroads and pipelines.

6. The Grantor reserves to itself, (its heirs, successors and assigns, as appropriate) all such rights and privileges in the Premises that do not interfere with, limit, or abridge the rights granted the Government and its assigns, hereunder, specifically reserving to the Grantor (its heirs, successors and assigns, as appropriate) the right and privilege to use, construct upon, and develop the Premises for those purposes, and those purposes only, which are specified in paragraph 1. above and within the height restrictions as set forth in paragraph 2. above.

This easement is granted subject to the condition that this easement shall cease and be terminated upon the written determination by the Government that it is no longer required for Government purposes.

IN WITNESS WHEREOF, the Grantor has caused this Easement Deed to be duly executed this 9th day of April, 1982

WITNESS:

GRANTOR

Patrick R. London Edward O. Seady

STATE OF Florida)
COUNTY OF Duval)

PERSONALLY appeared before me Marilyn J. Crowe and made oath that he/she saw the within named Edward O. Seady, sign, seal, and as their act and deed deliver the within written Easement and that he/she along with Patrick R. London witnessed the execution thereof.

Marilyn J. Crowe

SWORN TO before me this

9th day of April, 1982

Marilyn J. Crowe
Notary Public

NOTARY PUBLIC STATE OF FLORIDA AT LARGE
MY COMMISSION EXPIRES FEB. 11 1983
My Commission Expires: ~~EXPIRES THRU GENERAL INS. UNDERWRITERS~~

RECORDED IN OFFICIAL RECORDS BOOK
OF DUVAL COUNTY, FLORIDA
RECORD VERIFIED
RALPH W. WHITE
CLERK CIRCUIT COURT

This instrument was prepared by
Kelly S. Hodge, Assistant Counsel
for the Southern Division, Naval
Facilities Engineering Command,
P.O. Box 10068, Charleston, S.C. 29411

EASEMENT DEED

KNOW ALL MEN BY THESE PRESENTS:

Landmark First National Bank of Fort Lauderdale,

THAT as Trustee of Ruth B. Hodges Marital Trust of _____

U/W

Fort Lauderdale, Florida

_____, hereinafter called the Grantor, for and in consideration of the sum of One Dollar (\$1.00), the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed and by these presents does grant, bargain, sell and convey unto the United States of America and its assigns, hereinafter called the Government, an easement in perpetuity for the establishment, maintenance, operation and use of a compatible use zone in connection with the operation of the Naval Air Station, Key West, Florida in, upon, over and across that parcel of land situate in Monroe County, Florida, hereinafter called the Premises, more particularly described as follows:

A parcel of land lying and being in the County of Monroe, State of Florida, as recorded in Official Records Book 93 at Page 407 of the Public Books of Monroe County, Florida, being more particularly described as follows:

DS Paid 45¢ Date 6-22-82
MONROE COUNTY
RALPH WHITE, CLERK OF CIR. CT.
By Marie Bethel D.C.

All of Government Lots 2 and 3 of Section 19, Township 67 South, Range 26 East, Monroe County, Florida;

Containing 122.75 acres more or less.

BY THIS GRANT OF EASEMENT the Grantor, for itself, (its heirs, successors, and assigns, as appropriate) covenants, as a covenant running with the Premises, that:

I. It will not use or permit use of the premises for the construction of dwellings or habitable facilities or for any purpose that is not included in the following list of Compatible Land Uses:

- Food and Kindred Product Manufacturing
- Textile Mill Products Manufacturing
- Apparel and other finished products made from Fabrics,
- Leather and Simulated Materials Manufacturing
- Lumber and Wood products Manufacturing
- Furniture and Fixtures Manufacturing
- Paper and Allied Products Manufacturing
- Printing and Publishing Industry
- Chemicals and Allied Products Manufacturing
- Rubber and Miscellaneous Plastic Products Manufacturing
- Stone, Clay and Glass Products Manufacturing
- Primary Metal Industries
- Fabricated Metal Product Manufacturing
- Railroad and Rapid Rail Transit
- Motor Vehicle Transportation
- Marine Craft Transportation
- Highway and Street Right of Way
- Automobile Parking
- Transportation and Utilities
- Agricultural and Agricultural Related Activities
- Forestry Activities and Related Services
- Fishing Activities and Related Services

MONROE COUNTY, FLORIDA

82 JUN 22 P 3:55

Mining Activities and Related Services
 Noncommercial Forest Development
 Wholesale Trade
 Retail Trade of Building Materials, General Merchandise,
 Goods, Autos, Marine, Aircraft, Apparel and Accessories,
 Furniture, Home Furnishings and Equipment, Eating and
 Drinking
 Finance, Insurance & Real Estate Services
 Personal Services
 Business Services
 Repair Services
 Professional Services
 Contract Construction Services
 Outdoor Amusements
 Sports Activities
 Water Based Activities
 Playgrounds and Neighborhood Parks
 Community Parks

2. No man made or natural obstructions, including structures and trees, shall be constructed or permitted to grow so as to extend more than 116 feet above mean sea level and any such obstructions which extend above 116 feet above mean sea level shall be altered, trimmed, cut or otherwise removed by the Grantor. Provided, however, if the Grantor should fail to do so, the Government may in behalf of and at the expense of the Grantor effect such removal by the use of the Government forces or by contract, and in doing so shall have the right to salvage, sell, dispose of, or abandon in place any and all of the man made or natural obstructions so removed without liability to the Government.

3. All buildings on the premises will be designed, constructed, and equipped to reduce the noise level in the interior of the building 25 db below the external noise levels during aircraft operations.

4. The Government shall have the right of ingress and egress to, from and across the Premises at reasonable times and upon reasonable notice, to determine and insure compliance with the above covenant.

5. The easement herein granted is subject to all existing easements and rights of way for public roads and highways, public utilities, railroads and pipelines.

6. The Grantor reserves to itself, (its heirs, successors and assigns, as appropriate) all such rights and privileges in the Premises that do not interfere with, limit, or abridge the rights granted the Government and its assigns, hereunder, specifically reserving to the Grantor (its heirs, successors and assigns, as appropriate) the right and privilege to use, construct upon, and develop the Premises for those purposes, and those purposes only, which are specified in paragraph 1. above and within the height restrictions as set forth in paragraph 2. above.

This easement is granted subject to the condition that this easement shall cease and be terminated upon the written determination by the Government that it is no longer required for Government purposes.

IN WITNESS WHEREOF, the Grantor has caused this Easement Deed to be duly executed this 26th day of March, 1982

WITNESS:

GRANTOR

Bonnie J. Sorrentino
Louise Shaffer

Robert Schneider
Robert Schneider Vice Pres. & Trust Officer

STATE OF FLORIDA)
COUNTY OF BROWARD)

PERSONALLY appeared before me Bonnie J. Sorrentino and made oath that he/she saw the within named Robert Schneider Vice Pres. & Trust Officer, sign, seal, and as their act and deed deliver the within written Easement and that he/she along with Louise Shaffer witnessed the execution thereof.

George J. Stewart

SWORN TO before me this

26 day of March, 1982

Notary Public, State of Florida at Large
My Commission Expires Sept. 4, 1984

Notary Public

My Commission Expires: _____

RECORDED IN OFFICIAL RECORDS BOOK
OF BROWARD COUNTY, FLORIDA.
RECORD VERIFIED
RALPH W. WHITE
CLERK CIRCUIT COURT

This instrument was prepared by Kelly S. Hodge, Assistant Counsel for the Southern Division, Naval Facilities Engineering Command, P.O. Box 10068, Charleston, S.C. 29411

275158

OFF REC. 856pc1541

10 AS

EASEMENT DEED

KNOW ALL MEN BY THESE PRESENTS:

THAT D. W. Smoak of Fort Lauderdale, Florida

hereinafter called the Grantor, for and in consideration of the sum of One Dollar (\$1.00), the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed and by these presents does grant, bargain, sell and convey unto the United States of America and its assigns, hereinafter called the Government, an easement in perpetuity for the establishment, maintenance, operation and use of a compatible use zone in connection with the operation of the Naval Air Station, Key West, Florida in, upon, over and across that parcel of land situate in Monroe County, Florida, hereinafter called the Premises, more particularly described as follows:

A parcel of land lying and being in the County of Monroe, State of Florida, as recorded in Official Records Book 93 at Page 407 of the Public Boards of Monroe County, Florida, being more particularly described as follows:

DS Paid 454 Date 6-22-82

MONROE COUNTY

RALPH WHITE, CLERK OF CIR. CT.,

By Maria Bettel D.C.

All of Government Lots 2 and 3 of Section 19, Township 67 South, Range 26 East, Monroe County, Florida;

Containing 122.75 acres more or less.

BY THIS GRANT OF EASEMENT the Grantor, for itself, (its heirs, successors, and assigns, as appropriate) covenants, as a covenant running with the Premises, that:

I. It will not use or permit use of the premises for the construction of dwellings or habitable facilities or for any purpose that is not included in the following list of Compatible Land Uses:

- Food and Kindred Product Manufacturing
- Textile Mill Products Manufacturing
- Apparel and other finished products made from Fabrics, Leather and Simulated Materials Manufacturing
- Lumber and Wood products Manufacturing
- Furniture and Fixtures Manufacturing
- Paper and Allied Products Manufacturing
- Printing and Publishing Industry
- Chemicals and Allied Products Manufacturing
- Rubber and Miscellaneous Plastic Products Manufacturing
- Stone, Clay and Glass Products Manufacturing
- Primary Metal Industries
- Fabricated Metal Product Manufacturing
- Railroad and Rapid Rail Transit
- Motor Vehicle Transportation
- Marine Craft Transportation
- Highway and Street Right of Way
- Automobile Parking
- Transportation and Utilities
- Agricultural and Agricultural Related Activities
- Forestry Activities and Related Services
- Fishing Activities and Related Services

Official Court of Florida

82 JUN 22 P 3:55

(1)

Mining Activities and Related Services
Noncommercial Forest Development
Wholesale Trade
Retail Trade of Building Materials, General Merchandise,
Goods, Autos, Marine, Aircraft, Apparel and Accessories,
Furniture, Home Furnishings and Equipment, Eating and
Drinking
Finance, Insurance & Real Estate Services
Personal Services
Business Services
Repair Services
Professional Services
Contract Construction Services
Outdoor Amusements
Sports Activities
Water Based Activities
Playgrounds and Neighborhood Parks
Community Parks

2. No man made or natural obstructions, including structures and trees, shall be constructed or permitted to grow so as to extend more than 116 feet above mean sea level and any such obstructions which extend above 116 feet above mean sea level shall be altered, trimmed, cut or otherwise removed by the Grantor. Provided, however, if the Grantor should fail to do so, the Government may in behalf of and at the expense of the Grantor effect such removal by the use of the Government forces or by contract, and in doing so shall have the right to salvage, sell, dispose of, or abandon in place any and all of the man made or natural obstructions so removed without liability to the Government.

3. All buildings on the premises will be designed, constructed, and equipped to reduce the noise level in the interior of the building 25 db below the external noise levels during aircraft operations.

4. The Government shall have the right of ingress and egress to, from and across the Premises at reasonable times and upon reasonable notice, to determine and insure compliance with the above covenant.

5. The easement herein granted is subject to all existing easements and rights of way for public roads and highways, public utilities, railroads and pipelines.

6. The Grantor reserves to itself, (its heirs, successors and assigns, as appropriate) all such rights and privileges in the Premises that do not interfere with, limit, or abridge the rights granted the Government and its assigns, hereunder, specifically reserving to the Grantor (its heirs, successors and assigns, as appropriate) the right and privilege to use, construct upon, and develop the Premises for those purposes, and those purposes only, which are specified in paragraph 1. above and within the height restrictions as set forth in paragraph 2. above.

This easement is granted subject to the condition that this easement shall cease and be terminated upon the written determination by the Government that it is no longer required for Government purposes.

IN WITNESS WHEREOF, the Grantor has caused this Easement Deed to be duly executed this 26 day of March, 1982

WITNESS:

GRANTOR

x Barbara Sampson

x Quismaell

x Kathryn G. Gledhill

STATE OF FLORIDA)
COUNTY OF BROWARD)

PERSONALLY appeared before me D W Smoak and made oath that he/she saw the within named _____, sign, seal, and as their act and deed deliver the within written Easement and that he/she along with _____ witnessed the execution thereof.

SWORN TO before me this

26 day of March, 1982



Christene A. Crette
Notary Public

My Commission Expires: NOTARY PUBLIC STATE OF FLORIDA AT LARGE
MY COMMISSION EXPIRES DEC 16 1985
BONDED THRU GENERAL INS. UNDERWRITERS

RECORDED IN OFFICIAL RECORDS BOOK
OF BROWARD COUNTY, FLORIDA.
RECORDS VERIFIED
RALPH W. WHITE
CLERK CIRCUIT COURT

This instrument was prepared by
Kelly S. Hodge, Assistant Counsel
for the Southern Division, Naval
Facilities Engineering Command,
P.O. Box 10068, Charleston, S.C. 29411

207459

OFF REC.

856pc1544

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4

EASEMENT DEED

KNOW ALL MEN BY THESE PRESENTS:

Landmark First National Bank of Fort Lauderdale,

THAT as Trustee for Residuary Trust U/W of _____
Wyatt B. Hodges

Fort Lauderdale, Florida

_____, hereinafter called the Grantor, for and in consideration of the sum of One Dollar (\$1.00), the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed and by these presents does grant, bargain, sell and convey unto the United States of America and its assigns, hereinafter called the Government, an easement in perpetuity for the establishment, maintenance, operation and use of a compatible use zone in connection with the operation of the Naval Air Station, Key West, Florida in, upon, over and across that parcel of land situate in Monroe County, Florida, hereinafter called the Premises, more particularly described as follows:

A parcel of land lying and being in the County of Monroe, State of Florida, as recorded in Official Records Book 93 at Page 407 of the Public Boards of Monroe County, Florida, being more particularly described as follows:

DS Paid 45¢ Date 6-22-82
MONROE COUNTY
RALPH WHITE, CLERK OF CIR. CO.
By Marie Bettel L.S.

All of Government Lots 2 and 3 of Section 19, Township 67 South, Range 26 East, Monroe County, Florida;

Containing 122.75 acres more or less.

BY THIS GRANT OF EASEMENT the Grantor, for itself, (its heirs, successors, and assigns, as appropriate) covenants, as a covenant running with the Premises, that:

I. It will not use or permit use of the premises for the construction of dwellings or habitable facilities or for any purpose that is not included in the following list of Compatible Land Uses:

- Food and Kindred Product Manufacturing
- Textile Mill Products Manufacturing
- Apparel and other finished products made from Fabrics, Leather and Simulated Materials Manufacturing
- Lumber and Wood products Manufacturing
- Furniture and Fixtures Manufacturing
- Paper and Allied Products Manufacturing
- Printing and Publishing Industry
- Chemicals and Allied Products Manufacturing
- Rubber and Miscellaneous Plastic Products Manufacturing
- Stone, Clay and Glass Products Manufacturing
- Primary Metal Industries
- Fabricated Metal Product Manufacturing
- Railroad and Rapid Rail Transit
- Motor Vehicle Transportation
- Marine Craft Transportation
- Highway and Street Right of Way
- Automobile Parking
- Transportation and Utilities
- Agricultural and Agricultural Related Activities
- Forestry Activities and Related Services
- Fishing Activities and Related Services

82 JUN 22 P 3:55
OFFICIAL CLERK OF CIR. CO. MONROE COUNTY FLORIDA

Mining Activities and Related Services
Noncommercial Forest Development
Wholesale Trade
Retail Trade of Building Materials, General Merchandise,
Goods, Autos, Marine, Aircraft, Apparel and Accessories,
Furniture, Home Furnishings and Equipment, Eating and
Drinking
Finance, Insurance & Real Estate Services
Personal Services
Business Services
Repair Services
Professional Services
Contract Construction Services
Outdoor Amusements
Sports Activities
Water Based Activities
Playgrounds and Neighborhood Parks
Community Parks

2. No man made or natural obstructions, including structures and trees, shall be constructed or permitted to grow so as to extend more than 116 feet above mean sea level and any such obstructions which extend above 116 feet above mean sea level shall be altered, trimmed, cut or otherwise removed by the Grantor. Provided, however, if the Grantor should fail to do so, the Government may in behalf of and at the expense of the Grantor effect such removal by the use of the Government forces or by contract, and in doing so shall have the right to salvage, sell, dispose of, or abandon in place any and all of the man made or natural obstructions so removed without liability to the Government.

3. All buildings on the premises will be designed, constructed, and equipped to reduce the noise level in the interior of the building 25 db below the external noise levels during aircraft operations.

4. The Government shall have the right of ingress and egress to, from and across the Premises at reasonable times and upon reasonable notice, to determine and insure compliance with the above covenant.

5. The easement herein granted is subject to all existing easements and rights of way for public roads and highways, public utilities, railroads and pipelines.

6. The Grantor reserves to itself, (its heirs, successors and assigns, as appropriate) all such rights and privileges in the Premises that do not interfere with, limit, or abridge the rights granted the Government and its assigns, hereunder, specifically reserving to the Grantor (its heirs, successors and assigns, as appropriate) the right and privilege to use, construct upon, and develop the Premises for those purposes, and those purposes only, which are specified in paragraph 1. above and within the height restrictions as set forth in paragraph 2. above.

This easement is granted subject to the condition that this easement shall cease and be terminated upon the written determination by the Government that it is no longer required for Government purposes.

IN WITNESS WHEREOF, the Grantor has caused this Easement Deed to be duly executed this 26th day of March, 1982

WITNESS:

GRANTOR

Bonnie J. Sorrentino
Louise Shaffer

Robert Schneider
Robert Schneider Vice Pres. & Trust Officer

STATE OF FLORIDA)
COUNTY OF BROWARD)

PERSONALLY appeared before me Bonnie J. Sorrentino and made oath that he/she saw the within named Robert Schneider, Vice Pres. & Trust Officer, sign, seal, and as their act and deed deliver the within written Easement and that he/she along with Louise Shaffer witnessed the execution thereof.

Jadwiga I. Sekret

SWORN TO before me this
26 day of March, 1982

Notary Public, State of Florida at Large
My Commission Expires Sept. 4, 1984
Bonded Thru Tray Equip. Subscrip. No.

Notary Public

My Commission Expires: _____

RECORDED IN OFFICIAL RECORDS BOOK
OF BROWARD COUNTY, FLORIDA.
RECORDS VERIFIED
RALPH W. WHITE
CLERK CIRCUIT COURT

This instrument was prepared by
Kelly S. Hodge, Assistant Counsel
for the Southern Division, Naval
Facilities Engineering Command,
P.O. Box 10068, Charleston, S.C. 29411

275120

OFF REC 856rc1547

EASEMENT DEED

DATE 4-20-88
RESM 4-20-88
REG 11-1-88
MICRO 12-88
FILE 10-25-88

KNOW ALL MEN BY THESE PRESENTS:

THAT First National Bank in Ft. Lauderdale a/k/a Landmark First National Bank
of Fort Lauderdale, Florida

_____ , hereinafter called the Grantor, for and in consideration of the sum of One Dollar (\$1.00), the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and conveyed and by these presents does grant, bargain, sell and convey unto the United States of America and its assigns, hereinafter called the Government, an easement in perpetuity for the establishment, maintenance, operation and use of a compatible use zone in connection with the operation of the Naval Air Station, Key West, Florida in, upon, over and across that parcel of land situate in Monroe County, Florida, hereinafter called the Premises, more particularly described as follows:

A parcel of land lying and being in the County of Monroe, State of Florida, as recorded in Official Records Book 93 at Page 407 of the Public Boards of Monroe County, Florida, being more particularly described as follows:

All of Government Lots 2 and 3 of Section 19, Township 67 South, Range 26 East, Monroe County, Florida;

Containing 122.75 acres more or less.

BY THIS GRANT OF EASEMENT the Grantor, for itself, (its heirs, successors, and assigns, as appropriate) covenants, as a covenant running with the Premises, that:

1. It will not use or permit use of the premises for the construction of dwellings or habitable facilities or for any purpose that is not included in the following list of Compatible Land Uses:

- Food and Kindred Product Manufacturing
- Textile Mill Products Manufacturing
- Apparel and other finished products made from Fabrics, Leather and Simulated Materials Manufacturing
- Lumber and Wood products Manufacturing
- Furniture and Fixtures Manufacturing
- Paper and Allied Products Manufacturing
- Printing and Publishing Industry
- Chemicals and Allied Products Manufacturing
- Rubber and Miscellaneous Plastic Products Manufacturing
- Stone, Clay and Glass Products Manufacturing
- Primary Metal Industries
- Fabricated Metal Product Manufacturing
- Railroad and Rapid Rail Transit
- Motor Vehicle Transportation
- Marine Craft Transportation

DS Paid 45¢ Date 6-22-88
MONROE COUNTY
RALPH WHITE, CLERK OF CIR. CT.
R.W.

82 JUN 22 P 3:55
STATE OF FLORIDA

Highway and Street Right of Way
Automobile Parking
Transportation and Utilities
Agricultural and Agricultural Related Activities
Forestry Activities and Related Services
Fishing Activities and Related Services
Mining Activities and Related Services
Noncommercial Forest Development
Wholesale Trade
Retail Trade of Building Materials, General Merchandise, Goods,
Autos, Marine, Aircraft, Apparel and Accessories, Furniture,
Home Furnishings and Equipment, Eating and Drinking
Finance, Insurance & Real Estate Services
Personal Services
Business Services
Repair Services
Professional Services
Contract Construction Services
Outdoor Amusements
Sports Activities
Water Based Activities
Playgrounds and Neighborhood Parks
Community Parks

OFF REC 856 pg 1548

2. No man made or natural obstructions, including structures and trees, shall be constructed or permitted to grow so as to extend more than 116 feet above mean sea level and any such obstructions which extend above 116 feet above mean sea level shall be altered, trimmed, cut or otherwise removed by the Grantor. Provided, however, if the Grantor should fail to do so, the Government may in behalf of and at the expense of the Grantor effect such removal by the use of the Government forces or by contract, and in doing so shall have the right to salvage, sell, dispose of, or abandon in place any and all of the man made or natural obstructions so removed without liability to the Government.

3. All buildings on the premises will be designed, constructed, and equipped to reduce the noise level in the interior of the building 25 db below the external noise levels during aircraft operations.

4. The Government shall have the right of ingress and egress to, from and across the Premises at reasonable times and upon reasonable notice, to determine and insure compliance with the above covenant.

5. The easement herein granted is subject to all existing easements and rights of way for public roads and highways, public utilities, railroads and pipelines.

6. The Grantor reserves to itself, (its heirs, successors and assigns, as appropriate) all such rights and privileges in the Premises that do not interfere with, limit, or abridge the rights granted the Government and its assigns, hereunder, specifically reserving to the Grantor (its heirs, successors and assigns, as appropriate) the right and privilege to use, construct upon, and develop the Premises for those purposes, and those purposes only, which are specified in paragraph 1. above and within the height restrictions as set forth in paragraph 2. above.

This easement is granted subject to the condition that this easement shall cease and be terminated upon the written determination by the Government that it is no longer required for Government purposes.

IN WITNESS WHEREOF, the Grantor has caused this Easement Deed to be duly executed 6th day of April, 1982.

WITNESS:

GRANTOR:

Judith Stilts Fulton

Robert R. Schneider
Robert R. Schneider, Vice Pres. & Trust Officer

Cynthia McCormick

STATE OF FLORIDA)
COUNTY OF BROWARD)

PERSONALLY appeared before me Judith Stilts Fulton and made oath that he/she saw the within named Robert R. Schneider, Vice Pres. & Trust Officer, sign, seal, and as their act and deed deliver the within written Easement and that he/she along with Cynthia McCormick witnessed the execution thereof.

Jadwiga J. Jurate

SWORN TO before me this 6th day of April, 1982

Notary Public, State of Florida at large
My Commission Expires Sept. 4, 1984

NOTARY PUBLIC

My Commission Expires: _____

RECORDED IN OFFICIAL RECORDS BOOK
OF BROWARD COUNTY, FLORIDA
RECORD VERIFIED
RALPH W. WHITE
CLERK CIRCUIT COURT

This instrument was prepared by Kelly S. Hodge, Assistant Counsel for the Southern Division, Naval Facilities Engineering Command, P.O. Box 10068, Charleston, S.C. 29411

MANAGEMENT AGREEMENT
FOR CERTAIN SUBMERGED LAND BORDERING BOCA CHICA KEY
IN MONROE COUNTY

Agreement No. 750-0014

N62467-85-RP-00235

THE BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND OF THE STATE OF FLORIDA, referred to herein as the "Board" and the DEPARTMENT OF NATURAL RESOURCES, DIVISION OF STATE LANDS, as agency for the Board hereby grants to the UNITED STATES DEPARTMENT OF THE NAVY herein referred to as the "Navy", authorization to manage the areas described in Exhibit "A" attached hereto and made a part hereof. The lands described in Exhibit "A" are delineated on map bearing the legend "NAVAL AIR STATION, KEY WEST, FLORIDA, FEE ACQUISITION MAP MASTER PARCEL LOCATION MAP, NAVFAC DRAWING NO. 5114073, attached hereto and made a part hereof as Exhibit "B". Specifically, authorization is hereby granted to the Navy to manage these lands in accordance with the Navy's Air Installation Compatible Use Zone (AICUZ) plan for property protection, and for management as a water recreation and conservation area.

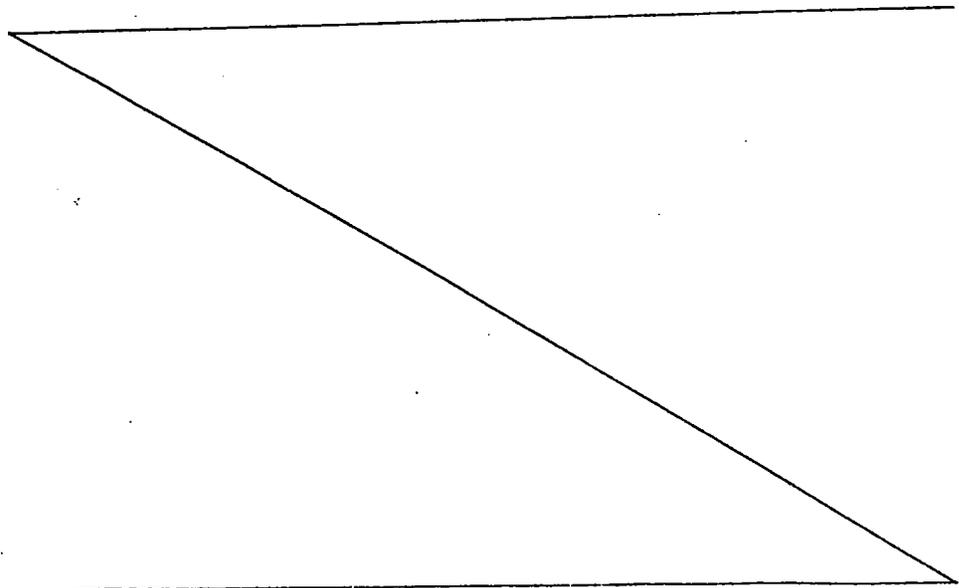
W I T N E S S E T H

The Board and the Navy, for and in consideration of the covenants hereinafter contained do hereby covenant as follows:

1. Subject to all existing encumbrances and the terms and conditions of the subject parcel, the Board hereby grants the Navy authorization to manage the subject property for property protection, recreation, and conservation purposes, which shall not conflict with the conservation, protection, and enhancement of said lands, nor shall this Agreement be construed in any way to interfere with the maintenance of public navigation projects or other public works projects authorized by the United States Congress, nor shall this Agreement be construed to apply to any land title to which is not vested in the Board.

2. It is understood and agreed that in addition to the property protection, conservation, and recreation activities herein provided for under this Agreement, the Navy shall furnish the Board a plan within six (6) months of the date of this Agreement. The plan shall outline and provide details of how the protection activities proposed for the subject property will be implemented. Upon receipt and acceptance of the plan by the Board, it shall serve as a guideline for future protection activities to be provided on the property. The plan will be reviewed jointly by the Board, or its agent and the Navy at no greater than five (5) year intervals and updated as necessary. The Navy shall have no right to use the premises for any activities other than those specified in the plan.

3. The Navy shall not engage in any activities except as provided for in the required plan without the advance written approval of the Board, pursuant to Section 253.034(4), Florida Statutes, and applicable rules.



4. Upon execution of this Agreement, the Navy shall have the right to enter onto and occupy the property for the purpose of fulfilling the activities designated in Paragraph 1.

5. The Board, or its designated representative, shall have the right at any time to inspect the works and operations of the Navy in any matter pertaining to this Agreement. Should the Navy fail to keep any of its covenants contained herein, the Board shall have the right to terminate this Agreement on the 60th day following written notice to the Navy, provided that the Navy fails to correct the deficiency within the 60 day period, and further provided that if the Navy takes corrective action satisfactory evidence shall be submitted to the Board of the corrective action taken.

6. The Board, or its designated representative, shall retain the right to enter onto the property or engage in management activities other than those provided in this Agreement, and shall retain the right to grant approval for uses of the property to third parties which are compatible with the purpose and terms of this Agreement. Provided however, that the Board shall, by written notification, advise Navy's designated representative at least fifteen (15) days prior to engaging in any management activity contrary to or allowing third parties any use of the property subject to this Agreement. Should the Navy object to the proposed management activity or third party use, it shall provide to the Board's designated representative a written statement specifying its objection within ten (10) days of receipt of written notification of the proposed activity or use. Upon receipt of such objection, the Board shall stay the effective date of the proposed activity or use for thirty (30) days.

7. This Agreement shall endure so long as the Navy wishes to manage the area for the purposes stated herein, or until the Agreement is terminated, as provided for herein.

8. Should the Board determine a need of greater public benefit or necessity has arisen, the Board shall have the right to terminate the Agreement upon providing 60 days written notice to the Navy.

9. The Navy shall have the right to terminate this Agreement upon providing 60 days written notice to the Board.

10. This agreement and any rights and privileges contained herein are for the sole use of the Navy and shall not be assigned or transferred to any other party.

11. The Navy shall be responsible for all damages to persons or property of others including the Board, for the negligent acts or omissions of its agents and employees in accordance with the Federal Tort Claims Act.

12. Section 267.061(1)(b), Florida Statutes, specifies that title to all treasure trove, artifacts, and such objects of antiquity having intrinsic, scientific or historical and archaeological value, which have been abandoned on state-owned lands or state-owned sovereignty submerged lands is vested in the Division of Archives, History and Records Management of the Department of State, for the purpose of administration and protection for the State of

Florida. Execution of this Agreement in no way affects any of the parties' obligations pursuant to Chapter 267, Florida Statutes. The disturbance of archaeological and historical sites on state-owned lands is prohibited unless prior authorization has been obtained from Archives. All proposals for changes in the character or use of state land shall be coordinated with Archives in order to mitigate potential damage or disturbance of, or to preserve, archaeological and historical sites and properties.

13. This Agreement does not convey any title interest to the area described in the Exhibit attached hereto.

14. Nothing herein shall be construed as binding the Navy to perform beyond its legal authority or to require it to assume or expend any sums in excess of monies which shall become available.

The Navy's authorized designated representative with respect to this Agreement is _____
All notices and correspondence under or arising from the terms of the Agreement, from the Board to the Navy shall be served on or mailed to this above stated address.

The Board's authorized designated representative with respect to the Agreement is _____
All notices and correspondence under or arising from the terms of this Agreement, from the Navy to the Board shall be served on or mailed to the above stated address.

IN TESTIMONY WHEREOF, the legally designated agent of the Board, and legally designated agent of the Navy have hereunto set their hands.

SEAL:

THE BOARD OF TRUSTEES OF THE
INTERNAL IMPROVEMENT TRUST
FUND OF THE STATE OF FLORIDA

By: Elton Gissendanner
Elton P. Gissendanner
Executive Director
Department of Natural Resources

Date: 8-6-85

Date: 8-6-85

WITNESS: Violet Davis

UNITED STATES DEPARTMENT
OF THE NAVY

By: W.M. Robe
(Name and Title)

Date: 11 July 1985

Date: 11 July 1985

WITNESS: Judith S. Owens



MY COMMISSION EXPIRES 8-17-1994

APPROVED AS TO
FORM AND LEGALITY
Lee K. Kone
COUNSEL

LEGAL DESCRIPTION FOR PARCEL NO. 15A

Those submerged lands lying and being in the County of Monroe, State of Florida having as its Northwestern limits the high lands adjacent to and Southeasterly of U.S. Highway No. 1; as its Easterly and Southeasterly limits the high lands adjacent to and Westerly of State Road 5941 (Old U.S. 4A) and as its Westerly limits the high lands of that subdivided portion of Government Lot 7 of Section 28, Township 67 South, Range 26 East, Monroe County, Florida, and the Easterly limits of the present United States of America U.S. Naval Air Station, Boca Chica Field;

Containing 500.0 acres more or less.

LEGAL DESCRIPTION FOR PARCEL NO. 15B

Those submerged lands lying and being in the County of Monroe, State of Florida having as its Northerly limits the present U.S. Highway No. 1; as its Easterly limits a portion of Government Lot 3 of Section 28; as its Southeasterly limits the Old U.S. Highway No. 1; and as its Westerly limits a portion of Government Lot 4 of said Section 28, all of Township 67 South, Range 26 East, Monroe County, Florida. Said submerged lands lying within that parcel designated in this project as Parcel No. 10;

Containing 25.0 acres more or less.

LEGAL DESCRIPTION FOR PARCEL NO. 15C

Those submerged lands lying and being in the County of Monroe, State of Florida having as its North limits the North line of Section 6, Township 68 South, Range 26 East, Monroe County, Florida; and as its East, South, and West limits the high land of a portion of Government Lot 1 of said Section 6.

Said submerged lands lying adjacent to and North of that portion of said Government Lot 1 that has been designated in this project as Parcel No. 11.

Containing 8.8 acres more or less.

LEGAL DESCRIPTION FOR PARCEL NO. 15D

Those submerged lands lying and being in the County of Monroe, State of Florida having part of its North limits the North line of S.E. 1/4 of Section 32, its Western limits as the West line of the S.E. 1/4 of Section 32 and part of the Northerly boundary, its Eastern and Southern boundary the high land of a portion of Government Lots 6 and 7, Section 32, all lying in Township 67 South, Range 28 East.

Said submerged lands lying adjacent North and West of that part of said Government Lot 6 and 7 that has been designated in this project as Parcel No. 17.

Exhibit A

Containing 84.38 acres, more or less.

Page 4 of 7 pages

Agreement No.

LEGAL DESCRIPTION FOR PARCEL 17

Those submerged lands lying and being in the County of Monroe, State of Florida having as its North limits the North line of the S.W. 1/4 of the S.E. 1/4, Section 33, a portion of South boundary the high land of Government Lot 10 Section 33, the West Boundary and a portion of the South Boundary the high land of Government Lots 7 and 8, Section 32, all lying in Township 67 South, Range 28 East.

Said submerged lands lying adjacent to North and East of that portion of said Government Lot 1 that has been designated in this project as Parcel No. 17.

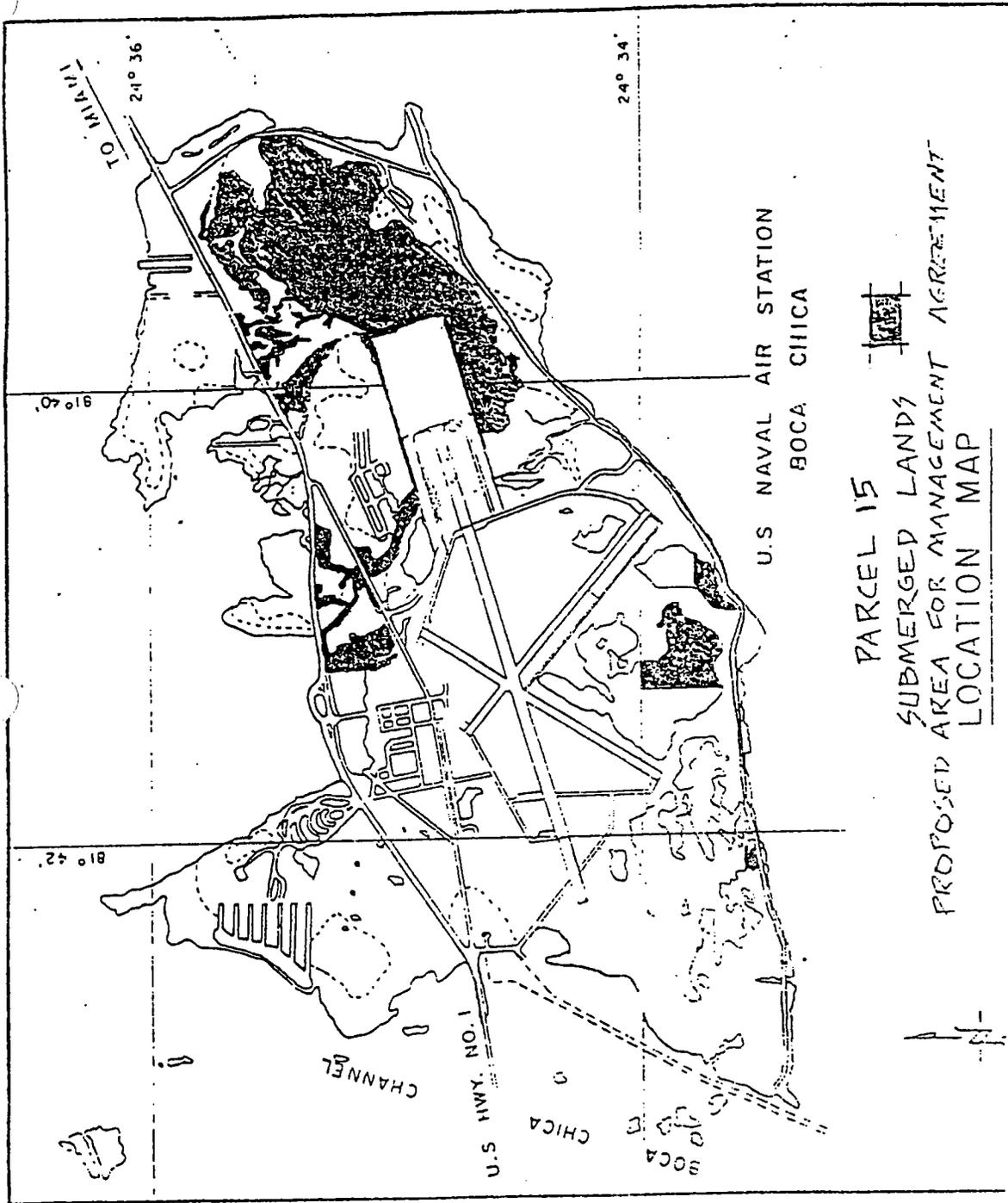
Containing 20.5 acres, more or less.

LEGAL DESCRIPTION FOR PARCEL 19

A portion of Government Lot 6, in Section 31, Township 67 South, Range 26 East, Monroe County, Florida, being more particularly described as follows:

Commence at the Northeast corner of Lot 20, Block A, of Boca Chico Beach as recorded in Plat Book 3, at Page 28 of the Public Records of Monroe County, Florida; thence S 89°39'46"E along the South line of said Section 31 for 361.41 to the Point of Beginning; thence N 38°56'02"E for 267.37 feet; thence S 00°16'55"W along the East line of said Government Lot 6 for 208.96 feet; thence S 88°39'46"W along the South line of said Section 31 for 166.89 feet to the Point of Beginning;

Containing 0.40 Acres more or less



PARCEL 15
 SUBMERGED LANDS
 PROPOSED AREA FOR MANAGEMENT AGREEMENT
 LOCATION MAP

Exhibit B as shown is a composite of
 "NAVAL AIR STATION, KEY WEST, FLORIDA
 FEE ACQUISITION MAP MASTER PARCEL
 LOCATION MAP, NAVAL DRAWING NO.
 5114073"

PLAN
IN CONNECTION WITH MANAGEMENT AGREEMENT
FOR CERTAIN SUBMERGED LAND BORDERING BOCA CHICA KEY
MONROE COUNTY, FL

1. The objective of this plan is to set forth procedures for the management of property covered by the Management Agreement No. 750-0014 over certain submerged land bordering the Naval Air Station, Boca Chica, Key West, Florida. The property will be utilized in a manner consistent with the Air Installations Compatible Use Zone (AICUZ) attached hereto as Appendix A, for property protection, and for management as a water recreation and conservation area.

2. To the extent that resources of the Naval Air Station are available for such purposes, the Navy will:

a. Provide surveillance over the submerged land for the purpose of protecting the property from:

(1) Dumping of wastes (liquid and solid)

(2) Dredge or fill activities of any type

(3) Construction activities not covered by permit issued by the State of Florida

(4) Any other activity which would contaminate the waters or degrade the land of either the property covered by this agreement or adjacent Navy property.

(5) Hunting, discharging of firearms, commercial fishing, and commercial collection of plant and animal specimens.

(6) Trespassing to the extent that the submerged lands are used as access to Naval Air Station property.

(7) Activities which generate smoke, fog, physical obstructions, electromagnetic interference, or other interference to aircraft operations at the adjoining Naval Air Station.

(8) Any other unlawful activity which would be detrimental to the natural environment of the property.

3. Normal recreational activities by the public on the submerged lands such as swimming, boating, bird watching, nature studies, non-commercial fishing, and other such non-controversial activities will not be restricted by Navy Management of the property except that any activities involving large numbers of people (over 25) shall be subject to the approval of the Commanding officer, Naval Air Station, Key West, Florida.

4. Enforcement action by the Navy will consist of issuing oral and written warnings to violators based on the authority of Management Agreement No. 750-0014 and this Plan. Should the violating activities persist, said violations will be referred to federal, state, or county law enforcement agencies, other appropriate regulating authorities, or the Florida State Department of Natural Resources.