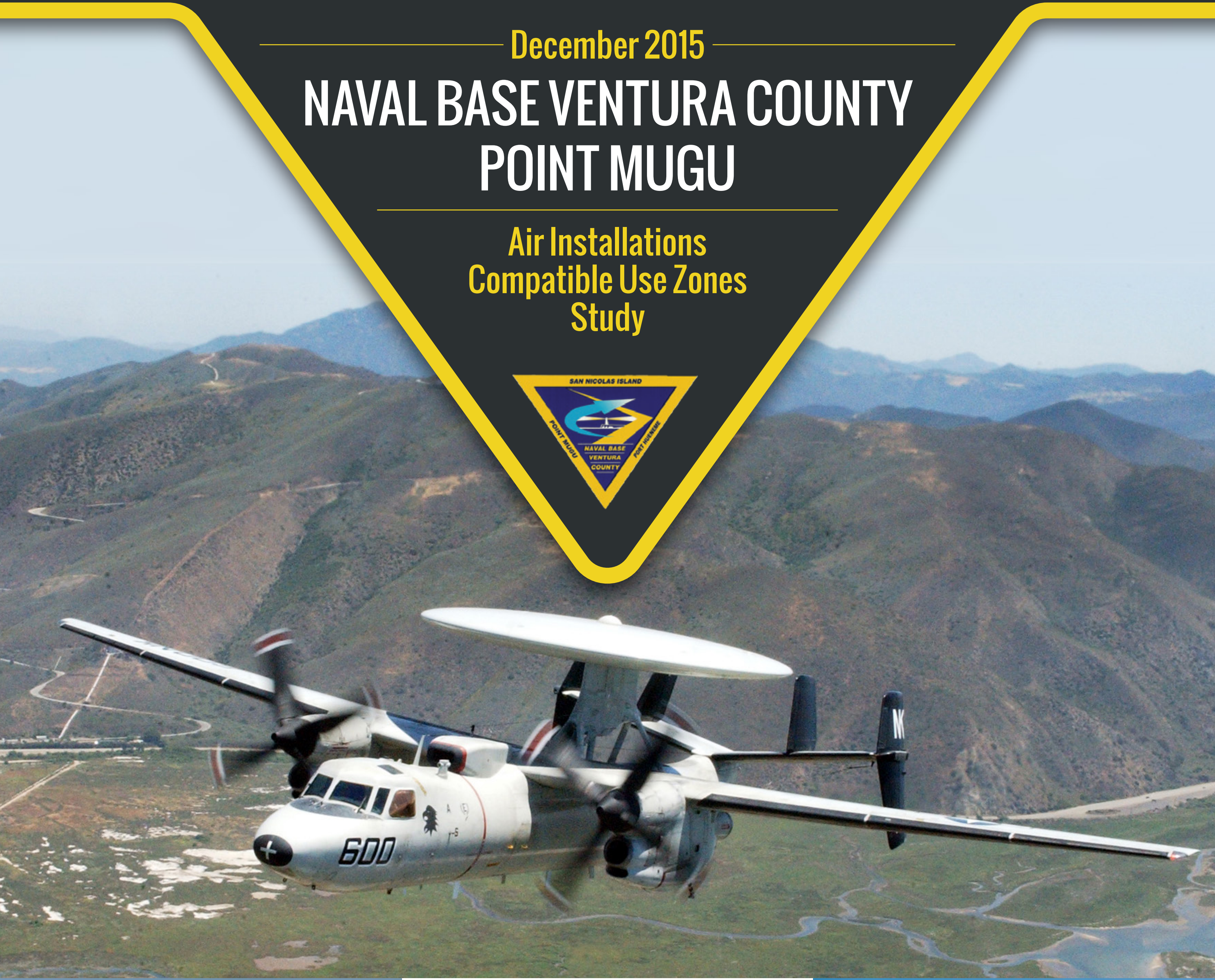
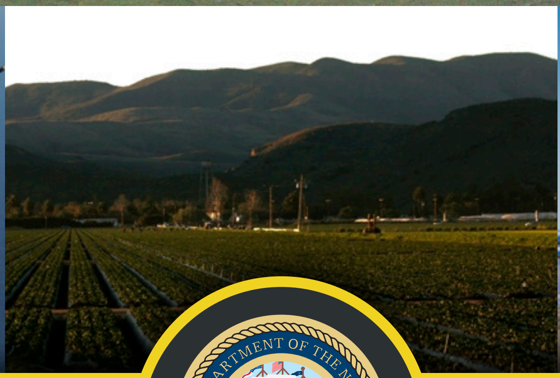
December 2015

NAVAL BASE VENTURA COUNTY POINT MUGU

Air Installations Compatible Use Zones Study





Prepared by:
United States Department of the Navy
Naval Facilities Engineering Command Southwest
San Diego, California

Air Installations Compatible Use Zones Study for Naval Base Ventura County Point Mugu

Final - December 2015

PREPARED BY

UNITED STATES DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHWEST

PREPARED FOR

UNITED STATES DEPARTMENT OF THE NAVY
NAVAL BASE VENTURA COUNTY

Approved for Public Release

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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 in the early 1970s to assist governmental entities and communities in identifying and planning for compatible land use and development near military installations. The DOD established the AICUZ Program in response to growing incompatible urban development around military airfields and community concerns regarding aircraft noise and accident potential areas. 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 2015 AICUZ Study was prepared for Naval Base Ventura County (NBVC), Point Mugu, California, in accordance with federal regulations and guidelines and United States Department of the Navy (Navy) Instruction. This AICUZ Study addresses past and expected changes in mission and aircraft and projected operational levels for 2015 through 2020, and is a formal update to the 1992 AICUZ Study Update.

This 2015 AICUZ Study provides prospective (calendar year [CY] 2020) aircraft operations, noise contours, and accident potential zones (APZs), identifies areas of incompatible land use, and recommends actions to encourage compatible land use.

Three operational scenarios are considered in this AICUZ Study: the historic (1992 AICUZ Study) noise contours and APZs, the baseline (five-year average, CY2009-2013) noise contours, and the prospective (2020) noise contours and APZs.

AICUZ Study development occurred over a two-year period (2013 and 2014). The baseline data is a five-year average of operations from CY2009 to CY2013. To maintain document integrity and clear data sources, operational activities that occurred in 2014 were not incorporated into the AICUZ Study.

ES.2 NBVC POINT MUGU

NBVC is comprised of three main operating areas: Point Mugu, Port Hueneme, and San Nicolas Island. NBVC supports approximately 50 tenant commands, with a base population of approximately 20,000 personnel. Tenant commands encompass a diverse set of specialties that support both Fleet and Fighter, including three warfare centers. This AICUZ study accounts for aircraft operations at the installation's airfield, Point Mugu; therefore, Port Hueneme and San Nicolas Island are not discussed in detail in this document.

NBVC Point Mugu is located along the coast of Ventura County, California, approximately 55 miles west of the city of Los Angeles. The airfield covers 4,490 acres of land, over half of which is natural saltwater marsh wetland. NBVC Point Mugu is bordered by Laguna Peak to the east, the Pacific Ocean to the south, and agricultural farmland to the north and west.

NBVC Point Mugu's primary mission is to provide the highest quality support for aircraft and test range operations at its installation and surrounding national airspace.

For this AICUZ Study, only tenant commands related to aircraft operations are discussed. Squadrons based at NBVC Point Mugu include four E-2 squadrons, one test and evaluation squadron (VX-30), and one Reserve C-130T squadron (VR-55). Although commercial military support aircraft (Airborne Tactical Advantage Company [ATAC]) and general aviation aircraft are not tenants, they are discussed due to their utilization of the airfield. The California Air National Guard (CAANG) is also discussed and included in the AICUZ analysis due to its proximity to the installation and use of the installation's runways.

ES.3 AIRCRAFT OPERATIONS

This AICUZ Study accounts for changes in mission, aircraft, and projected operational levels from 2015 to 2020 and, for planning purposes, presents them in this AICUZ Study. As such, the analysis includes current and projected aircraft that are (or will be) based at NBVC Point Mugu, as well as current and projected transient aircraft that operate (or will operate) at the airfield. Projected aircraft include aircraft new to the military inventory (e.g., Unmanned Aircraft Systems [UAS]), upgrades and replacements of existing platforms, increases in the number of aircraft/squadrons, and aircraft phased out and replaced by a similar aircraft. Most of the aircraft operations conducted at NBVC Point Mugu use aircraft based at the installation. Based military aircraft for the baseline scenario include: E-2C, P-3, S-3, C-130, H-25, F-21, MQ-8B/C, and C-130 (CAANG). Similarly, the military based aircraft for the prospective scenario include E-2C, C-130, C-20, C-37, MK-58, F-21, MQ-8B/C, Unmanned Carrier Launched Surveillance Strike (UCLASS) aircraft, MQ-4C, and C-130 (CAANG). The AICUZ analysis also includes air carrier, general aviation, and transient aircraft.

Each airfield has designated runways, and those runways have 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. Operations conducted at NBVC Point Mugu include arrivals (straight-in, overhead break, carrier break), patterns (touch-and-go, ground control approach [GCA], field carrier landing practice [FCLP]), and departures.

"Annual operations" describe all aircraft operations that occur at NBVC Point Mugu during a calendar year, including based and transient aircraft. Total annual operations account for each arrival and departure, including those conducted as part of a pattern operation. Annual operations have decreased over time, from 69,160 annual operations in the historic scenario to 29,493 annual operations for the baseline scenario. The prospective scenario annual operations, adjusted to account for Navy operations that will occur prior to 2020, are 39,454.

ES.4 Aircraft Noise

This AICUZ Study discusses and presents 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 historic, baseline, and prospective noise contours.

The two primary sources of aircraft noise at NBVC Point Mugu are ground engine maintenance "run-up" operations and 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. The noise exposure from aircraft at the airfield, as with all air installations in California, is measured using a variant of the day-night average sound level (DNL) noise metric. The California variant is the Community Noise Equivalent Level (CNEL), which is slightly more stringent.

In support of this AICUZ Study, NBVC Point Mugu conducted a noise analysis for the baseline and prospective scenarios. As part of the analysis, data for aircraft operations were collected from installation personnel, pilots, Air Traffic Control (ATC), Air Operations (Air Ops), and squadron personnel, as well as a range of resource documents. The noise analysis was conducted according to DOD guidelines and best practices, and leveraged the DOD NOISEMAP suite of computer-based modeling. The 2014 noise study analyzes noise generated by aircraft departing from or arriving to the airfield as well as during training flight patterns in the vicinity (Wyle 2014). The noise study also includes an analysis of noise created by parked aircraft conducting engine maintenance tests.

The CNEL is depicted on a map as a noise contour that connects points of equal noise value. The contours generally follow the flight paths of aircraft. The noise contours generated from the modeling program graphically illustrate where aircraft noise occurs in and around an airfield and at what sound level. The prospective noise contours align with Runway 03/21. The contours follow Runway 21 arrivals from the northeast and departures to the southwest. The 65 decibel (dB) and 60 dB CNEL contours extend approximately 2.6 miles and 4 miles northeast of the base boundary, respectively. The 65 dB and 60 dB CNEL contours extend to the west, abeam the runway, by 0.5 mile and 1 mile, respectively. The 65 dB and 60 dB CNEL extend beyond the installation boundary, but only over the Pacific Ocean.

NBVC Point Mugu's total area within the prospective noise contours (60 dB CNEL and greater) is 6,580 acres. Approximately 30 percent (2,015 acres) of this total is on-station, with 70 percent (4,565 acres) off-station. Over 98 percent of the ≥75 dB CNEL contours are on-station, with less than 2 percent off-station. Because the airfield is adjacent to the Pacific Ocean, and due to the installation's course rules and flight tracks, over 30 percent of the contours in Noise Zone 1 (60 to <65 dB CNEL) and Noise Zone 2 (65 to <75 dB CNEL) are over the ocean. The remaining "over land acres" include approximately 1,518 on-station acres and 2,562 off-station acres. Land use recommendations apply to 65 dB CNEL and greater; however, the prospective noise contours include 60 dB CNEL and greater to illustrate that noise extends beyond the 65 dB CNEL.

A comparison of the prospective and historic noise contours shows few similarities, except for a concentration of contours along Runway 03/21. Overall, the contours are reduced in size and off-station impact. The primary factor in the decrease in noise contour coverage is the reduction in annual operations from 69,160 to 39,454, a loss of nearly 30,000 annual operations.

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 historic 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. 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.

Prospective Clear Zones and APZs were developed according to projected annual aircraft operations data. The analysis of the data and application of the AICUZ Instruction results in four APZ combinations for NBVC Point Mugu. Approximately 4,487 acres are impacted by the airfield's prospective APZs. Approximately 39 percent of the impacted area is within the airfield's boundary, and the remaining impacted areas are within Ventura County; however, 50 percent of the off-station APZ area is over the Pacific Ocean. APZs impact less than 1,400 land acres, a majority of which are included in the APZ combination to the northeast associated with the arrivals onto Runway 21, where land use is primarily agricultural.

The prospective Clear Zones and APZs and the historic Clear Zones and APZs are similar in land and water area coverage; however, the total area impacted has decreased by approximately 700 acres. The reduction is due to the loss of APZ II coverage to the northeast and southwest (over the Pacific Ocean). Overall, the change in APZs is attributed to the reduction in aircraft operations and, to a lesser extent, the flight tracks flown.

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 NBVC Point Mugu is the responsibility of local governments and landowners, through this AICUZ Study; 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 the unincorporated area of Ventura County and the planning area for the City of Oxnard. To determine land use compatibility, the Navy examined both existing and planned land uses near NBVC Point Mugu. The local land use practices of local jurisdictions can impact the airfield's mission and must be considered to properly manage development within the AICUZ footprint. Land use planning in Ventura County and Oxnard directly influences the land area surrounding the airfield. The City of Camarillo and the City of Port Hueneme influence the region, but the AICUZ footprint does not currently overlap their jurisdictions. Land use planning programs, General Plans, zoning codes, councils, and commissions for local jurisdictions with the potential to influence land use near the airfield are discussed as part of the AICUZ Study.

ES.7 Land Use Compatibility Analysis and Recommendations

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 CNEL measurements. Noise Zone 1 (60 to <65 dB CNEL) is an area of low or no impact. Noise Zone 2 (65 to <75 dB CNEL) is an area of moderate impact where some land use controls are recommended. Noise Zone 3 (≥75 dB CNEL) 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 exposure contours and APZs by examining existing and planned land uses near NBVC Point Mugu. The AICUZ footprint is the basis for the land use compatibility analysis. To analyze whether existing land use is compatible with aircraft operations, the prospective 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 parcel level using the Navy's land use compatibility guidance and land use data from Ventura County. Analyzing future compatibility was conducted in a similar manner, while also considering County zoning and the City of Oxnard's planning and growth boundaries. For analysis purposes, the area surrounding NBVC Point Mugu with compatibility concerns was divided into three main areas: north, east, and west.

Overall, land use compatibility concerns are minimal to moderate due to strong local land use controls and zoning boundaries to contain urban development, protect farmland, and prevent incompatible development (e.g., Ventura County Airport Comprehensive Land Use Plan [ACLUP], Coastal Zoning ordinance, Guidelines for Orderly Development, Save Open-Space and Agricultural Resources [SOAR] ordinances, City Urban Restriction Boundaries, Spheres of Influence, Land Conservation Act [LCA], and Greenbelts Guidelines).

The AICUZ Program recommends that noise contours, APZs, height obstruction criteria, and land use recommendations be incorporated into local community planning to minimize impacts to the military mission and the surrounding communities. This AICUZ Study provides broad-based recommendations and site-specific recommendations for the Navy and NBVC Point Mugu. The Navy has the responsibility to communicate and collaborate with the local governments on land use planning, zoning, and compatibility concerns that can impact 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 should recognize their responsibility in providing land use controls in those areas encumbered by the AICUZ footprint by incorporating AICUZ information into planning policies and regulations.

Mutual cooperation between NBVC Point Mugu and the neighboring communities is key to the AICUZ Program's success. The AICUZ Study recommendations, when implemented, will continue to advance NBVC Point Mugu and community partners in achieving their shared goal, which is 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

ACLUP	Airport Comprehensive Land Use Plan
AICUZ	Air Installations Compatible Use Zones
Air Force	United States Air Force
Air Ops	Air Operations
APZ	accident potential zones
Army	United States Army
ATAC	Airborne Tactical Advantage Company
ATC	Air Traffic Control
AW	Airlift Wing
BASH	bird/animal aircraft strike hazard
CAANG	California Air National Guard
CACCLW	Commander, Airborne Command Control, and Logistics Wing
CBC	Construction Battalion Center
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CIP	Capital Improvement Program
CNEL	Community Noise Equivalent Level
CNRSW	Commander, Navy Region Southwest
CPLO	Community Plans and Liaison Officer
CSU	California State University
CSUCI	California State University Channel Islands
CUP	Conditional Use Permit
CY	calendar year
dB	decibel
dBA	A-weighted decibel

DET	Detachment
DNL	day-night average sound level
DOD	United States Department of Defense
du/acre	dwelling units per acre
EMI	electromagnetic interference
FAA	Federal Aviation Administration
FCLP	field carrier landing practice
GCA	ground control approach
GIS	Geographic Information System
HUD	United States Department of Housing and Urban Development
JLUS	Joint Land Use Study
LAFCo	Local Agency Formation Commissions
LCA	Land Conservation Act
Marine Corps	United States Marine Corps
MCAS	Marine Corps Air Station
MOA	Military Operations Area
MSL	mean sea level
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NATOPS	Naval Air Training and Operating Procedures Standardization
NAVAIR	Naval Air Systems Command
NAVFAC	Naval Facilities Engineering Command
Navy	United States Department of the Navy
NAWCWD	Naval Air Warfare Center Weapons Division
NAWS	Naval Air Weapons Station
NBVC	Naval Base Ventura County
NEPA	National Environmental Policy Act
NLR	Noise Level Reduction
OPNAVINST	Office of the Chief of Naval Operations Instruction

R-	Restricted Area
RDAT&E	Research, Development, Acquisition, Test, and Evaluation
REPI	Readiness and Environmental Protection Integration
SCAG	Southern California Association of Governments
SEL	sound exposure level
SLUCM	Standard Land Use Coding Manual
SOAR	Save Open-Space and Agricultural Resources
SUA	Special Use Airspace
TDR	transfer of development rights
U.S.C.	United States Code
UAS	Unmanned Aircraft System(s)
UCLASS	Unmanned Carrier Launched Surveillance Strike
UMS	Unmanned Maritime System(s)
USCG	United States Coast Guard
VIDS	Visual Information Display System
W-	Warning Area

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1 INTRODUCTION

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. 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 benefit. Installations provide economic benefits through jobs and contracts, while host communities provide housing, services, retail, and schools. The presence of a military base attracts nearby community and private development of housing, restaurants, shops, and other land uses. This development can be complementary in nature and enhance an installation's value and function. In contrast, the surrounding land uses may be located in areas of high noise exposure or accident potential, making this development incompatible with the sustained long-term mission of the base.

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.

As the communities surrounding 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. Installations, as stakeholders in the community, 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.

The Naval Base Ventura County (NBVC) Point Mugu AICUZ Study is an update to the 1992 AICUZ Study (Navy 1992). This AICUZ Study addresses past and expected changes in mission and aircraft, and projected operational levels for 2015 through 2020.

1.1 AICUZ Program

> 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.

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 impact of aircraft operations in a community, while encouraging compatible development to minimize future conflicts.

The objectives of the AICUZ Program, according to the Office of the Chief of Naval Operations Instruction (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 in the vicinity of an airfield, including: 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 that attract birds, especially waterfowl; and electromagnetic interference (EMI) sources that may adversely affect aircraft communication, navigation, or other electrical systems. This topic is discussed in more detail in Section 5.4, Flight Safety.

To meet the objectives of the AICUZ Program, the Navy recommends that local community planning authorities incorporate development criteria in areas surrounding a base and incorporate noise exposure contours and APZs into local plans and development ordinances. Noise exposure contours and APZs, which are described in detail in Chapters 4 and 5, respectively, are areas of concern for an air installation and its neighboring communities. Since 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 the local communities to foster compatible development.

The scope of this AICUZ Study analyzes:

- Historic, baseline, and prospective aircraft operations[1];
- 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 Plans 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, include:

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

The Navy's AICUZ Program Instruction (OPNAVINST 11010.36C) currently governs the AICUZ Program and provides guidelines for compatible land use.

[1] Although aircraft based at NBVC Point Mugu also utilize designated Military Operations Areas (MOAs) (i.e., airspace where military operations warrant limiting nonparticipating aircraft use) and other airports, this AICUZ Study focuses on aircraft operations at the installation, itself, including arrivals, departures, and pattern work (e.g., touch-and-go).

1.2 Responsibility for Compatible Land Use

The AICUZ Program promotes compatible land use development around military air installations through mutual cooperation and engagement with the community. Therefore, ensuring land use compatibility near an air installation is a collaborative effort by many organizations and groups (e.g., 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, it is the state and local government agencies that have the authority to preserve land use compatibility through the adoption and implementation of appropriate control measures recommended in this AICUZ Study.

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 NBVC Point Mugu AICUZ Studies Overview

Updates to an AICUZ Study 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, NBVC Point Mugu has experienced many mission and operational changes, and has undergone two complete AICUZ studies. The following sections highlight the AICUZ Study history at the airfield, 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 only two AICUZ studies completed for NBVC Point Mugu since the inception of the AICUZ Program. The following sections present the key elements of these two AICUZ studies.

1977 AICUZ Study for NAS Point Mugu

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 the installation's AICUZ Program and formalized the installation's communication and outreach with the local communities. Developed when the installation was "Naval Air Station [NAS] Point Mugu," the original AICUZ Study included analysis of the installation's predominant aircraft (A-7s, F-4s, S-2s, P-3s, and H-46s) and their flight tracks and runway utilization. Noise measurement procedures using the "Typical Day" methodology were modeled using approved methods of the time.

1992 AICUZ Study Update for Naval Air Weapons Station Point Mugu

This AICUZ Study Update, published in September 1992, revised the original 1977 AICUZ Study. The update established AICUZ areas for the airfield and provided strategies for compatible land use. The AICUZ Study Update was published under the authority of the 1975 DOD Instruction and the 1988 OPNAVINST 11010.36A.

The installation, then "Naval Air Weapons Station Point Mugu," experienced several changes in mission, aircraft, operations, and community development since the original AICUZ Study was published. During development of the 1992 AICUZ Study Update, the most frequently used aircraft at the installation included the H-60, UH-1, C-130, F-18, and P-3. The 1992 Study utilized the 1990 Aircraft Noise Survey (Harris, Miller, Miller, and Hanson, Inc. [HMMH) 1990) as the basis for aircraft operations and noise analysis. The noise model used the "Average Busy Day" methodology and state-of-the-art noise measurements and computation methods.

1.3.2 Changes that Necessitate this AICUZ Update

AICUZ updates follow DOD and Navy Instruction. Updates are determined necessary based on a variety of factors, primarily if an air installation has a significant 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 2015 AICUZ Study was developed in accordance with OPNAVINST 11010.36C and is a formal update to the 1992 AICUZ Study Update. This 2015 AICUZ Study provides projected aircraft operations for CY2020 at NBVC Point Mugu. The justifications for this 2015 AICUZ Study include:

- The current AICUZ Study is 23 years old.
- AICUZ Program guidance and instructions have been updated since publication of the current AICUZ Study:
    - DOD Instruction was updated in 2015; and
    - OPNAVINST was updated in 2008.
- 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.

   (Note: The Noise Study developed in support of this 2015 AICUZ Study utilized version 7.2 of NOISEMAP.)

- Significant changes in aircraft type operating at the air station since the 1992 AICUZ Study:
   - The majority of aircraft included in the 1992 AICUZ Study no longer operate at the airfield. Of the 13 aircraft that were based aircraft in the 1992 AICUZ Study (A-3, A-6, A-7, F-86, F-4, F-14, F-18, C-12, C-130, P-3, H-46, UH-1, H-60), only two (C-130 and P-3) remain as current based aircraft; and
   - Homebasing of E-2, S-3, F-21, MK-58, and MQ-8B/C aircraft.
- Consideration of projected aircraft and operations by CY2020:
   - Addition of a fifth E-2 squadron (VAW-115) and the additional E-2 aircraft to current squadrons;
   - Increase in training operations from East Coast E-2 squadrons;
   - Addition of Unmanned Aircraft Systems (UAS) operations;
   - Increase in F/A-18 and MV-22 transient operations;
   - Transient EA-6 and some F/A-18 operations replaced by EA-18G and F-35, respectively.
- Changes in types of transient aircraft and an increase in their annual operations.
- Adjustments made for flight tracks and flight track utilization.
- Designated locations for aircraft maintenance and engine run-ups have changed.
- 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 1992 AICUZ Study, are discussed further in Chapters 3, 4, and 5.

1.3.3 AICUZ Study

This AICUZ Study addresses the expected changes in mission, aircraft, and projected operational levels that will occur between 2015 and 2020. Pursuant to Navy Instruction, this AICUZ Study evaluates historic noise contours and APZs, baseline noise contours, and the prospective noise contours and APZs. The comparison of these three data sets provides an understanding of the changes at NBVC Point Mugu that occurred over the past 23-year period and provides the basis for the prospective scenario.

This AICUZ Study is comprised of the following chapters:

- Chapter 1: Provides background information on the AICUZ Program, NBVC Point Mugu 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.

AICUZ Study development occurred over a two-year period (2013 and 2014).The baseline data reflect the five-year average for operations from CY2009 to CY2013. To maintain document integrity and clear data sources, operational activities that occurred in 2014 were not incorporated into the AICUZ Study.

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2

NBVC Point Mugu

2.1 Location and History

NBVC is comprised of three main operating areas: Point Mugu, Port Hueneme, and San Nicolas Island. NBVC is located along the coast of Ventura County, California, approximately 55 miles west of the city of Los Angeles (Figure 2-1). NBVC Point Mugu, the installation's airfield, covers 4,490 acres of land, over half of which is natural saltwater marsh wetland. NBVC Point Mugu is bordered by Laguna Peak to the east, the Pacific Ocean to the south, and agricultural farmland to the north and west.

> NBVC was officially established on October 11, 2000, when NAS Point Mugu and CBC Port Hueneme were consolidated. San Nicolas Island was transferred to NBVC in 2004.

In 1946, President Truman approved the creation of a new missile center at Point Mugu, California. NAS Point Mugu was established on August 1, 1949, to support the U.S. Naval Air Missile Test Center by providing material and service support, including military personnel administration, Air Traffic Control (ATC), and flight line functions. Built as a temporary depot during World War II, Construction Battalion Center (CBC) Port Hueneme was officially established and began operating on May 18, 1942 as the Advance Base Depot and trained, staged, and supplied the construction battalion. In 1945, the Advance Base Depot was renamed the Naval CBC.

The process of consolidating the commands of NAS Point Mugu and CBC Port Hueneme began in 1998. The two commands were transferred to Commander, Navy Region Southwest (CNRSW), San Diego under the Chief of Naval Installations Command regionalization. Base Operating Support services were also first consolidated in 1998 as part of a Navy-wide cost savings program and, on October 11, 2000, NBVC was officially established during a ceremony held at Point Mugu. In 2004, San Nicolas Island, located approximately 62 miles southwest off the coast of Ventura County, was transferred to NBVC from Naval Air Warfare Center, Weapons Division. Today, NBVC provides the DOD with a premier mobilization site, complete with a deepwater port, railhead, and one of three major naval air installations on the West Coast, NBVC Point Mugu.

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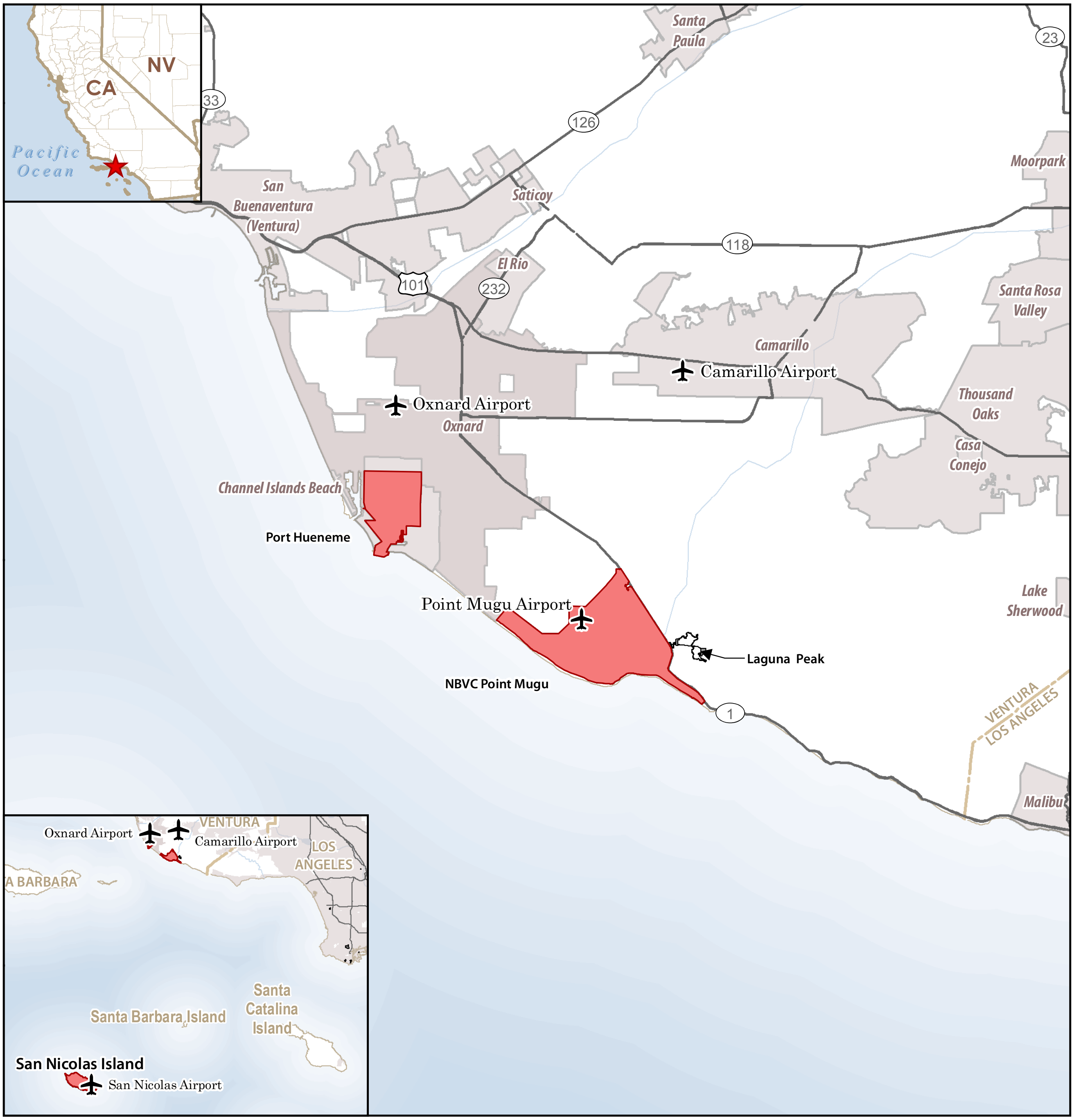

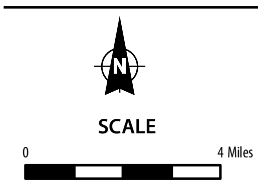

Legend

- NBVC
- Urban Area
- Waterbody
- Airport
- Highway
- County Boundary

Figure 2-1
Regional Location Map

NBVC
Ventura County, California

Source: ESRI 2012; Navy, 2012
Ecology and Environment, Inc. 2012

2.2 MISSION AND INSTALLATION ACTIVITIES

NBVC Point Mugu's primary mission is to provide the highest quality support for aircraft and test range operations at its installation and surrounding airspace. The airfield offers a variety of services required to operate and maintain a fully functioning installation, including mission support and facilities, environmental resources management, and personnel and family support services.

Tenant commands with aircraft operations are discussed below. Although California Air National Guard (CAANG) aircraft are based and maintained at Channel Islands Air National Guard Station, CAANG is also discussed and included in the AICUZ analysis due to its proximity to NBVC Point Mugu and its use of the airfield's runways for take-offs and arrivals. Similarly, commercial military support aircraft, Airborne Tactical Advantage Company (ATAC), and general aviation aircraft are also included in this analysis, as they utilize NBVC Point Mugu but are based at nearby Camarillo Airport.

2.2.1 TENANT COMMANDS

NBVC supports approximately 50 tenant commands, which encompass a diverse set of specialties that support both Fleet and Fighter. The squadrons based at NBVC Point Mugu include four E-2 Hawkeye squadrons, one test and evaluation squadron (VX-30), and one Reserve C-130T squadron (VR-55).

E-2 HAWKEYE SQUADRONS

The E-2 Hawkeye is the Navy's all-weather Airborne Early Warning and Command and Control platform. Missions include surface surveillance coordination, strike and interceptor control, search and rescue guidance, and communications relay. VAW-117 was the first fleet squadron to receive the new E-2C Hawkeye 2000 aircraft in keeping with the Navy's process of realigning assets to meet changing operational demands in the Pacific. The Hawkeye 2000 features new technologies to give warfare commanders the most complete, up-to-the-minute intelligence information possible. By 2022, the E-2D Advanced Hawkeye aircraft is expected to replace the E-2C. There are approximately 17 Hawkeye aircraft based at NBVC Point Mugu. Section 3.1.1, Based Aircraft, describes the E-2C aircraft.

VAW-112 "Golden Hawks," Tail Code NG

The primary mission of VAW-112 is "to provide effective Airborne Early Warning and Command and Control services to Fleet, Joint, and Coalition forces across the full spectrum of military operations." VAW-112 was established in April 1967, operating the E-2A in the western Pacific in support of the Vietnam War aboard the USS Enterprise. After years of various services to the Navy, VAW-112 has transitioned to the Communications, Navigation, and Surveillance/Air Traffic Management system (Commander, Airborne Command Control, and Logistics Wing [CACCLW] 2014a).

VAW-113 "Black Eagles," Tail Code NK

The primary mission of VAW-113 is, "to safely and efficiently provide on-scene, carrier airborne command and control anytime, anywhere in order to effectively execute our warfare commander's intent" (CACCLW 2014b). Commissioned in April 1967, the "Black Eagles" deployed aboard the USS Constellation in support of the Vietnam War. VAW-113 was the first E-2 squadron to operate with the F-14A and F-14D Tomcat and the F/A-18 Hornet. VAW-113 has been consistently recognized and awarded for distinguished performance in aviation safety and has over 87,600 hours of Class A mishap-free flights (CACCLW 2014b).

VAW-116 "Sun Kings," Tail Code NE

The primary mission of VAW-116 is, "to provide dominant and continuous airborne command, control, surveillance, and precision targeting by utilizing state of the art technology and the most highly trained personnel in the United States Navy" (CACCLW 2014c). VAW-116 was commissioned in April 1967 to support the Vietnam War. In addition to many others, this squadron was used for support in Operation Enduring Freedom and Operation New Dawn in Iraq.

VAW-117 "Wallbangers," Tail Code NH

The primary mission of VAW-117 is to, "provide Command and Control and Airborne Early Warning any time, any place in order to accomplish our warfare commander's intent" (CACCLW 2014d). VAW-117 was established in July of 1974 as part of the Fighter Early Warning Wing, Pacific Fleet. As stated previously, VAW-117 was the first fleet squadron to receive the new E-2C Hawkeye 2000 aircraft (CACCLW 2014d).

TEST AND EVALUATION SQUADRON

VX-30, Naval Test Wing Pacific, "Bloodhounds," Tail Code BH

VX-30 is an Air Test and Evaluation squadron, "committed to providing unparalleled research, development, test, and evaluation of manned and unmanned fixed- and rotary-wing aircraft and weapons systems" (Naval Air Systems Command [NAVAIR] 2014). Established in May of 1995, VX-30 provides support to the Sea Test Range, in addition to others. VX-30 is one of two squadrons that comprise the Navy Test Wing Pacific, with VX-31 the second squadron, which is located at Naval Air Warfare Center Weapons Division (NAWCWD), China Lake, California. Naval Test Wing Pacific is a component of NAWCWD. VX-30 has a diverse inventory of operational aircraft, including the C-130F Hercules, the S-3B Viking, and the NP-3D Orion, used for Research, Development, Acquisition, Test, and Evaluation (RDAT&E) (NAVAIR 2014). The newest aircraft to arrive at VX-30 is the MQ-8B/C Firescout, which arrived in the summer of 2014 and began testing in the fall of 2014. VX-30 currently operates three C-130Fs, each with unique cargo and aerial refueling capabilities. VX-30's primary mission on the C-130s is cargo transportation and in-flight refueling for units conducting tests on the Sea Test Range, as well as a range clearance platform.

NAVAL AIR WARFARE CENTER WEAPONS DIVISION

NAWCWD is an organization within NAVAIR, dedicated to maintaining a center of excellence in weapons development for the Navy. NAWCWD has two locations: China Lake, hosting the land test range; and NBVC Point Mugu, hosting the sea test range. The Sea Range is DOD's largest and most extensively instrumented over-water range that offers realistic, open-ocean, and littoral operating environments. The Sea Range consists of 36,000 square miles of controlled sea and airspace. Temporary expansion of the area is possible through coordination with local Navy facilities and the FAA. The range supports the test and evaluation of a wide variety of weapons, ships, aircraft and specialized systems for a broad spectrum of military, Homeland Defense, National Aeronautics and Space Administration (NASA), foreign ally, and private sector programs, from small-scale static tests to complex multi-participant, multi-target operations in dense electronic combat environments.

RESERVE SQUADRON (C-130)

VR-55, Fleet Logistics Support Squadron, "Minutemen," Tail Code RU

The VR-55 Squadron is a Navy C-130 squadron, operating five C-130T aircraft. VR-55 provides around-the-clock logistical coverage to naval assets deployed throughout the world. The primary mission of VR-55 is to provide world-class service to the Navy and Marine Corps teams and all other services by safely transporting passengers and cargo in support of the Fleet Commanders' short notice air logistics requirements.

2.2.2 CALIFORNIA AIR NATIONAL GUARD

AIR FORCE'S 146TH AIRLIFT WING, CHANNEL ISLANDS AIR NATIONAL GUARD, C-130J

The 146th Airlift Wing (AW) is a unit of the CAANG. The mission of the 146th AW, Channel Islands Air National Guard is to "provide a combat ready militia for the security, welfare, and humanitarian needs of our community, state, and nation." The 146th AW is comprised of four groups and wing headquarters at Channel Islands Air National Guard Station. The four groups are the 146th Mission Support Group, the 146th Operations Group, the 146th Maintenance Group, and the 146th Medical Group, as described below (CAANG 2014):

- The 146th Mission Support Group is the main support function for over 1,200 military personnel. The Mission Support Group consists of the Security Forces Squadron, Civil Engineering Squadron, Logistics Readiness Squadron, as well as Communications Flight, Mission Support Flight, Base Services Flight, and the Base Contracting Office.
- The 146th Operations Group provides normal airlift for military cargo, personnel, and patient movement, and also supports homeland contingency operations. The 146th Operations Group consists of the 115th Airlift

Squadron, the Aeromedical Evacuation Squadron, as well as Operations Support Flight, Airlift Control Flight, and the 195th Weather Flight.

- The primary mission of the 146th Maintenance Group is to provide 24/7 aircraft maintenance support of combat and peacetime airlift operations.
- The 146th Medical Group's primary mission is to provide bio-environmental, public health, and medical support to monitor the health and wellness of the members of the 146th AW.

2.2.3 Commercial and General Aviation

Commercial Aviation – Airborne Tactical Advantage Company

The ATAC comprises the world's largest outsourced civilian tactical airborne training organization and provides high-quality live training to the Navy. The two primary aircraft used by ATAC are the Kfir (F-21) and Hunter (MK-58). ATAC has trained Navy, Marine Corps, United States Air Force (Air Force), and United States Army (Army) aircrews, ship crews, and Combat Controllers. ATAC has flown over 32,000 hours of tactical flying support operating from nearby Camarillo Airport.

General Aviation

General aviation aircraft, Gulfstreams and Cessnas, support the transport of personnel from NBVC Point Mugu to San Nicolas Island and Naval Air Weapons Station (NAWS) China Lake in support of the NAWCWD mission.

2.2.4 Projected Activities

The Navy is in the process of realigning assets to meet the changing operational and deployment demands in the Pacific, as well as Global Force Management scheduling requirements, the introduction of UAS, and the replacement of aging aircraft projected within the next five years.

Operational projections for NBVC Point Mugu include adding an E-2C squadron from Naval Station Norfolk that will move to the airfield in approximately 2020. In addition to a fifth E-2C squadron (VAW-115), the total number of aircraft assigned to each E-2 squadron will increase from four to five as squadrons transition from the E-2C Hawkeye 2000 to the E-2D Advanced Hawkeye.

NAVAIR will extend its UAS RDAT&E operations and training capability to include unmanned maritime systems (UMS) operations on the Sea Range by 2020. The proposed UAS operations will occur at NBVC Point Mugu, including R-2519, San Nicolas Island, R-2535, and within the associated Special Use Airspace (SUA) over the Sea Range (Navy 2013a). Projected activities include increased operations of the Fire Scout UAS (MQ-8B/C) and the introduction of Unmanned Carrier Launched Surveillance Strike (UCLASS) aircraft (the F-4 and F-16 were used as surrogates for modeling purposes). The projected increase in UAS activity includes an increase in chase aircraft operations conducted by F/A-18 aircraft. NBVC Point Mugu is the only DOD air installation operating manned and unmanned systems together in Class D airspace, with the Fire Scout models (MQ-8B and MQ-8C) being the only UAS authorized for these operations.

It is anticipated that a new squadron, VUP-19 DET Point Mugu, will operate the Navy's MQ-4C Triton UAS with flight operations starting in 2017 (Navy 2013b). The Triton UAS provides continuous maritime intelligence, surveillance, and reconnaissance data collection and dissemination capability. The long-range (2,000 nautical miles), high-altitude drone is designed to complement manned naval Intelligence, Surveillance, and Reconnaissance aircraft, such as the P-3C and P-8A.

2.3 Operational Areas

In 1941, the Seabees put down a section of runway that would become Point Mugu's first airstrip. The airstrip, now known as "NBVC Point Mugu," supports NBVC's based and transient aircraft on the West Coast (Figure 2-2). In addition to the airfield, NBVC Point Mugu's primary operational areas include the airspace surrounding the installation, the designated military training airspace, and Camarillo Airport. NBVC Point Mugu is located approximately 6 miles south of Camarillo Airport, and 7 miles southeast of the Oxnard Airport. Relative to large commercial airports, NBVC Point Mugu is 53 miles southeast of Santa Barbara Airport, 47 miles southwest of Burbank Airport, and 56 miles northwest of Los Angeles International Airport. The following sections present NBVC Point Mugu's general airfield features and descriptions of airspace, and provides a brief overview of operations conducted at Camarillo Airport.

2.3.1 Airfield

NBVC Point Mugu has two runways, 03/21 and 09/27. Runway 03/21 is 11,100 feet long and 200 feet wide, and runway 09/27 is 5,500 feet long and 200 feet wide. The primary runway is 03/21 and supports a majority of aircraft operations. Runways are numbered according to their magnetic heading for aircraft on approach or departure. For example, on Runway 03/21, the numbers 03 and 21 signify that this runway is most closely aligned with a compass heading of 30 and 210 degrees, respectively. The airfield's elevation is 13 feet above mean sea level (MSL).

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 accommodate intensive use by heavy or high-performance aircraft. Class B runways are all other fixed-wing runways. In addition, runways are classified according to the type of aircraft that operate from the runway. Runways at NBVC Point Mugu are Class B runways.

The airfield and tower are open daily, from 7:00 a.m. to 11:00 p.m. (0700 to 2300), and are closed on federal holidays. Extenuating circumstances can result in extended operation hours and days, or temporarily suspend operations.

Legend

- NBVC Point Mugu Installation Boundary
- California Air National Guard
- Runway
- School
- Municipal Boundary
- Highway
- Street

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Navy, 2012; Google Maps Schools 2012

Figure 2-2
NBVC Point Mugu

NBVC
Ventura County, California

2.3.2 AIRSPACE

The use of airspace over NBVC Point Mugu and San Nicolas Island is dictated by the FAA's National Airspace System and 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 ATC clearance is required. Uncontrolled airspace is the portion of the airspace not designated as Class A through Class E within which ATC has no authority or responsibility to control air traffic (FAA 2014) (Figure 2-3).

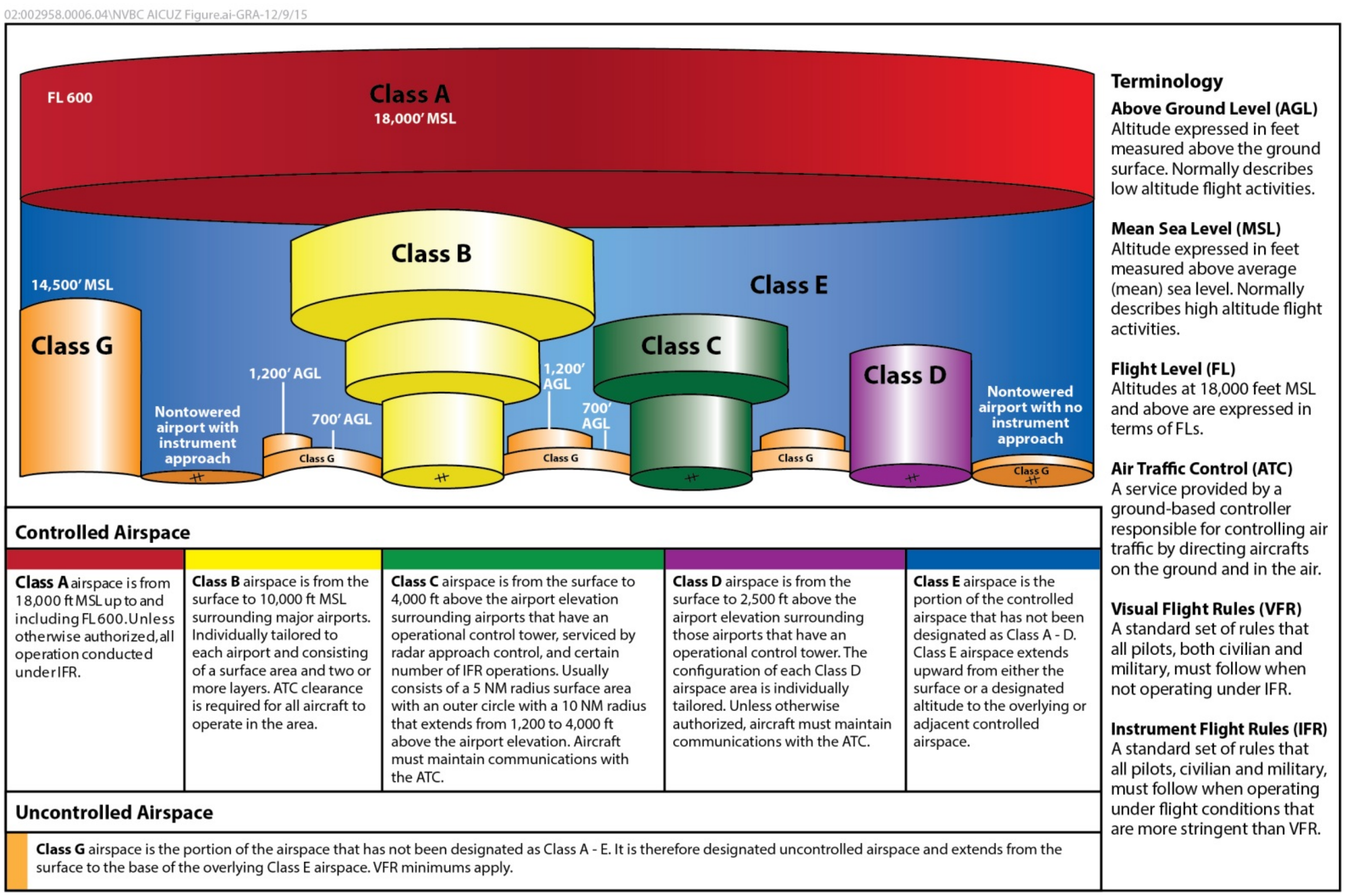

FIGURE 2-3 GENERAL AIRSPACE CLASSIFICATIONS

The controlled airspace under the jurisdiction of an airfield's control tower and immediately adjacent to the runways is defined by the FAA as Class D airspace. NVBC Point Mugu's Class D airspace extends from the surface to 3,000 feet within 4.3 nautical miles of the center of each airfield, excluding an exception within Oxnard and Camarillo Class D airspace (Figure 2-4). The typical pattern altitude at the airfield is 1,200 feet above MSL; however, flights operating within Class D airspace may be routed at higher or lower altitudes, when necessary for takeoff or landing, anywhere within the 4.3-nautical-mile radius. Aircraft within NBVC Point Mugu's Class D airspace must maintain communications with ATC. Airspace surrounding San Nicolas Island is Class D airspace when active, and Class E airspace when not active.

SUA is the designation of airspace within which certain activities must be confined, or where limitations may be imposed on aircraft operations that are not part of those activities. The SUA dimensions are defined so that military activities can operate and have boundaries that limit access by non-participating aircraft. Restricted Areas (R-) are designated where operations are hazardous to non-participating aircraft and contain airspace within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. SUA R-2519 overlays a portion of NBVC Point Mugu. R-2535A/B overlay San Nicolas Island and the ocean out to approximately 3 nautical miles. The R-2535A/B airspace is excluded from Warning Area (W-) 289S when it is active. Figure 2-5 depicts SUA in the immediate vicinity of NBVC Point Mugu and within the region.

The Sea Range spans 36,000 square miles and allows the military to test and track weapons systems in SUA (Warning Areas and Restricted Areas) (Figure 2-5). Managed by the NAWCWD, it is the world's largest instrumented missile test Sea Range where telemetry data can be tracked and recorded using technology housed at San Nicolas Island, NBVC Point Mugu, Laguna Peak, and Santa Cruz Island.

2.3.3 Camarillo Airport

Camarillo Airport, a general aviation airport, is located approximately 6 miles north of NBVC Point Mugu in the southwest corner of the City of Camarillo. Camarillo Airport has one east-west runway, Runway 08/26, that is 6,013 feet long and 150 feet wide. This airport is owned and operated by Ventura County in partnership with the City of Camarillo. Until 1969, Camarillo Airport was operated by the United States Air Force and known as "Oxnard Air Force Base." In 1976, the airfield reopened as a general aviation airport and currently supports several aviation businesses providing flight instruction, aircraft maintenance, and aircraft charter and storage (Ventura County 2014a), and is the base of ATAC. ATAC uses aircraft as an adversary for training and readiness missions for the Navy. ATAC is exclusively responsible for its aircraft, equipment, and personnel. As such, for financial purposes and ease of operations, ATAC utilizes the services provided at Camarillo Airport for aircraft maintenance and related services. There are 510 based aircraft at Camarillo Airport and approximately 148,000 annual operations were recorded in 2013. Is it important to note that while ATAC operations occur at Camarillo Airport and are part of the training program at NBVC Point Mugu, noise impacts generated from these operations are not presented in this AICUZ. Noise contours and impacts associated with ATAC operations occurring at Camarillo Airport are presented in the 2000 Airport Comprehensive Land Use Plan (ACLUP) for Ventura County.

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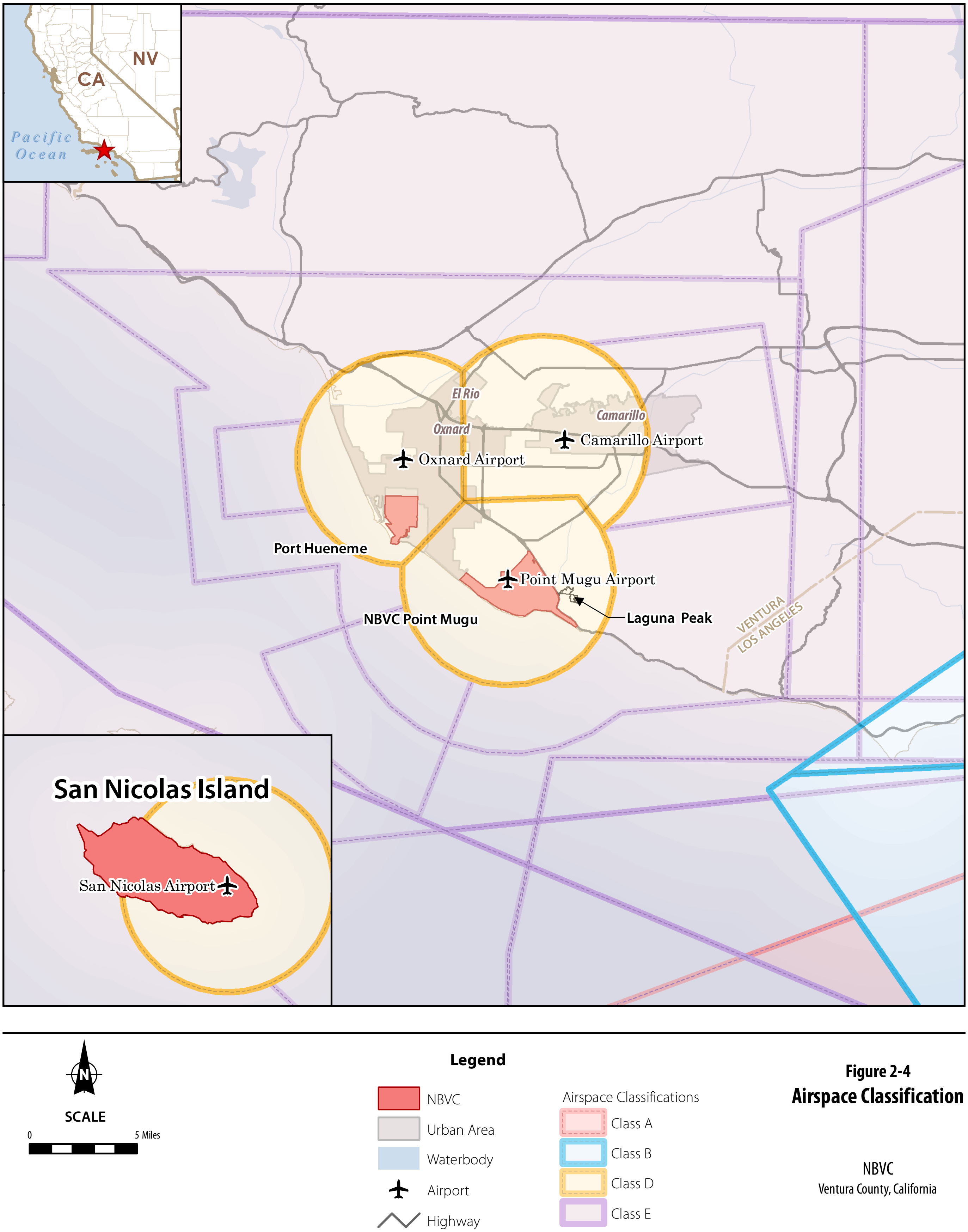


Figure 2-4
Airspace Classification

NBVC
Ventura County, California

Source: ESRI 2012; Navy, 2012
Ecology and Environment, Inc. 2012

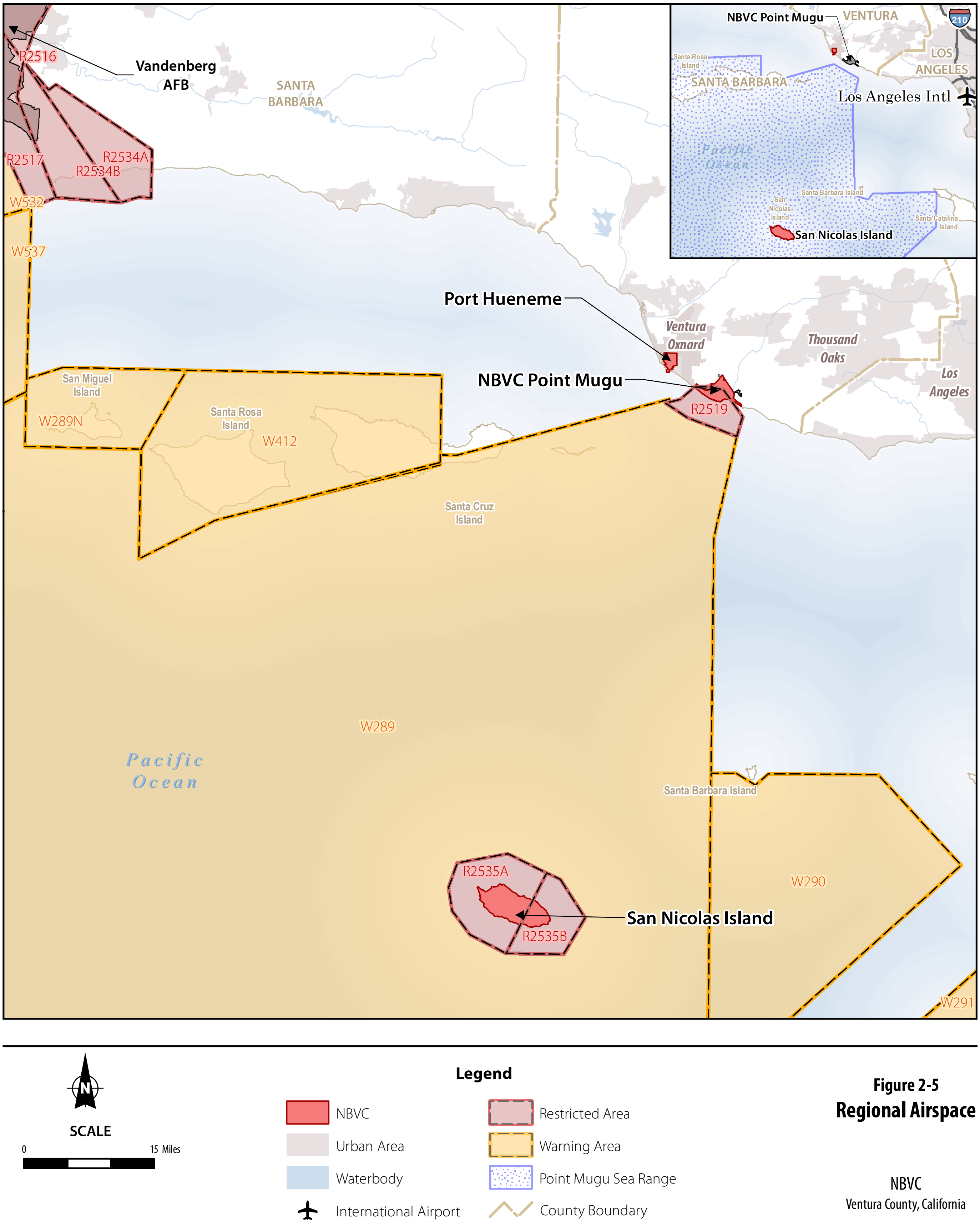


Figure 2-5
Regional Airspace

NBVC
Ventura County, California

Source: ESRI 2012; Navy, 2012
Ecology and Environment, Inc. 2012

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 NBVC's mission continues to ensure the viability of the installation into the future and its positive impact on the local communities and the surrounding region.

NBVC is the largest employer in Ventura County. The base employs a combined workforce of approximately 20,000, military, civilian, and contract personnel, with direct annual payroll expenditures totaling $711.1 million, and onsite construction activities created approximately 5,850 jobs. In total, NBVC contributed a $2 billion economic impact and supported 20,060 jobs (direct and indirect) throughout the Ventura County region for Fiscal Year 2010 (NBVC 2010). Additionally, NBVC supports year-round training for transient military personnel. In Fiscal Year 2010, NBVC had approximately 133,143 off-base visitors, resulting in over $34 million in spending for local goods and services (NBVC 2010).

NBVC is located in the unincorporated area of Ventura County, just a few miles from the cities of Oxnard, Camarillo, and Port Hueneme. Oxnard is the largest city in Ventura County, and has a population of 197,899, with a density of over 7,600 persons per square mile (U.S. Census Bureau 2010a). Camarillo, with a population of 66,428 in 2013, had the second highest rate of growth in the county since 2000 (Ventura County 2014b). Port Hueneme, with a population of 22,138, showed slight population growth during the same period.

Oxnard is the largest and most populous city in Ventura County.

Ventura County has a total population of 832,970, and approximately 11.6 percent of the county's population is within the unincorporated area of the county. Ventura County's population grew approximately 10.6 percent between 2000 and 2012 (Southern California Association of Governments [SCAG] 2013), and the county's population is expected to continue to increase through 2060 to approximately 1.03 million (California Department of Finance 2013). The county's unincorporated population growth rate between 2000 and 2012 was lower than the overall county, at 3.7 percent.

The State of California's population is projected to grow significantly over the next few decades. According to the United States Census, the 2010 population of the state was just over 37.2 million (U.S. Census Bureau 2010b). By 2020, the population is projected to grow to over 40 million, and by 2050 the population will have grown to over 50 million (California Department of Finance 2013). Southern California, which includes Ventura County, is projected to lead the state's growth over the next 50 years. The regional population is projected to grow to 31 million by 2060 (California Department of Finance 2013).

Table 2-1 provides population data and growth projections for the city of Oxnard, Ventura County, and the state of California.

TABLE 2-1 REGIONAL POPULATION ESTIMATES AND PROJECTIONS

POPULATION AREA	1990[a]	2000[a]	2010[a]	2020[b]	2030[b]	% GROWTH 2010-2020	% GROWTH 2020-2030
Ventura County	669,016	753,197	823,318	867,535	912,548	5.4%	5.2%
City of Oxnard	142,216	170,358	197,899	234,304[c]	285,521[d]	18.4%	21.9%
State of California	29,760,021	33,871,648	37,253,956	40,643,643	44,279,354	9.1%	8.9%

Sources:
(a) U.S. Census Bureau 2010a, 20110b
(b) California Department of Finance 2013
(c) Ventura Council of Governments 2008
(d) City of Oxnard 2009

3 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 the 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 NBVC Point Mugu, including based aircraft, transient aircraft, and projected aircraft, as well as preflight and maintenance operations, flight operations, annual operations, flight track use, operational alternatives, and Camarillo Airport operations.

3.1 AIRCRAFT TYPES THAT OPERATE AT NBVC POINT MUGU

This AICUZ Study analyzes three types of aircraft: fixed-wing, rotary-wing, and tilt-rotor. 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. Tilt-rotor aircraft typically take off and land in a helicopter configuration and can transition in flight to a fixed-wing mode of operation for higher speeds and longer distances. UAS, which operate without a pilot onboard, can be fixed-wing or rotary-wing.

Aircraft that operate at NBVC Point Mugu are either based or transient. Based aircraft are permanently assigned at NBVC Point Mugu. Based aircraft utilize NBVC Point Mugu 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 NBVC Point Mugu. Transient aircraft conduct training or other mission-related operations at the airfield, but may only land briefly to refuel. Only fixed-wing aircraft and UAS are based at NBVC Point Mugu.

This NBVC Point Mugu AICUZ Study accounts for changes in mission, aircraft, and projected operational levels over the next five years (through 2020), the timeframe that the Navy can adequately account for changes in operations, and for planning purposes. As such, the analysis includes aircraft that are currently based and projected to operate at NVBC Point Mugu, as well as current and projected transient aircraft operating at the airfield in the future. These projected aircraft include aircraft new to the military inventory (e.g., UAS), upgrades and replacements of existing platforms, increases in the number of aircraft/squadrons, and aircraft phased out and replaced by a similar aircraft. Based, transient, and projected aircraft that utilize or will utilize NBVC Point Mugu by 2020 are discussed below.

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.

3.1.1 Based Aircraft

The based 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 NBVC Point Mugu.

Fixed-Wing Aircraft

E-2C Hawkeye 2000 (VAW-112, 113, 116, 117)

The E-2C Hawkeye 2000 provides all-weather, airborne, early warning, and command and control functions for the Navy's carrier battle group. Additional missions include surface surveillance coordination, strike and interceptor control, search and rescue coordination, and ATC.

S-3B Viking (VX-30)

VX-30 is the only Navy squadron that still operates the S-3B Viking since its decommissioning in January of 2009. The primary mission of the S-3B program is to provide local range surveillance and clearance in support of Sea Range operations. The S-3B is a four-seat, twin-engine, jet aircraft originally built in the early 1970s. The aircraft provides electronic warfare and surface surveillance capabilities.

E-2C Hawkeye 2000

S-3B Viking

P-3 Orion (VX-30)

The P-3 Orion is a four-engine, turboprop, anti-submarine and maritime surveillance aircraft. The P-3 was developed in the 1960s and was one of the world's premier multi-mission long-endurance aircraft. The P-3 is VX-30's most utilized aircraft, and is used on the Sea Range for surveillance, clearance, and data capture during testing.

C-130 Hercules (VX-30, VR-55, Channel Islands Air National Guard)

The C-130 Hercules is a four-engine, turboprop, military aircraft capable of performing landings and takeoffs on unpaved runways. The C-130T is a multi-role, multi-mission, tactical tanker/transport with underwing fuel tanks and pods. This versatile asset provides in-flight refueling to tactical aircraft and helicopters, as well as rapid ground refueling, when required. Missions performed by this aircraft include aerial delivery of troops and cargo, emergency resupply into unimproved landing zones, medical evacuation, and tactical and evacuation missions. The C-130J Super Hercules is a four-engine, turboprop, military transport aircraft operated by the Channel Islands Air National Guard. The C-130J is a comprehensive update of the C-130 Hercules, with new engines and a new flight deck and other systems.

P-3 Orion

C-130J Super Hercules

Unmanned Aircraft System

MQ-8B/C Fire Scout (VX-30)

The MQ-8B/C Fire Scout is an unmanned, autonomous, rotary-wing aircraft developed specifically for the Navy. The first MQ-8B/C was delivered to the Navy in July 2013, and testing is ongoing at NBVC Point Mugu. The MQ-8B/C is designed to provide reconnaissance, aerial weaponry support, and precision targeting support for ground, air, and sea forces. The MQ-8B/C is an unmanned modified version of the Bell 407 helicopter. VTUAV DET Point Mugu operates MQ-8B maintenance operations. VX-30 is testing the larger MQ-8C model in partnership with Northrup-Grumman.

MQ-8C Fire Scout

Commercial Aviation

F-21 Kfir (ATAC)

The F-21 Kfir fighter jet is a single-seat, multi-task, fighter aircraft. In 1975, the Israel Aerospace Industries built the aircraft for the Israeli Air Force and to meet the requirements of United States Navy and Air Force training programs. As such, the aircraft was sold/leased to various countries. The Navy and Marine Corps leased 27 aircraft with the designation F-21A for use as aggressor aircraft (i.e., aircraft that represent a "threat") in air combat training. Today, ATAC uses the F-21 as an adversary aircraft for accomplishing training and readiness missions for the Navy and other services.

MK-58 Hunter (ATAC)

The MK-58 Hunter is a transonic, single-seat, fighter aircraft with swept-back wings, variable incidence tail plane, powered flying controls, and cabin pressurization. Originally designed as an air superiority fighter in the 1950s, the MK-58 became the most successful post-war British Military aircraft, with almost 2,000 produced. ATAC also uses the MK-58 as an adversary aircraft for accomplishing training and readiness missions for the Navy and other services.

F-21 Kfir

MK-58 Hunter

General Aviation

G-159 Gulfstream I, G-1159 Gulfstream II/III (Naval Air Warfare Centers)

The G-159 Gulfstream I is a twin-turboprop aircraft first introduced in 1958. The G-1159 Gulfstream II, a twin-engine jet, followed in 1967, and the Gulfstream III was introduced in 1979. The Gulfstream was originally developed as a business/executive aircraft, and was later used by the Navy in a bombardier/navigation training role. At NBVC Mugu, Northrop Grumman uses this aircraft to test electronic and data systems onboard UAS.

Cessna 182/Cessna 206/Cessna 208/Cessna 210 (Naval Air Warfare Centers)

Cessna aircraft are multi-seat, single-engine, prop planes commonly utilized by civilian pilots and flight schools. In the military, this aircraft is primarily used for search and rescue, homeland security support, and airborne communications training. Cessnas aboard NBVC Point Mugu provide support to squadrons and the three warfare centers.

G-1159 Gulfstream III

Cessna 182

3.1.2 Transient Aircraft

The most common transient aircraft utilizing NBVC Point Mugu are described below. In addition to the aircraft listed in this section, E-2C, P-3, and C-130 aircraft from other non-based squadrons utilize the airfield. Other transient aircraft not described below include small turbo-prop passenger planes and single prop passenger planes, and large jet or cargo aircraft, including the C-5, C-17, KC-135, among others.

NBVC Point Mugu also supports aircraft detachments, commonly called "DETs." Detachments are subsections of non-based squadrons that conduct scheduled training events at other installations. The DETs scheduled out of NBVC Point Mugu commonly use the Sea Range for training exercises and utilize NBVC Point Mugu for maintenance and refueling requirements.

F/A-18C Hornet

MV-22B Osprey

MH-60 R/S Seahawk

F/A-18C/D Hornet and F/A-18 E/F Super Hornet

The combat-proven F/A-18 Hornet is the first tactical aircraft designed from its inception to carry out both air-to-air and air-to-ground missions. The F/A-18 can deliver conventional air-to-air and air-to-ground weapons for various missions. Use of the F/A-18C/D/E/F will transition to the F-35 in the future. Typical transient F/A-18 aircraft are homebased out of NAS Lemoore, California.

MV-22B Osprey

The MV-22B Osprey is a tilt-rotor, vertical/short takeoff and landing aircraft designed to accomplish medium-lift missions. The MV-22B can operate as a helicopter or a turboprop aircraft and offers twice the speed, six times the range, and three times the payload of the aircraft it replaced (CH-46). Transient MV-22B aircraft are used by marine squadrons from Marine Corps Air Station (MCAS) Miramar and MCAS Camp Pendleton. An emerging mission of the MV-22 is for carrier onboard delivery, replacing the C-2.

MH-60 R/S Seahawk

The MH-60 R/S Seahawk is a four-blade, twin-engine, medium-lift, utility helicopter designed for various missions. The MH-60R focuses on anti-submarine warfare, anti-surface warfare, surveillance, communications relay, combat search and rescue, naval gunfire support, and logistics support. The MH-60S missions include anti-surface warfare, combat support, humanitarian disaster relief, combat search and rescue, and medical evacuation. Helicopter detachments from MH-60S squadrons homeported at NAS North Island in San Diego, California, conduct essential Fleet training while operating from NBVC Point Mugu.

3.1.3 Projected Missions

Aircraft that are expected to operate as based or transient aircraft at NBVC Point Mugu in the prospective scenario are addressed in this AICUZ Study. These aircraft are described below.

F-35 Lightning II (Transient)

The F-35 Lightning II is a fifth-generation, single-seat, single-engine, stealth, multi-role fighter that can perform close air support, tactical bombing, and air defense missions. The F-35 has three variants: (1) conventional takeoff and landing; (2) short takeoff and vertical landing; and (3) carrier-based. The F-35 is programmed to replace F/A-18C/D/E/F aircraft by transitioning one squadron at a time. This transition is expected to begin within the next five years and continue over the next 10 to 20 years. NBVC Point Mugu anticipates the F-35 A/B variants to utilize airfield facilities.

C-20 Gulfstream III (VX-30)

The C-20 Gulfstream III is expected to replace the P-3C when it is no longer in active service at VX-30. The C-20 is a military version of the Gulfstream III aircraft. The C-20 is a twin-engine, turbofan aircraft that seats 12 people and is capable of all-weather, long-range, high-speed, nonstop, transoceanic flights. The Navy primarily uses the C-20 to transport high-ranking military officials and provides long-range global airlift and logistical support (NAVAIR 2012a).

C-37 Gulfstream V (VX-30)

The C-37 is expected to replace the range clearance operations of the S-3B after it retires from naval service. The C-37 is the military version of the Gulfstream V aircraft. This aircraft is a low-wing business jet capable of all-weather, long-range, high-speed, nonstop flights. The C-37 is primarily used for passenger airlift and can seat 14 people (NAVAIR 2012b).


F-35 Lightning II


C-20 Gulfstream III


C-37 Gulfstream V


EA-18G Growler


MQ-4C Triton

MH-65D Dolphin

EA-18G Growler (Transient)

The EA-18G Growler is an Airborne Electronic Attack aircraft. The EA-18G will replace the EA-6B, providing the capability to detect, identify, locate, and suppress hostile emitters. The EA-18G will have the capability to operate autonomously or conduct relay operations in support of large-scale operations. Transient EA-18G aircraft operations are expected to increase at the same rate that EA-6B operations at NBVC Point Mugu decrease.

MQ-4C Triton UAS (Naval Air Warfare Centers,VUP-19 DET Point Mugu)

The MQ-4C Triton is an unmanned aerial vehicle and is based on the proven RQ-4B Global Hawk UAS. The MQ-4C incorporates a reinforced airframe and wing and a new de-icing and lightning protection systems. The Triton includes the AN/ZPY-3 multi-function active-sensor radar system, allowing it to survey more than 2.7 million square miles in a single mission. The MQ-4C will supply the Navy with a persistent global intelligence, surveillance, and reconnaissance system to protect the Fleet and to detect, track, classify, and identify maritime, littoral, and land targets.

MH-65D Dolphin Helicopter (USCG)

The MH-65D Dolphin is an all-weather twin-engine, single main rotor helicopter operated by the United States Coast Guard (USCG) primarily for search and rescue operations. The aircraft is also used for homeland security patrols, cargo transport, and drug interdiction operations. The aircraft is flown by a crew of four, including two pilots, one flight mechanic, and one rescue swimmer/emergency medical technician. In April 2015, the USCG announced that two air crews and helicopters serving the greater Los Angeles area would begin operating out of NBVC Point Mugu while a permanent new base of operations is being selected and constructed. Construction and outfitting of the new facility could take several years.

UCLASS (Naval Air Warfare Centers)

UCLASS will be the first deployed carrier-based UAS and will provide persistent, unmanned, semi-autonomous, carrier-based intelligence, surveillance, reconnaissance, and targeting with precision strike capability to support 24/7 carrier operational coverage.

3.2 Aircraft Operations at NBVC Point Mugu

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 NBVC Point Mugu: pre-flight and maintenance operations and 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 pads. Engine maintenance activities include engine rinses and washes, maintenance turns, and high-power turns. Sometimes the engine may be removed from the aircraft and placed on an engine stand. Pre-flight and engine maintenance run-up locations are depicted on Figure 3-1 and illustrate the differences between historic, baseline, and prospective locations. Over time, pre-flight and engine maintenance locations have adapted to accommodate a variety of aircraft, to include new aircraft operating at NBVC Point Mugu, and to accommodate prospective requirements. Prospective maintenance run-up sites are closer to aircraft operations and reduce noise impacts along the shoreline. The noise associated with pre-flight and engine maintenance run-ups was included in the noise analysis and in the modeling associated with the historic, baseline, and prospective conditions, and is discussed in detail in Section 4.2, NBVC Point Mugu Airfield Noise Sources and Noise Modeling.

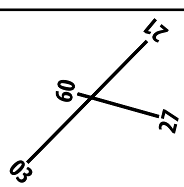
3.2.2 Flight Operations

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 NBVC Point Mugu are described below and depicted on Figure 3-2.

Path: \\prtbhp1\GIS\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_3-1_Maintenance_Operations.mxd 1/6/2016

SCALE

0 1 Miles



Legend

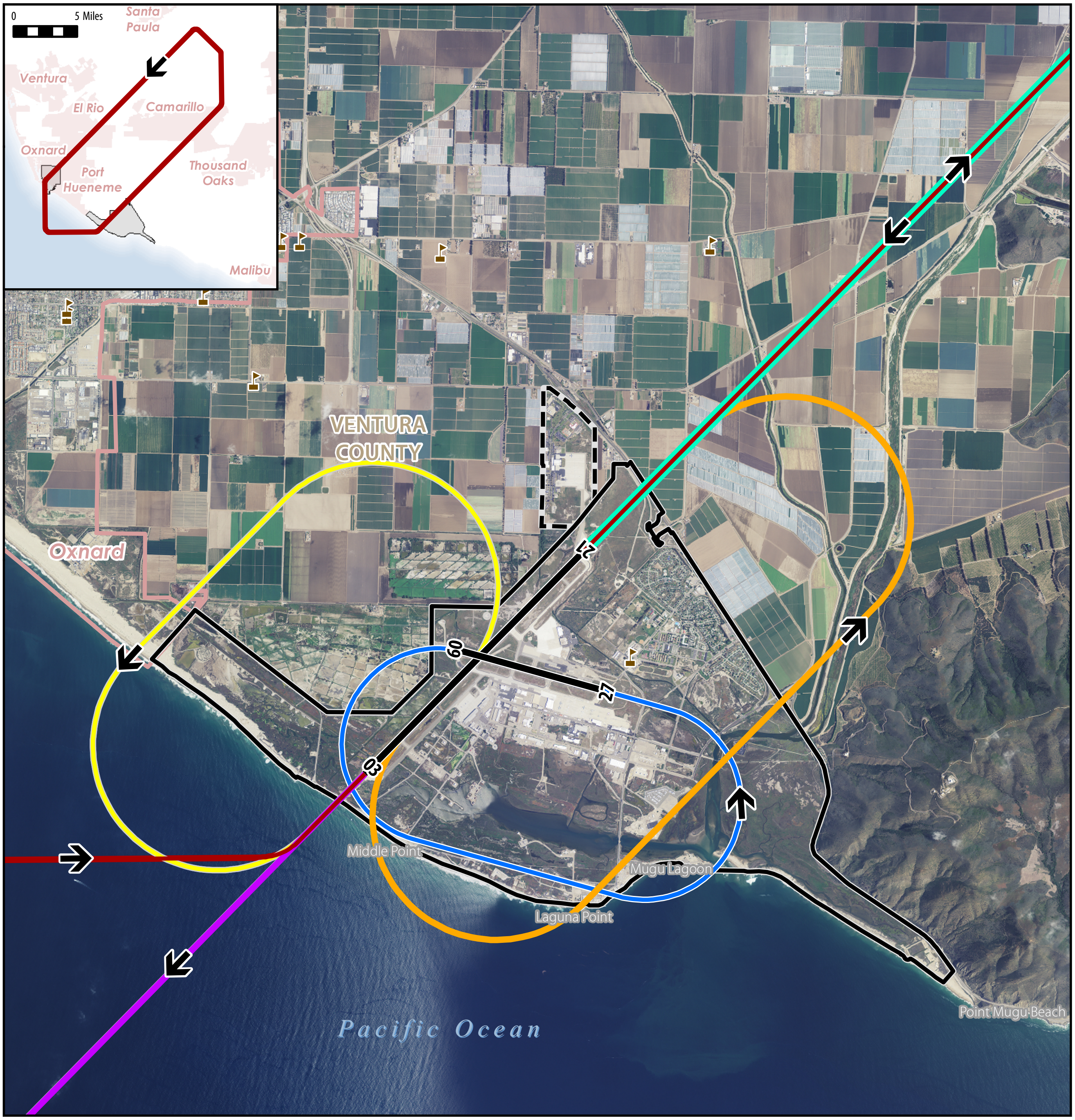
- NBVC Point Mugu Installation Boundary
- California Air National Guard
- Runway
- Baseline Run-up Location
- Prospective Run-up Location
- Historic Run-up Location
- School
- Municipal Boundary
- Highway
- Street

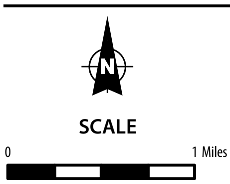
Figure 3-1
Pre-Flight and Engine Maintenance Operations Locations

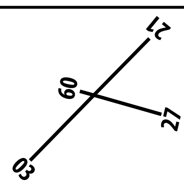
NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Navy, 2012; Google Maps Schools 2012

Path: \\Prtbhp1\gis\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_3-2_Representative_Tracks.mxd 1/5/2016







Legend

- NBVC Point Mugu Installation Boundary
- California Air National Guard
- Runway
- School
- Municipal Boundary
- Waterbody
- Highway
- Street
- Straight-In/Full-Stop Arrival: 21A2
- Overhead Break Arrival: 03O2
- Field Carrier Landing Practice (FCLP): 27F1
- Ground Control Approach (GCA): 21G1
- Touch-and-Go: 21T1
- Departure: 21D1

Figure 3-2
Representative Flight Tracks

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Navy, 2012; Google Maps Schools 2012

- 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.
- 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 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 done 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 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. Figure 3-2 depicts a representative flight track for each of the operations described above, and flight tracks are further discussed in Section 3.2.3, Annual Operations.

3.2.3 Annual Operations

"Annual operations" describe all aircraft operations that occur at NBVC Point Mugu during a calendar year, including based and transient aircraft. 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. The airfield utilizes a Visual Information Display System (VIDS), which combines the processing, control, and display of several small ATC systems into a single integrated information management system. VIDS contains detailed historic flight information, including flight operations by aircraft type, operation performed, runway utilized, and time of day of the operation. For the baseline and prospective scenarios analyzed in this AICUZ Study, operation source data were acquired from VIDS data, Air Traffic Activity Reports that are maintained by ATC personnel, interviews with ATC and squadron personnel, and key documents that reference projected operations at the airfield. The prospective scenario was then adjusted to account for planned changes the Navy anticipates will occur prior to CY2020.The historic scenario, as presented in the 1992 AICUZ Study, utilized ATC tower report logs and interviews.

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;
- Identified as based or transient;
- Squadron the aircraft is assigned to;
- Time of day the operation is conducted;
- Operation performed;
- Runway the operation is conducted on; and
- 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 historic, baseline, and prospective scenarios. 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 three operational scenarios:

- The historic scenario, or 1992 AICUZ Study (which used CY1990 data);
- The baseline scenario, or five-year (CY2009-2013) average of flight operations; and
- The prospective scenario, or future (CY2020) level for operations.

This section describes how operations information was gathered and provides a concise interpretation of operations data for each of the three scenarios listed above. Tables 3-1 to 3-6, provided at the end of the discussion, present the operational factors, tempos, and environment for each scenario.

Historic Scenario (CY1990)

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 historic scenario's 69,160 annual operations (see Table 3-1) are attributed to the variety of missions and based aircraft that were at the airfield during CY1990, including two types of helicopters (H-60 and UH-1). The helicopter was the most frequently used aircraft and accounted for over 28 percent of based aircraft annual operations, followed by the C-130 (15 percent), F-18 (13 percent), and P-3 (9 percent). Approximately 95 percent of annual operations were from based aircraft, and the remaining 5 percent was attributed to transient aircraft operations (Table 3-2). Pattern operations were performed most frequently, representing 68 percent of all operations, or approximately 47,000 annual operations. The majority (82 percent) of all operations were conducted during daytime hours (7:00 a.m. to 7:00 p.m. [0700 to 1900]), 17 percent were conducted during evening hours (7:00 p.m. to 10:00 p.m. [1900 to 2200]), and the remaining 1 percent were conducted during nighttime hours (10:00 p.m. to 7:00 a.m. [2200 to 0700]).

Baseline Scenario (five-year average CY2009-2013)

As shown in Table 3-1, from the historic scenario, baseline operations have decreased to 29,493 total operations. The primary factor attributed to the decrease is the reduction in pattern operations flown at the airfield. Pattern operations decreased by approximately 37,000 annual operations, from 68 percent of the historic annual operations to 31 percent (or 9,201 operations) of the baseline annual operations (see Table 3-3). The number of annual arrivals and departures are similar for the historic to baseline scenarios, at approximately 11,000 and 10,000, respectively. The daytime, evening, and nighttime split of operations also is similar with the historic scenario, at 81 percent, 16 percent, and 3 percent, respectively.

The baseline scenario is comprised of a mix of aircraft, both based and transient. While there was a loss of based aircraft during this time (A-3, A-6, F-86, F-4, F-14, F-18, C-12, H-46, UH-1, and H-60), there was also a gain of new aircraft (E-2C, P-3, S-3, F-21, MK-58, MQ-8C, and a mix of general aviation aircraft) (see Table 3-5). The most notable difference is the addition of the four E-2C squadrons, which contribute over 11,000 annual operations, or approximately 38 percent of annual flight operations, in the baseline scenario. The E-2Cs conduct approximately 75 percent of all pattern operations, and 35 percent of those are FCLPs. The FCLP patterns are designed to simulate the requirements of landing on the deck of a carrier and provide required training for the E-2C squadrons in advance of deployment. The second most frequent aircraft operating at the airfield in the baseline scenario is the C-130, which includes VX-30, reserve squadron VR-55, and the Channel Islands Air National Guard. C-130 operations account for 9 percent of annual flight operations.

The Channel Islands Air National Guard began operations at NBVC Point Mugu in 1990 and conduct nearly 2,000 operations annually. The other VX-30 aircraft (P-3, S-3, and MQ-8B/C) perform approximately 1,300 annual operations while conducting their mission. ATAC, which provides a critical component to the Navy's training program, contributes approximately 1,500 annual operations in their role as adversary aircraft. Noteworthy contributors to total flight operations are air carriers and general aviation (22 percent). Over 4,000 annual operations support the Air Warfare Centers and transport passengers to San Nicolas Island, NAWS China Lake, or other support facilities.

The transient aircraft category is approximately 22 percent of the total flight operations in the baseline scenario (see Table 3-3), and transient fighters (FA-18) account for 3 percent of total annual operations. A majority of these operations are attributed to F/A-18s based at NAS Lemoore. However, rotary-wing aircraft are the most significant contributor to the transient counts, at approximately 3,450 annual operations, or 12 percent of total annual operations. Helicopter squadrons based out of NAS North Island routinely utilize the airfield as detachments conducting training events. Other military transient aircraft include E-2Cs, P-3s, C-2s, and C-130s and contribute approximately 1,150 operations annually. Civilian operations (approximately 2,200) account for the remainder of transient operations and include C-172, PA28, and P-68, among others.

Prospective Scenario (CY2020)

AICUZ studies account for future missions and operations. As such, this AICUZ Study provides analysis for the prospective scenario and incorporates known and anticipated changes in mission and operations for 2015 through 2020 (see Table 3-4). Relative to the baseline scenario, the changes for the prospective scenario include:

- An increase in E-2 flight operations by 65 percent
  - Existing E-2 squadrons will increase aircraft from four to five per squadron
  - A fifth E-2 squadron (VAW-115) (five aircraft) will base at NBVC Point Mugu
  - Training operations from East Coast E-2 Squadrons will increase
- Introduction of based UAS
  - UCLASS aircraft
  - MQ-8B/C
  - MQ-4C
- Changes in transient operations
  - 10 percent increase in transient F/A-18 flight operations
  - 50 percent increase in transient MV-22 operations
  - Addition of 250 annual transient F-35 operations
  - Transient EA-6B aircraft will be replaced by EA-18G aircraft

- Changes in VX-30 aircraft mix
  - S-3 and P-3 operations will cease due to aircraft retirement
  - Addition of based C-20 and C-37 aircraft
- An increase in evening (7:00 p.m. to 10:00 p.m. [1900 to 2200]) operations from 16 percent to 18 percent of total flight operations, with nighttime (10:00 p.m. to 7:00 a.m. [2200 to 0700]) operations remaining at 3 percent
- Change in run-up locations for engine maintenance activity
  - Run-up activity for E-2 will move from RU-12 to RU-1B and from outdoor test stand RU-13 to RU-13A (see Figure 3-1)

Based on the changes listed above, the Navy forecasts that total operations at NBVC Point Mugu will increase to approximately 39,500 annual flight operations in CY2020 (see Table 3-6). This represents an increase of 34 percent for annual flight operations relative to baseline. Approximately 75 percent of all flight operations will be generated from based aircraft. E-2C operations are attributed to 65 percent of the annual increase in operations. The operation type and the time of the day the operations occur are scaled to remain consistent with the baseline scenario.

Flight operations during the evening (7:00 p.m. to 10:00 p.m. [1900-2200]) and nighttime (10:00 p.m. to 7:00 a.m. [2200-0700]) will remain similar to the baseline scenario, at 18 percent and 3 percent, respectively (see Table 3-1). The E-2C will remain the most frequently utilized aircraft at NBVC Point Mugu, with 47 percent of total flight operations, and the C-130 and C-130J will contribute to 11 percent of annual flight operations. The addition of UAS operations (approximately 2,500 annually) will consist of arrivals and departures only, with 15 percent pattern activities. Transient fighter aircraft will continue to account for 3 percent of total annual flight operations.

TABLE 3-1 OVERVIEW OF ANNUAL OPERATIONS FOR THREE OPERATIONS SCENARIOS

SCENARIO	TOTAL ANNUAL OPERATIONS							CHANGE IN OPS FROM BASELINE
	DAYTIME		EVENING		NIGHTTIME		TOTAL	
	OPS	%	OPS	%	OPS	%	OPS	
Historic (CY1990)[a]	56,390	82%	11,769	17%	1,001	1%	69,160	39,667
Baseline (5-Year Average CY2009-2013)[b]	23,955	81%	4,720	16%	818	3%	29,493	--
Prospective (CY2020)[b]	31,327	79%	6,923	18%	1,204	3%	39,454	9,961

Sources:
(a) Navy 1992 and HMMH 1990
(b) Wyle 2014
Notes:
Daytime hours are from 7:00 a.m. to 7:00 p.m. (0700 to 1900).
Evening hours are from 7:00 p.m. to 10:00 p.m. (1900 to 2200).
Nighttime hours are from 10:00 p.m. to 7:00 a.m. (2200 to 0700).
Key:
% = percent of operations conducted during that time of day
Ops = operations

TABLE 3-2 HISTORIC SCENARIO (CY1990)

GROUP		AIRCRAFT	DEPARTURE				ARRIVALS (STRAIGHT-IN, OVERHEAD BREAK, CARRIER BREAK)				PATTERNS (TOUCH-AND-GO, GCA, FCLP)				TOTAL ANNUAL OPERATIONS			
			DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL
Based	Military	A-3, A-6, A-7, F-86, F-4, F-14, F-18, C-12, C-130, P-3, H-46, UH-1, H-60	9,075	1,847	32	10,954	8,873	1,863	91	10,827	37,879	8,038	878	46,795	55,827	11,748	1,001	68,576
	Based Totals		**9,075**	**1,847**	**32**	**10,954**	**8,873**	**1,863**	**91**	**10,827**	**37,879**	**8,038**	**878**	**46,795**	**55,827**	**11,748**	**1,001**	**68,576**
Transient*	All Aircraft Types	T-38 (C-130,C-12, CV-440, CV-340, CV-580T)	260	10	0	270	260	9	0	269	43	2	0	45	563	21	0	584
	Transient Totals		**260**	**10**	**0**	**270**	**260**	**9**	**0**	**269**	**43**	**2**	**0**	**45**	**563**	**21**	**0**	**584**
Grand Totals			**9,335**	**1,857**	**32**	**11,224**	**9,133**	**1,872**	**91**	**11,096**	**37,922**	**8,040**	**878**	**46,840**	**56,390**	**11,769**	**1,001**	**69,160**

Notes:
* = Representative list of transient aircraft
Daytime hours are from 7:00 a.m. to 7:00 p.m. (0700 to 1900).
Evening hours are from 7:00 p.m. to 10:00 p.m. (1900 to 2200).
Nighttime hours are from 10:00 p.m. to 7:00 a.m. (2200 to 0700).

TABLE 3-3 BASELINE SCENARIO (FIVE-YEAR AVERAGE CY2009-2013)

GROUP		AIRCRAFT	DEPARTURE				ARRIVALS (STRAIGHT-IN, OVERHEAD BREAK, CARRIER BREAK)				PATTERNS (TOUCH-AND-GO, GCA, FCLP)				TOTAL ANNUAL OPERATIONS			
			DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL
Based	Military	E-2C, P-3, S-3, C-130, H-25, F-21, MQ-8B/C, C-130 (ANG)	3,807	917	187	4,911	3,701	1,024	186	4,911	6,107	2,136	381	8,624	13,615	4,077	754	18,446
	Air Carrier	G-159, E-120	1,542	14	16	1,572	1,562	10	0	1,572	0	0	0	0	3,104	24	16	3,144
	Gen Aviation	C-182, C-206, C-208, C-210	644	72	7	723	611	111	1	723	0	0	0	0	1,255	183	8	1,446
	Based Totals		**5,993**	**1,003**	**210**	**7,206**	**5,874**	**1,145**	**187**	**7,206**	**6,107**	**2,136**	**381**	**8,624**	**17,974**	**4,284**	**778**	**23,036**
Transient*	Fighter	F-16, F/A-18, F-15, AV-8, EA-6, T-34	344	41	0	385	366	19	0	385	51	9	0	60	761	69	0	830
	Helo	AH-1, UH-1, H-46, H-53, H-60, AH64, H-65, V-22	1,494	87	20	1,601	1,495	90	16	1,601	198	31	2	231	3,187	208	38	3,433
	Civil Transport	B-737, B-707, B-744, B-752, C-2, C-5, C-9, C-17, C-40, C-172, DC9, E-2C, KC-135, BE20, B-20, HU16, P-3, P8, PA31, PA28, P-68	931	22	1	954	925	28	1	954	177	109	0	286	2,033	159	2	2,194
	Transient Totals		**2,769**	**150**	**21**	**2,940**	**2,786**	**137**	**17**	**2,940**	**426**	**149**	**2**	**577**	**5,981**	**436**	**40**	**6,457**
Grand Totals			**8,762**	**1,153**	**231**	**10,146**	**8,660**	**1,282**	**204**	**10,146**	**6,533**	**2,285**	**383**	**9,201**	**23,955**	**4,720**	**818**	**29,493**

Notes:
* = Representative list of transient aircraft
Daytime hours are from 7:00 a.m. to 7:00 p.m. (0700 to 1900).
Evening hours are from 7:00 p.m. to 10:00 p.m. (1900 to 2200).
Nighttime hours are from 10:00 p.m. to 7:00 a.m. (2200 to 0700).

TABLE 3-4 PROSPECTIVE SCENARIO (CY2020)

GROUP		AIRCRAFT	DEPARTURE				ARRIVALS (STRAIGHT-IN, OVERHEAD BREAK, CARRIER BREAK)				PATTERNS (TOUCH-AND-GO, GCA, FCLP)				TOTAL ANNUAL OPERATIONS			
			DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL	DAY	EVE	NIGHT	TOTAL
Based	Military	E-2C, C-130, C-20, C-37, MK-58, F-21, MQ-8B/C, UCLASS, MQ-4C, C-130 (ANG)	6,026	1,369	268	7,663	5,921	1,476	266	7,663	8,705	3,428	607	12,740	20,652	6,273	1,141	28,066
Based	Air Carrier	G-159, E-120	1,543	14	15	1,572	1,563	9	0	1,572	0	0	0	0	3,106	23	15	3,144
Based	Gen Aviation	C-182, C-206, C-208, C-210	643	73	7	723	611	111	1	723	0	0	0	0	1,254	184	8	1,446
Based	**Based Totals**		**8,212**	**1,456**	**290**	**9,958**	**8,095**	**1,596**	**267**	**9,958**	**8,705**	**3,428**	**607**	**12,740**	**25,012**	**6,480**	**1,164**	**32,656**
Transient*	Fighter	F-16, F/A-18, F-35, F-15, AV-8, EA-18G, T-34	470	45	0	515	495	21	0	516	106	10	0	116	1,071	76	0	1,147
Transient*	Helo	AH-1, UH-1, H-46, H-53, H-60, AH64, H-65, V-22	1,504	87	20	1,611	1,505	90	16	1,611	202	31	2	235	3,211	208	38	3,457
Transient*	Civil Transport	B-737, B-707, B-744, B-752, C-2, C-5, C-9, C-17, C-40, C-130, C-172, DC9, E-2C, KC-135, BE20, B-206, HU16, P-3, P8, PA31, PA28, P-68	931	22	1	954	925	28	1	954	177	109	0	286	2,033	159	2	2,194
Transient*	**Transient Totals**		**2,905**	**154**	**21**	**3,080**	**2,925**	**139**	**17**	**3,081**	**485**	**150**	**2**	**637**	**6,315**	**443**	**40**	**6,798**
Grand Totals			**11,117**	**1,610**	**311**	**13,038**	**11,020**	**1,735**	**284**	**13,039**	**9,190**	**3,578**	**609**	**13,377**	**31,327**	**6,923**	**1,204**	**39,454**

Notes:
* = Representative list of transient aircraft
UCLASS – F-4 and F-16's used as surrogates for noise modeling purposes.
Daytime hours are from 7:00 a.m. to 7:00 p.m. (0700 to 1900).
Evening hours are from 7:00 p.m. to 10:00 p.m. (1900 to 2200).
Nighttime hours are from 10:00 p.m. to 7:00 a.m. (2200 to 0700).

TABLE 3-5 ANNUAL OPERATIONS – BASELINE SCENARIO (FIVE-YEAR AVERAGE CY2009-2013)

AIRCRAFT TYPE	SQUADRON	OPERATION TYPE	NUMBER OF ANNUAL OPERATIONS			
			DAY	EVENING	NIGHT	TOTAL
E-2C	VAW-112,113,116,117	Departure and Arrival	2,967	1,393	246	4,606
		Closed Pattern	4,249	1,996	354	6,599
P-3	VX-30	Departure and Arrival	458	6	6	470
		Closed Pattern	109	2	2	113
S-3	VX-30	Departure and Arrival	541	26	25	592
		Closed Pattern	131	5	5	141
C-130	VX-30, VR-55	Departure and Arrival	1,682	278	82	2,042
		Closed Pattern	408	68	20	496
Hunter	ATAC	Departure and Arrival	596	26	0	622
		Closed Pattern	243	7	0	250
Kfir	ATAC	Departure and Arrival	406	8	0	414
		Closed Pattern	203	3	0	206
Fire Scout	VX-30	Departure and Arrival	14	0	0	14
		Closed Pattern	0	0	0	0
C-130J	Channel Islands Air National Guard	Departure and Arrival	844	204	14	1,062
		Closed Pattern	764	55	0	819
Air Carrier (G-159, E-120)	Air Warfare Centers	Departure and Arrival	3,105	23	16	3,144
		Closed Pattern	0	0	0	0
General Aviation (C-182, -206, -208, -210)	Air Warfare Centers	Departure and Arrival	1,254	184	8	1,446
		Closed Pattern	0	0	0	0
Transient	Various	Departure and Arrival	5,555	287	38	5,880
		Closed Pattern	426	149	2	577
		Annual Total	**23,955**	**4,720**	**818**	**29,493**

Source: Wyle 2014
Notes:
Daytime hours are from 7:00 a.m. to 7:00 p.m. (0700 to 1900).
Evening hours are from 7:00 p.m. to 10:00 p.m. (1900 to 2200).
Nighttime hours are from 10:00 p.m. to 7:00 a.m. (2200 to 0700).

TABLE 3-6 ANNUAL OPERATIONS – PROSPECTIVE SCENARIO (CY2020)

AIRCRAFT TYPE	SQUADRON	OPERATION TYPE	NUMBER OF ANNUAL OPERATIONS			
			DAY	EVENING	NIGHT	TOTAL
E-2C	VAW-112,113,116,117	Departure and Arrival	4,896	2,297	407	7,600
		Closed Pattern	7,010	3,293	585	10,888
C-20	VX-30	Departure and Arrival	680	28	26	734
		Closed Pattern	0	0	0	0
C-37	VX-30	Departure and Arrival	320	4	4	328
		Closed Pattern	77	2	2	81
C-130	VX-30, VR-55	Departure and Arrival	1,682	278	82	2,042
		Closed Pattern	408	68	20	496
Hunter	ATAC	Departure and Arrival	596	26	0	622
		Closed Pattern	243	7	0	250
Kfir	ATAC	Departure and Arrival	406	8	0	414
		Closed Pattern	203	3	0	206
Fire Scout	VX-30	Departure and Arrival	500	0	0	500
		Closed Pattern	0	0	0	0
UCLASS	Air Warfare Centers	Departure and Arrival	200	0	0	200
		Closed Pattern	0	0	0	0
MQ-4C UAS	Air Warfare Centers	Departure and Arrival	1,824	0	0	1,824
		Closed Pattern	0	0	0	0
C-130J	Channel Islands Air National Guard	Departure and Arrival	844	204	14	1,062
		Closed Pattern	764	55	0	819
Air Carrier (G-159, E-120)	Air Warfare Centers	Departure and Arrival	3,105	23	16	3,144
		Closed Pattern	0	0	0	0

TABLE 3-6 ANNUAL OPERATIONS – PROSPECTIVE SCENARIO (CY2020)

AIRCRAFT TYPE	SQUADRON	OPERATION TYPE	NUMBER OF ANNUAL OPERATIONS			
			DAY	EVENING	NIGHT	TOTAL
General Aviation (C-182, -206, -208, -210)	Air Warfare Centers	Departure and Arrival	1,254	184	8	1,446
		Closed Pattern	0	0	0	0
Transient	Various	Departure and Arrival	5,830	293	38	6,161
		Closed Pattern	485	150	2	637
		Annual Total	**31,327**	**6,923**	**1,204**	**39,454**

Source: Wyle 2014
Notes:
Daytime hours are from 7:00 a.m. to 7:00 p.m. (0700 to 1900).
Evening hours are from 7:00 p.m. to 10:00 p.m. (1900 to 2200).
Nighttime hours are from 10:00 p.m. to 7:00 a.m. (2200 to 0700).

3.2.4 Runway and Flight Track Utilization

NBVC Point Mugu has two runways:

- Runway 03/21 is 11,100 feet long and 200 feet wide. Runway 21 is the primary runway and supports the majority of aircraft operations
- Runway 09/27 is 5,500 feet long and 200 feet wide.

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.

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 NBVC Point Mugu 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 NBVC Point Mugu follow the course rules in the Air Ops Manual.

The changes in runway utilization from historic, to baseline, to prospective levels is shown in Table 3-7. Runway utilization varies significantly by aircraft type, although Runway 21 is the primary runway utilized in the baseline and prospective scenarios.

TABLE 3-7 CHANGES IN RUNWAY UTILIZATION

RUNWAY	PERCENT UTILIZATION FOR EACH SCENARIO		
	HISTORIC[a]	BASELINE[b]	PROSPECTIVE[b]
3	23	14	12
21	57	59	57
9	3	1	1
27	17	26	31

Sources:
(a) Navy 1992 and HMMH 1990
(b) Wyle 2014

Flight tracks are nominal representations of an aircraft's typical route and demonstrate how and where aircraft fly in relation to an airfield. Flight tracks provide safety, consistency, and control of an airfield. Flight tracks are bands, often a few hundred feet to several miles wide. The flight tracks and utilization data collected as part of this AICUZ Study inform the flight frequency concentrations of aircraft flights for the baseline and prospective 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. Flight tracks remain identical to the baseline scenario in the prospective scenario. Based and transient flight frequencies are shown separately to emphasize the frequency of each and to acknowledge the transient overflight areas and the associated noise exposure.

Figure 3-3 depicts the flight frequency concentrations of all aircraft flights for the baseline scenario. The highest density of aircraft activity occurs along Runway 03/21, extending 5 miles northeast along the runway heading. Areas west of the airfield have less than 500 events per year.

Figure 3-4 depicts the flight concentration of transient aircraft for the baseline scenario. A similar trend on Figure 3-3 is seen on Figure 3-4, but with lower concentrations along Runway 03/21. The areas to the west of NBVC Point Mugu and along the GCA box pattern also show a smaller concentration, with flight densities of less than 300 events per year in most areas.

Figure 3-5 depicts the flight frequency concentrations of aircraft flights for the prospective scenario. The highest density of aircraft activity will remain along Runway 03/21, extending 5 miles northeast along the runway heading, with an increase in flight density of approximately 20 percent. Areas west of NBVC Point Mugu will experience increases in flight density of up to 65 percent per year, primarily due to the increase in E-2 operations.

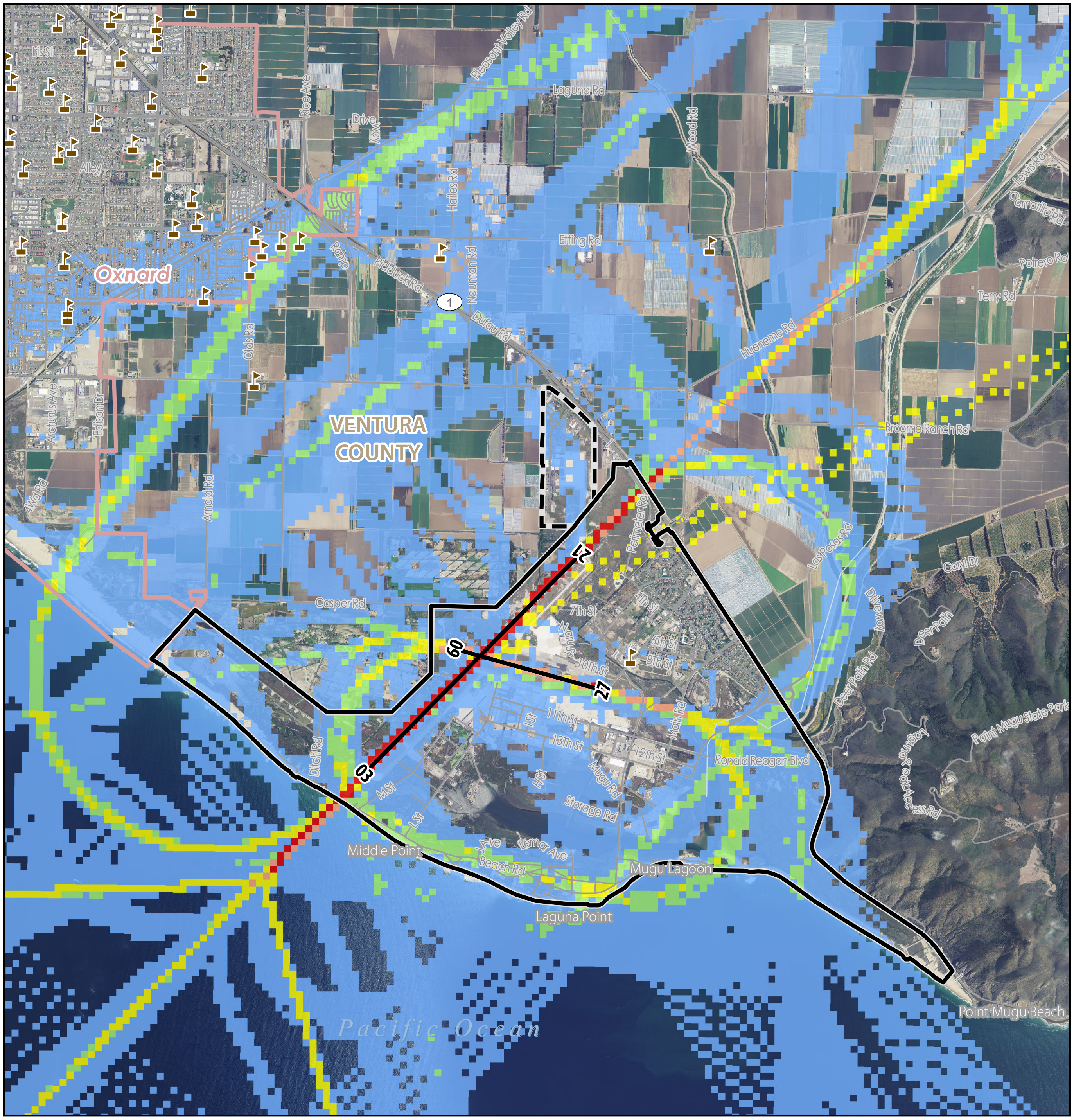
Figure 3-6 depicts the flight concentration of transient aircraft for the prospective scenario, primarily comprised of helicopters, fighter jets, small turboprop, and C-130 aircraft. There will be only a small increase (5 percent) in overall transient flight density under the prospective scenario relative to the baseline. The primary cause for the increase will be additional fighter aircraft that will continue to utilize Runway 21 for most arrivals (approaching from the northeast) and departures (taking off out over the ocean). The transient fighter jets will occasionally perform closed pattern operations (e.g., touch-and-go and GCA box patterns). The other cause for the increase in transient flights will be MV-22 operations, which will utilize similar flight corridors as those used by the C-130.

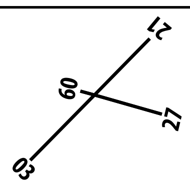
3.2.5 Camarillo Airport Operations

Camarillo Airport, a general aviation airport, is located approximately 6 miles north of NBVC Point Mugu in Ventura County. The airport supports general aviation (typically small propeller type aircraft and flight instruction), aircraft maintenance, and aircraft charter and storage. The Ventura County Department of Airports reported that there were 510 based aircraft at Camarillo Airport and approximately 148,000 annual operations for 2013 (Ventura County 2014a). Of the based aircraft at Camarillo Airport in 1998 (the most recent information available), approximately 92 percent were propeller aircraft, with the remaining 8 percent split between jet aircraft and helicopters (Ventura County 2008).

While primarily utilized by general aviation aircraft, ATAC, a Navy contractor, utilizes the services provided at Camarillo Airport. ATAC conducts operations (straight-in arrivals and departures) for training and readiness missions at Camarillo Airport approximately 20-30 times per year using two jet aircraft, the Kfir and the Hunter. ATAC aviators adhere to published procedures and noise abatement guidelines; however, the presence of Kfir and Hunter aircraft at Camarillo Airport are noticeable against the small propeller type aircraft seen and heard in the area.

Path: \\Prtbhp1\gis\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_3-3_FlightFreq_Baseline.mxd 12/31/2015





N

SCALE

0 1 Miles

Legend

- NBVC Point Mugu Installation Boundary
- California Air National Guard
- Runway
- School
- Municipal Boundary
- Waterbody
- Highway
- Street

Flights Per 250ft x 250ft Area

- 0-500
- 500-1,000
- 1,000-3,000
- 3,000-5,000
- 5,000+

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Navy, 2012; Google Maps Schools 2012

Figure 3-3

Flight Frequency - Total Annual Baseline Scenario Operations

NBVC
Ventura County, California

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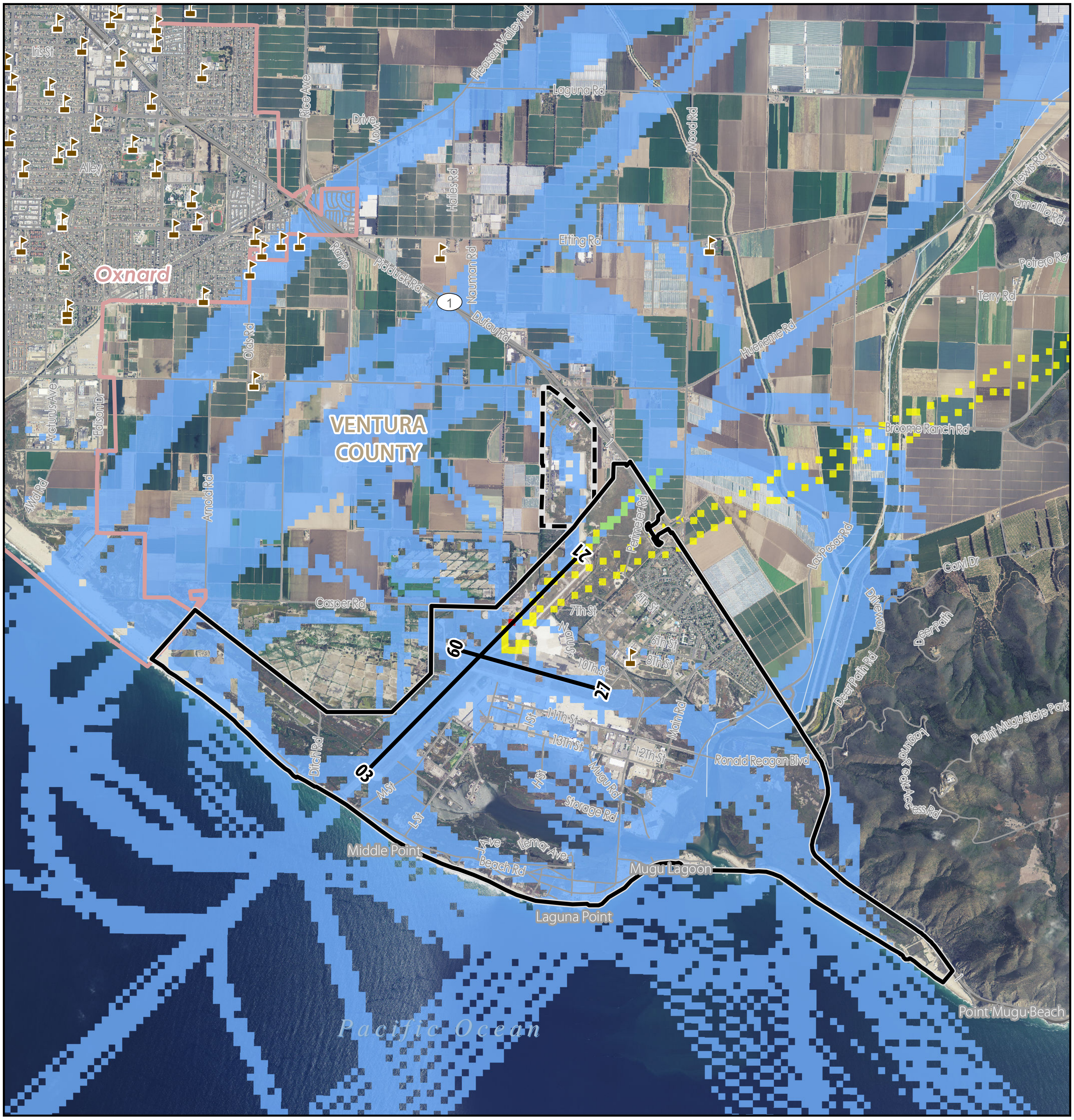
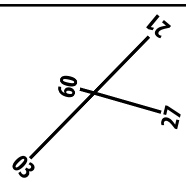




N

SCALE

0 1 Miles

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Navy, 2012; Google Maps Schools 2012

Legend

- NBVC Point Mugu Installation Boundary
- California Air National Guard
- Runway
- School
- Municipal Boundary
- Waterbody
- Highway
- Street

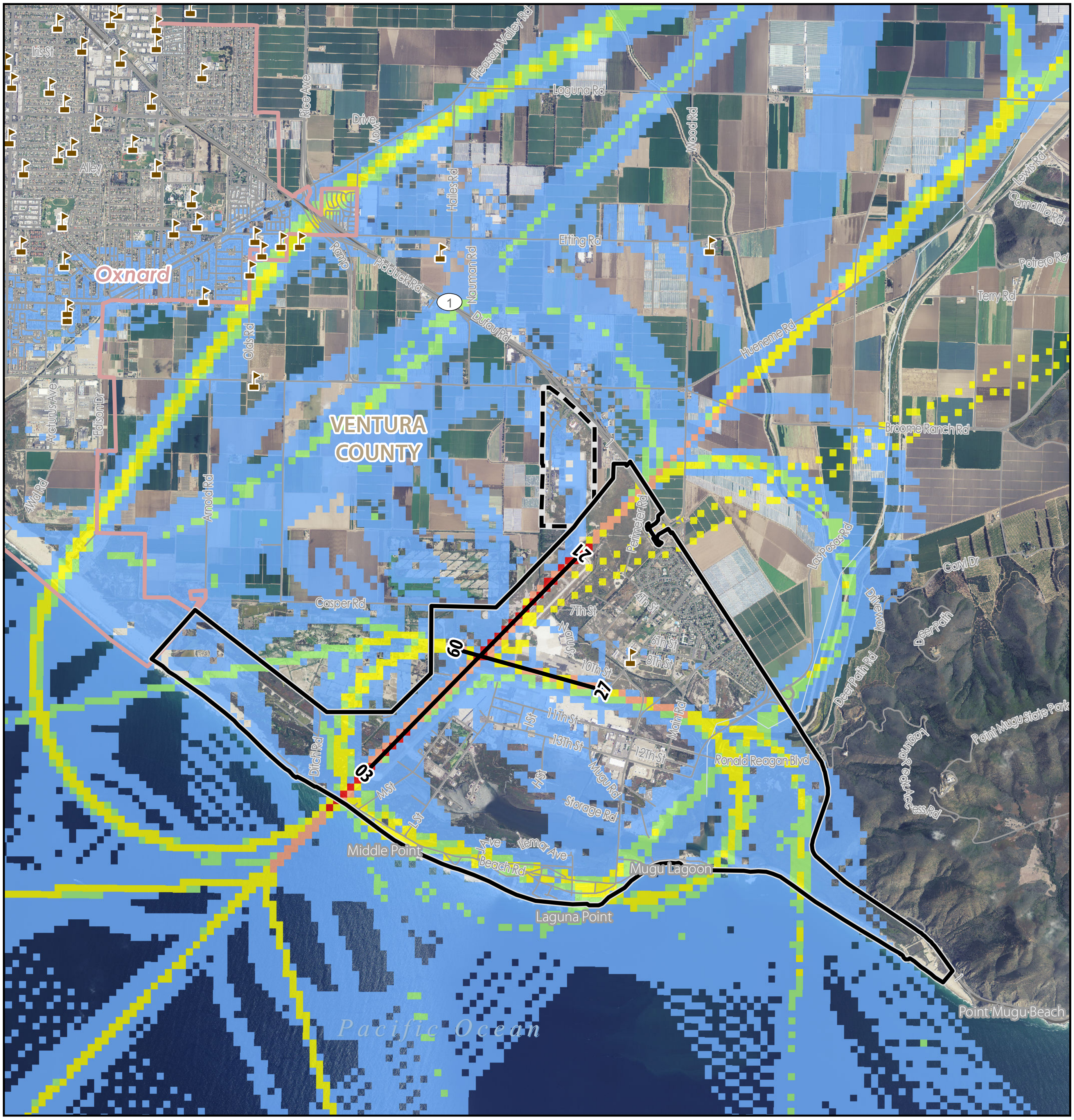
Flights Per 250ft x 250ft Area

- 0-500
- 500-1,000
- 1,000-2,000
- 2,000-3,000
- 3,000+

Figure 3-4
Flight Frequency - Transient Annual Baseline Scenario Operations

NBVC
Ventura County, California

Path: \\Prtbhp1\gis\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_3-5_FlightFreq_Prospective.mxd 12/31/2015



SCALE

0 1 Miles

21 09 27 03

Legend

- NBVC Point Mugu Installation Boundary
- California Air National Guard
- Runway
- School
- Municipal Boundary
- Waterbody
- Highway
- Street

Flights Per 250ft x 250ft Area

- 0-500
- 500-1,000
- 1,000-5,000
- 5,000-10,000
- 10,000+

Figure 3-5

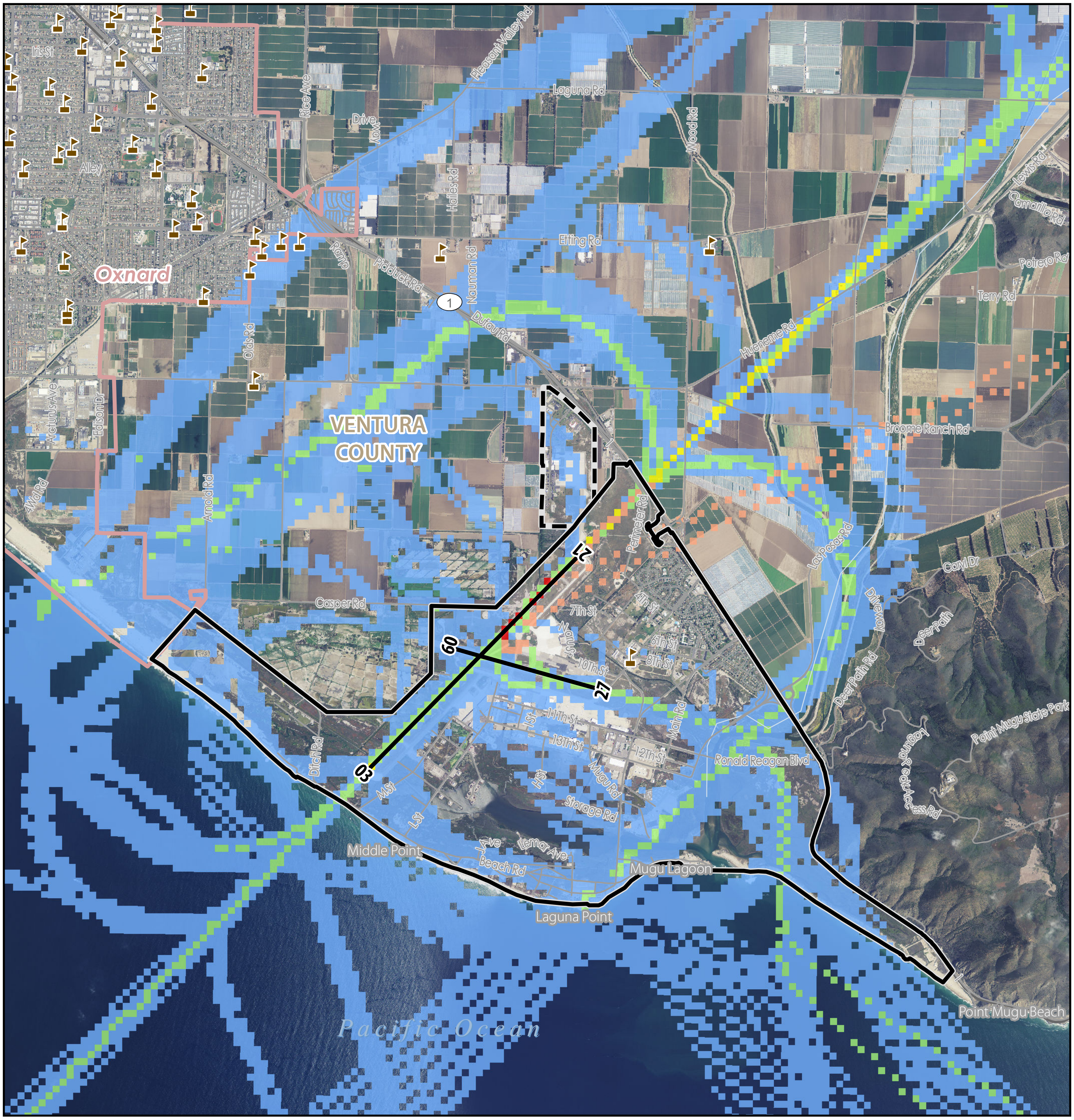
Flight Frequency - Total Annual Prospective Scenario Operations

NBVC

Ventura County, California

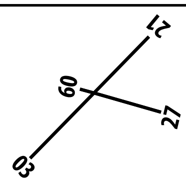
Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Navy, 2012; Google Maps Schools 2012

Path: \\Prtbhp1\gis\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_3-6_FlightFreq_ProspectiveTransient.mxd 12/31/2015



SCALE

0 1 Miles



Legend

- NBVC Point Mugu Installation Boundary
- California Air National Guard
- Runway
- School
- Municipal Boundary
- Waterbody
- Highway
- Street

Flights Per 250ft x 250ft Area

- 0-100
- 100-500
- 500-1,000
- 1,000-2,000
- 2,000+

Figure 3-6

Flight Frequency - Annual Transient Prospective Scenario Operations

NBVC

Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Navy, 2012; Google Maps Schools 2012

Camarillo Airport is within flight paths used by NBVC Point Mugu operators for arrivals, departures, and GCA box patterns. The proximity of military aircraft to Camarillo Airport often results in misrepresentations of noise sources at the airport. Based military aircraft rarely conduct operations at Camarillo Airport (i.e., arrivals or departures), and the presence of military aircraft in the vicinity of the airport is predominately related to overflights arriving to or departing from NBVC Point Mugu.

The noise contours presented in this AICUZ study do not include aircraft operations at Camarillo Airport. The noise contours and impacts associated with Camarillo Airport are presented in the 2000 ACLUP for Ventura County. The ACLUP "is intended to protect and promote the safety and welfare of residents near airports in the county, while promoting the continued operation of those airports" (Coffman Associates, Inc. 2000). The Camarillo Airport noise contours and land use compatibility analysis, developed and presented by Ventura County, are discussed in Section 6.1.4, Ventura County.

3.2.6 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.

NBVC Point Mugu 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 runway in use, arrivals/departures, noise abatement, altitudes and airspeed, allowable weather conditions, and aircraft emergencies. As such, aviators performing operations at NBVC Point Mugu follow established rules and procedures while operating at the airfield. Likewise, aviators perform operations at specific altitudes, airspeeds, 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 NBVC Point Mugu.

NBVC Point Mugu course rules are updated in response to changes in mission and safety hazards and to minimize noise and safety impacts, some of which are operational alternatives. The following course rules are operational alternatives that have been implemented and have, subsequently, reduced off-base noise and impacts:

- The primary use runway (Runway 21) accounts for approximately 85 percent of departures over the ocean, thus avoiding populated areas.
- FCLP is conducted at Runway 27. FCLP at Runway 03 was discontinued due to safety hazards, such as bird/animal aircraft strike hazards (BASH).

- ATAC uses Camarillo Airport for maintenance and re-fueling operations.
- UAS will depart and arrive over the ocean.
- UAS shall minimize flights over buildings and shall not overfly housing areas.
- NBVC Point Mugu operators adhere to noise abatement procedures, discussed in detail in Section 4.3.1, Noise Abatement.

NBVC 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, the capacity to implement operational alternatives is limited by several factors that are outlined in the NBVC Point Mugu Air Ops manual or otherwise identified. These factors consist of limitations or restrictions on flight tracks, altitudes, or runway usage, as described below:

- Runway 21 is the preferred runway for all normal operations due to prevailing winds, weather, and airspace restrictions.
- Certain operations are limited due to high terrain east of the airfield.
- Environmentally protected species in the lagoon areas and along the shoreline require pilots to maintain certain altitudes during arrivals and departures.
- Resident and migratory bird activity increases the potential for BASH. To reduce this hazard, flight patterns are altered during times of increased bird activity.
- Potential for conflict with light/low/slow aircraft in the vicinity of the airfield.
- Variations in flight operations around the installation could shift impacts from agricultural to urbanized areas.

4

AIRCRAFT NOISE

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. Since noise from aircraft operations could impact areas near NBVC Point Mugu, the Navy has analyzed the noise resulting from its aircraft and has established noise exposure contours around the installation using the guidance provided in the AICUZ Instruction. Noise exposure 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 historic, baseline, and prospective noise contours.

4.1 SOUND MEASUREMENTS AND GUIDANCE

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. 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.

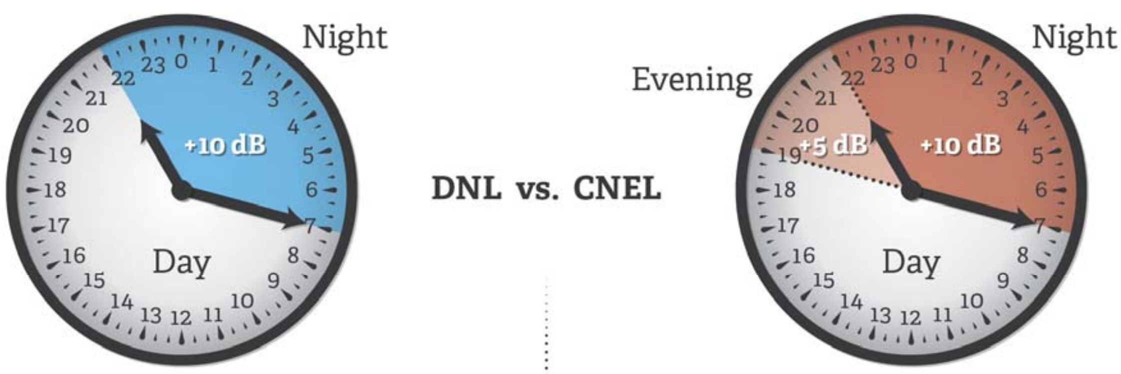
In this AICUZ Study, all noise levels are presented in dBA. For brevity, the adjective "A-weighted" is often omitted and the measurements are expressed as dB.

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 (Berglund and Lindvall 1995), and the threshold of pain is 140 dB.

The noise exposure from aircraft at NBVC Point Mugu, as with all air installations in California, is measured using a variant of 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 is the standard metric used in the United States. The California variant is the Community Noise Exposure Level (CNEL), which is slightly more stringent. The DNL and CNEL metrics present reliable measures of community sensitivity to aircraft noise.

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 was developed by the U.S. Environmental Protection Agency to define the level of noise exposure on a community.

DNL describes the normalized noise level of all aircraft operations over a 24-hour period and does not represent the sound level for a specific event. Noise is measured in intervals (e.g., seconds, minutes, and hours) and normalized over a 24-hour period. *Ten decibels are added to nighttime (10:00 p.m. to 7:00 a.m.) sound levels* to account for heightened sensitivity to noise during night hours.

CNEL was developed similar to DNL and other noise exposure metrics.

As such, CNEL is very similar to DNL except that in addition to *adding 10 decibels to noise levels during nighttime hours, CNEL adds 5 decibels to noise levels during the evening hours (between 7:00 p.m. and 10:00 p.m.)* to account for people's increased sensitivity to noise when they are outdoors, at home, or when fewer noise-producing activities typically occur.

CNEL represents the total sound energy at a location over a 24-hour period. Both CNEL and DNL add 10 dB to events occurring between 10:00 p.m. and 7:00 a.m. (2200 and 0700). CNEL also adds 5 dB to events occurring between 7:00 p.m. and 10:00 p.m. (1900 and 2200). These decibel adjustments represent the added intrusiveness of sounds due to increased sensitivity to noise when ambient sound levels are low.

CNEL 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). Scientific studies and social surveys conducted to evaluate community annoyance with all types of environmental noise have found DNL and CNEL to be the best measures available of community annoyance (Federal Interagency Committee on Urban Noise 1980; Federal Interagency Committee on Noise 1992). Although CNEL 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 CNEL of 65 dBA could result from only a few noisy events or from a large number of quieter events.

The CNEL is depicted on a map as a noise contour that connects point of equal noise value. Contours are displayed in 5-dBA increments (i.e., 60, 65, 70, 75, 80, and 85 DNL). For land use planning purposes, the AICUZ Program divides noise exposure into three categories, known as “noise zones,” based on CNEL measurements.

- Noise Zone 1: 60 to less than 65 CNEL (60 to <65 dB CNEL);
- Noise Zone 2: 65 to less than 75 CNEL (65 to <75 dB CNEL); and
- Noise Zone 3: Greater than or equal to 75 CNEL (≥75 dB CNEL).

Land use recommendations within these zones are discussed and provided in Chapter 7, Land Use Compatibility Analysis and Recommendations. Calculated noise contours do not represent exact measurements and are discussed further in Section 4.3, Noise Abatement and Complaints. Noise levels inside a contour may be similar to those outside a contour line. Where the contour lines are close together, the change in noise level is greater. Where the lines are far apart, the change in noise level is gradual.

4.2 NBVC Point Mugu 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 historic, baseline, and prospective noise contours at NBVC Point Mugu. The Navy utilized NOISEMAP, the DOD standard model for assessing noise exposure from military aircraft operations at air installations. NOISEMAP calculates CNEL 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.

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).

In support of this AICUZ Study, NBVC Point Mugu conducted a noise analysis. As part of the analysis, data for aircraft operations was collected from installation personnel, pilots, ATC, Air Ops, and squadron personnel, as well as from a range of resource documents (e.g., VIDS, Air Traffic Activity Reports, Environmental Assessments, and other publications). Specific data sources are discussed in Section 3.2.3, Annual Operations. The noise analysis was conducted according to DOD guidelines and best practices, and leveraged the DOD NOISEMAP suite of computer-based modeling tools (Wyle 2014). The noise study analyzes aircraft noise generated by aircraft while departing or arriving to NBVC Point Mugu as well as training flight patterns in the vicinity. The noise study also includes an analysis of noise created by parked aircraft conducting engine maintenance tests (Wyle 2014) (see Figure 3-1). CNEL noise contours for average daily flight and run-up events that were computed from this information are discussed in Section 4.4, AICUZ Noise Contours.

4.3 Noise Abatement and Complaints

NBVC Point Mugu implements noise abatement measures, to the best of its ability, commensurate with safety and operational training requirements. Noise abatement procedures are implemented under the Air Ops Manual and are summarized below. The purpose of these procedures is to minimize impacts from aircraft noise. Noise impacts cannot be completely minimized or avoided; therefore, on occasion, NBVC Point Mugu receives calls from concerned citizens regarding noise and manages noise concerns and complaints according to the protocol discussed below.

4.3.1 Noise Abatement

NBVC Point Mugu minimizes aircraft noise in the community by implementing 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 Navy cannot alter critical portions of flight patterns to accommodate noise complaints without increasing the risk to pilots; however, there are measures in place to reduce noise impacts. Noise abatement procedures at NBVC Point Mugu are discussed below:

- Airfield hours of operation: 7:00 a.m. to 11:00 p.m. (0700 to 2300), seven days a week.
- Limits on the types of flight and ground operations performed during the following times: Monday through Friday, 6:00 p.m. to 8:00 a.m. (1800 to 0800) and 24 hours on Saturdays, Sundays, and holidays; flights occur during these times, but the types of operations are limited.
- Prior approval required for jet high-power turn-up areas after 10:00 p.m. (2200) nightly, and between the hours of 8:00 am to 12:30 p.m. (0800 to 1230) on Sundays.
- Flight crews (pilots and ground maintenance) are required to attend an ATC Course Rules Brief prior to commencing flight operations. All stationed pilots are required to have annual course rules brief.
- Conduct quarterly NBVC Point Mugu Air Ops Department Airfield Users Group Meeting.
- In cooperation with the United States Fish and Wildlife Service, limit aircraft departures for Runways 21 and 9/27 to minimize impacts to protected or environmentally sensitive species.
- Pilots should avoid densely populated areas when at low altitudes and avoid overflights of cities or towns in the local area whenever possible. Pilots are to remain clear of the following areas, except when following designated procedures:
  - California State University Channel Islands (CSUCI);
  - Leisure Village;
  - Channel Islands Harbor; and
  - Lagoon areas.

NBVC Point Mugu personnel are active members in the communities surrounding the airfield and continuously engage with stakeholders to establish open communication and resolution of noise issues.

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 overflown or 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 a noise;

- The predictability of noise; and
- Weather conditions.

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

Noise complaints are received by Air Ops personnel and coordinated with the Public Affairs Office and CPLO. Noise complaints are recorded according to date, time, and location of the event and the general nature of the complaint. The complaint is mapped and Air Ops consults on what event occurred during the time and place of the complaint. A follow-up call to the individual who initiated the complaint is made, and an explanation of the noise event is provided. Historically, noise complaints have been minimal. Complaints typically occur with several calls regarding one event. Because the resident population near the airfield is generally accustomed to the presence of aircraft and the accompanying noise, noise complaints typically occur during unscheduled operations and jet aircraft activity.

Change in dB and in Perceived Loudness

1 Decibel:
Requires close attention to notice

3 Decibels:
Barely noticeable

5 Decibels:
Quite noticeable

10 Decibels:
Dramatic – twice or half as loud

20 Decibels:
Striking – fourfold change

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 NBVC Point Mugu, local community planning organizations, and citizens in locating and addressing incompatible land uses and in planning for future development.

The noise contours in this AICUZ Study are identified as either historic, baseline, or prospective. The prospective noise contours represent NBVC Point Mugu's noise environment and planning tool for 2015 through 2020. The historic and baseline contours allow comparison. The airfield's operational tempo over time and the projected operations are presented in Chapter 3, Aircraft Operations, and detailed in Tables 3-1 through 3-7.

The prospective AICUZ noise contours for NBVC Point Mugu are presented in the following sections, along with detailed descriptions of the noise environment. Also provided are comparisons and figure overlays of the historic and baseline 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 exposure contours are provided and discussed in Chapter 7, Land Use Compatibility Analysis and

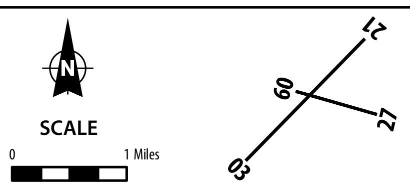
Recommendations. Land use recommendations apply to 65 dB CNEL and greater,; however, the prospective noise contours include 60 dB CNEL and greater to illustrate that noise extends beyond the 65 dB CNEL.

4.4.1 Prospective Noise Contours

As shown on Figure 4-1, the prospective noise contours align with Runway 03/21. The contours follow Runway 21 arrivals from the northeast and departures to the southwest. The 65 dB and 60 dB CNEL contours extend approximately 2.6 miles and 4 miles northeast of the base boundary, respectively. The narrow section of the noise contours to the northeast is due to Kfir and transient fighter aircraft straight-in arrivals to Runway 21 and from the final leg of the GCA box pattern to Runway 21. The 65 dB and 60 dB CNEL contours extend to the west, abeam the runway, by 0.5 mile and 1 mile, respectively. The bulge to the west is caused by Kfir and transient FA-18 Hornet departures from Runways 21 and 03 and E-2 FCLP on Runway 27. The 65 dB and 60 dB CNEL contours extend beyond the installation boundary, but only over the Pacific Ocean. The hook over the ocean turning back toward the north is primarily caused by Kfir departures from Runway 21 as they climb and turn to the north. Although the Kfir and FA-18 account for a small portion of total operations, both generate sound exposure levels (SELs) 10 to 20 dB greater than other based aircraft, such as the C-130 or E-2. The disconnected contours contained within the airfield boundary east of the runway are due to maintenance run-up operations at the new outdoor test stand location (Wyle 2014).

To further describe the 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 acreage within the prospective noise contours was calculated using geographic information system (GIS) overlay analysis and is presented in Table 4-1.

The total area within the prospective noise contours is 6,580 acres. Approximately 30 percent (2,015 acres) of this total is on-station, with 70 percent (4,565 acres) off-station. Over 98 percent of the ≥75 dB CNEL contours are on-station, with less than 2 percent off-station. Because NBVC is adjacent to the Pacific Ocean, and due to the installation's course rules and flight tracks, over 30 percent of the contours in Noise Zone 1 (60 to <65 dB CNEL) and Noise Zone 2 (65 to <75 dB CNEL) are over the ocean. The remaining "over land acres" include approximately 1,518 on-station acres and 2,562 off-station acres. Chapter 7, Land Use Compatibility Analysis and Recommendations, presents land use within the off-station acres and the compatibility analysis.



Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Municipal Boundary
- Prospective (2020) AICUZ Noise Contour and dB CNEL Value

Prospective Noise Zones

- Noise Zone 1 (60 to <65 dB CNEL)
- Noise Zone 2 (65 to <75 dB CNEL)
- Noise Zone 3 (≥75 dB CNEL)

Figure 4-1
Prospective (CY2020) AICUZ Noise Contours

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012;

TABLE 4-1 COMPARISON OF LAND AND WATER AREAS IMPACTED WITHIN THE THREE NOISE ZONES

SCENARIO	LOCATION	NOISE ZONE 1 60 TO < 65 dB CNEL		NOISE ZONE 2 65 TO < 75 dB CNEL		NOISE ZONE 3 ≥ 75 dB CNEL		TOTAL ACRES IMPACTED
		LAND	WATER[2]	LAND	WATER[2]	LAND	WATER[2]	
		ACRES[1]						
Historic	On-Station	191	21	2,356	194	1,500	0	4,262
	Off-Station[3]	5,046	4,951	6,369	4,006	842	317	21,531
	Totals	5,237	4,972	8,725	4,200	2,342	317	**25,793**
		10,209		**12,925**		**2,659**		
Baseline	On-Station	567	0	864	0	331	0	1,762
	Off-Station[3]	1,530	1,382	755	432	3	4	4,106
	Totals	2,097	1,382	1,619	432	334	4	**5,868**
		3,479		**2,051**		**338**		
Prospective	On-Station	642	0	876	0	497	0	2,015
	Off-Station[3]	1,661	1,498	901	499	6	0	4,565
	Totals	2,303	1,498	1,777	499	503	0	**6,580**
		3,801		**2,276**		**503**		

Notes:
[1] Acreage data calculated in coordination with the development of the 2015 AICUZ Study for NBVC Point Mugu.
[2] The water boundary was defined according to the California Coastal Commission.
[3] Off-station acreages include the Channel Islands Air National Guard area.

> The ambient noise level (sometimes-called background noise level) is the background sound level at a given location, normally specified as a reference level to the study. The noise gradient illustrated on Figure 4-2 ends at 45 dB CNEL, because that is the general point in which the ambient noise becomes greater.

NOISE GRADIENT AND PROPAGATION

The sound associated with aircraft operations extends beyond the plotted CNEL contours. Figure 4-2 provides a CNEL color gradient that illustrates how the noise originating at NBVC Point Mugu 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 the installation and decrease to much lower levels further out in Ventura County. Figure 4-2 also depicts the noise outside the 65 dB CNEL noise contour, which is considered minimal by the AICUZ Program. The area within the 45 dB CNEL represents an approximate location where dominant noise exposure sources may shift from aircraft to non-aircraft sources and the natural ambient noise levels that were not included in the noise study. Much of the lower CNEL values result from aircraft at higher altitudes further from the ground or much less frequent aircraft flight activity than those within the 65 dB CNEL contour. The GCA box patterns, touch-and-go patterns, and landing approaches to Runway 21 generate most of the noise outside of the 65 dB CNEL contour (most green shaded areas on Figure 4-2) due to the lower altitudes required for these operations.

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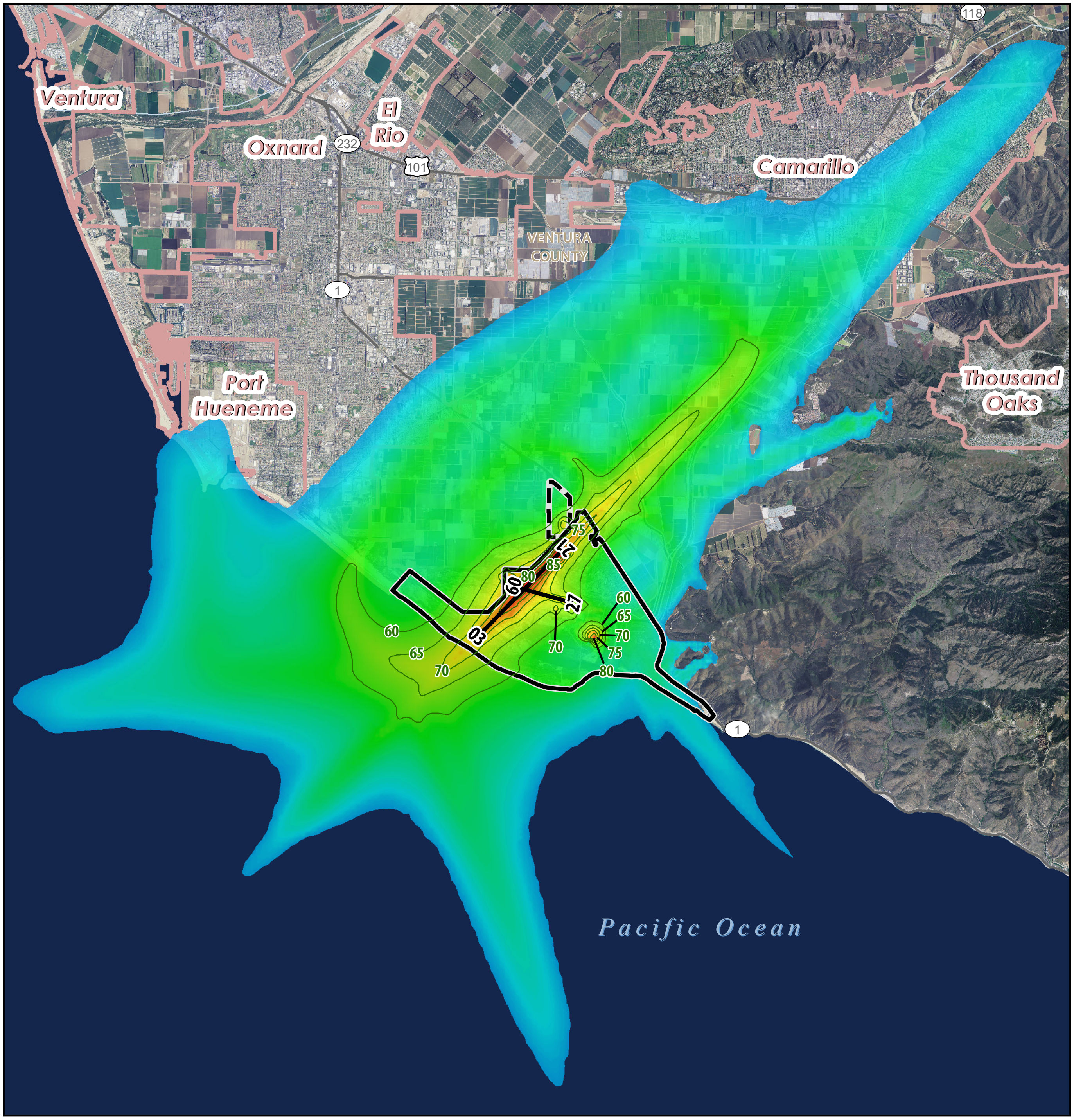

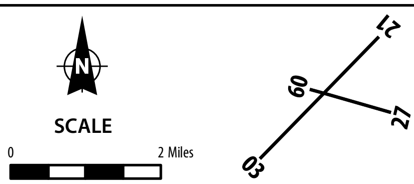

Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Municipal Boundary
- Prospective (2020) AICUZ Noise Contour and dB CNEL Value

Prospective CNEL (dB)

85+
65
45

Figure 4-2

Prospective (CY2020) AICUZ Noise Gradient

NBVC

Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012;

4.4.2 Comparison of Prospective Noise Contours and Baseline Noise Contours

A comparison of the prospective and the baseline noise contours shows overall similarities in shape, size, and location, and in CNEL levels, as depicted on Figure 4-3. The baseline 65 dB and 60 dB CNEL contours extend approximately 2.5 miles and 4 miles to the northeast of the base boundary, respectively. The 65 dB and 60 dB CNEL contours extend to the west 1 mile and 0.5 mile, respectively. The 65 dB CNEL extends beyond the installation boundary, but only over the Pacific Ocean.

The prospective noise contours are similar to the baseline contours with the operational changes presented in Section 3.2.3, Annual Operations, which include an increase in 9,961 annual operations, additional based aircraft (e.g., a fifth E-2 squadron, VAW-115), introduction of new aircraft (e.g., C-20, C-37, MQ-4C, UCLASS), and incorporation of increased and different transient fighter aircraft. This is due, in part, to the identical flight tracks, nearly identical flight track utilization, and similar percentages of operations flown during the day, evening, and night. Overall, the contours are similar with increases in CNEL of approximately 1 dB due to the increase in E-2 and transient fighter operations (see Chapter 3, Aircraft Operations, and Tables 3-1 through 3-7) in the prospective scenario. The introduction and basing of additional aircraft (e.g., UCLASS) will have a negligible effect on the overall prospective CNEL exposure relative to baseline. The noticeable difference is the on-station noise contours associated with aircraft maintenance locations to the southeast along the coastline. The acreage within the baseline noise contours (Table 4-1) is similar to acreage calculated for the prospective scenario. There is an approximate 712-acre variance between the scenarios, and the percentages of on-station acres (30 percent) and off-station acres (70 percent) remain unchanged. The increase in Noise Zone 1 (60 to <65 dB CNEL) and Noise Zone 2 (65 to <75 dB CNEL) is relative to the prospective scenario, each with slight increases in both on- and off-station coverage.

4.4.3 Comparison of Prospective Noise Contours and Historic Noise Contours

A comparison of prospective and historic noise contours shows few similarities, except for a concentration of contours along Runway 03/21, as depicted on Figure 4-4. The historic 65 dB and 60 dB CNEL contours extend approximately 5.4 miles and 7.2 miles to the northeast of the base boundary, respectively. The 65 dB and 60 dB CNEL contours extend to the west 1.2 miles and 2.1 miles, respectively. The 65 dB CNEL to the south extends beyond the installation boundary, but only over the Pacific Ocean, except for the southeast where it overlays a small area, 0.4 mile, of the foothills of the coastal Santa Monica Mountains.

The historic noise contours covered 25,793 acres, with 2,659 acres in Noise Zone 3 (≥75 dB CNEL). Contours within Noise Zone 2 made up approximately half of the total impacted acres; of those, 6,369 acres were off-station over land impacts. Approximately 83 percent of the contours were off-station, of which 43 percent were over the Pacific Ocean. The prospective scenario will impact approximately 19,213 acres less than the historic scenario.

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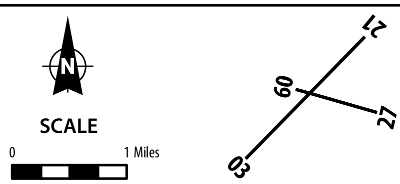


Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Municipal Boundary
- Baseline Noise Contour and dB CNEL Value
- Prospective (2020) AICUZ Noise Contour and dB CNEL Value

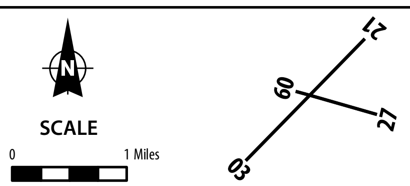
Prospective Noise Zones

- Noise Zone 1 (60 to <65 dB CNEL)
- Noise Zone 2 (65 to <75 dB CNEL)
- Noise Zone 3 (≥75 dB CNEL)

Figure 4-3
Comparison of Baseline (2014) and Prospective (CY2020) AICUZ Noise Contours

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012;



Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Municipal Boundary
- Historic (1990) AICUZ Noise Contour and dB CNEL Value
- Prospective (2020) AICUZ Noise Contour and dB CNEL Value

Prosepective Noise Zones

- Noise Zone 1 (60 to <65 dB CNEL)
- Noise Zone 2 (65 to <75 dB CNEL)
- Noise Zone 3 (≥75 dB CNEL)

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012;

Figure 4-4
Comparison of Historic (1992) and Prospective (CY2020) AICUZ Noise Contours

NBVC
Ventura County, California

As discussed in Section 1.3.2, Changes that Necessitate this AICUZ Update, significant changes occurred in the operational environment at the airfield from the historic to prospective scenarios that account for the change in noise contours. The primary factor in the decrease in noise contour coverage is the reduction in annual operations from 69,160 to 39,454, a loss of nearly 30,000 annual operations (Section 3.2.3, Annual Operations). Other important factors include significant changes in aircraft and types of operations flown and flight tracks followed. The SELs of the differing aircraft have an overall impact on the modeling results. The based aircraft mix in the historic scenario were louder than the based aircraft in the prospective scenario. In the historic scenario, approximately 47,000 (68 percent) of the annual operations were patterns, whereas only 13,337 (34 percent) of the annual operations are projected patterns in the prospective scenario. In addition, the difference in the noise modeling software and methodologies utilized (i.e., “Average Busy Day” in the historic scenario compared to “Average Annual Day” in the prospective scenario) resulted in slight reductions in contours. Advancements in noise modeling improve the accuracy of aircraft noise analysis, and more sophisticated GIS mapping techniques and tools allow for added accuracy in the depiction of noise exposure contours.

5 AIRFIELD SAFETY

Community and airfield safety is paramount to the Navy. The Navy has established a flight safety program and areas of accident potential around NBVC Point Mugu 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.

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 NBVC Point Mugu are discussed in detail in this section.

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 historic 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 are not a prediction of the number of accidents or the odds of an accident occurring; APZs only reflect the most likely location of an accident.

APZs align with departure, arrival, and pattern flight tracks, and are designed to minimize potential harm if a mishap were to occur by limiting activities in the designated APZs. The Navy and local planning authorities use APZs to ensure compatible development in close proximity to runway ends and slightly beyond. Although the likelihood of an accident is remote, the Navy recommends that land uses that concentrate large numbers of people, such as apartments, churches, and schools, be avoided 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. The runways at NBVC Point Mugu are Class B runways. The AICUZ Instruction defines the components of standard APZs for Class B, as follows, and as shown on Figure 5-1:

- Clear Zone. The Clear Zone is a trapezoidal area 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 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 and has less measurable potential for aircraft accidents relative to APZ I or the Clear Zone. APZ II is always provided where APZ I is required. The dimensions of APZ II are 3,000 feet in width by 7,000 feet in length and, as with APZ I, may curve to correspond with the predominant flight track.

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.

An accident is more likely to occur in APZ I than in APZ II, and is more likely to occur in the Clear Zone than in APZ I or APZ II.

APZs extend from the end of the runway, but apply to the predominant arrival and/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 shown on Figure 5-1. As the distance of a flight track to an installation decreases, the potential for flight tracks to overlap or converge increases. When similar mode 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 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.

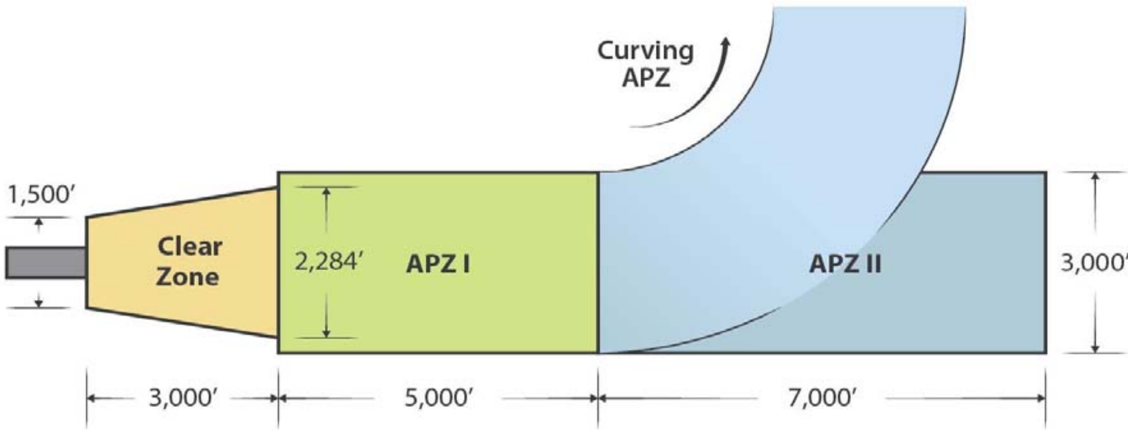


FIGURE 5-1 STANDARD CLASS B RUNWAY, FIXED-WING APZS

Within the Clear Zone, for safety concerns, most uses are incompatible with military aircraft operations. For this reason, the Navy's policy is to acquire real property interests within the Clear Zone to ensure incompatible development does not occur. Within APZ I and APZ II, some land uses are compatible; however, people-intensive uses (e.g., schools, apartments, etc.) 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 prospective APZs for NBVC Point Mugu, including a detailed analysis of their development and the areas impacted. Also provided are comparisons and figure overlays with historic APZs. The comparisons identify changes to APZs based on projected aircraft operations, and targets land use recommendations to mitigate incompatible development. Baseline APZs are not included since the prospective APZs depict the probable area of impact and account for baseline conditions. An analysis of land use and compatibility within APZs for the airfield are provided and discussed in Section 7.2, Land Use Compatibility Analysis.

5.2.1 Prospective Clear Zones and APZs

Prospective Clear Zones and APZs that were developed according to projected annual aircraft operations data are presented on Figure 5-2. The prospective scenario APZs graphically represent the detailed aircraft operations counts, flight tracks, and runway utilization data presented in Section 3.2.3, Annual Operations, and according to AICUZ Instruction APZ development guidance. The analysis of the data and application of the Instruction results in four APZ combinations for NBVC Point Mugu. All runways at NBVC Point Mugu are active; therefore, Clear Zones are applied. Acreages associated with prospective APZs are provided in Table 5-1 (presented at the end of this section) and are discussed in this section and in Chapter 7, Land Use Compatibility Analysis and Recommendations. Individual runways' clear zones and APZs are discussed further in this section.

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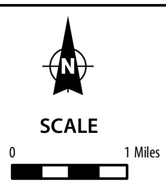
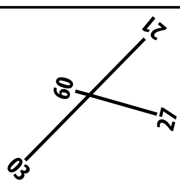




Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Municipal Boundary

Prospective (2020) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface

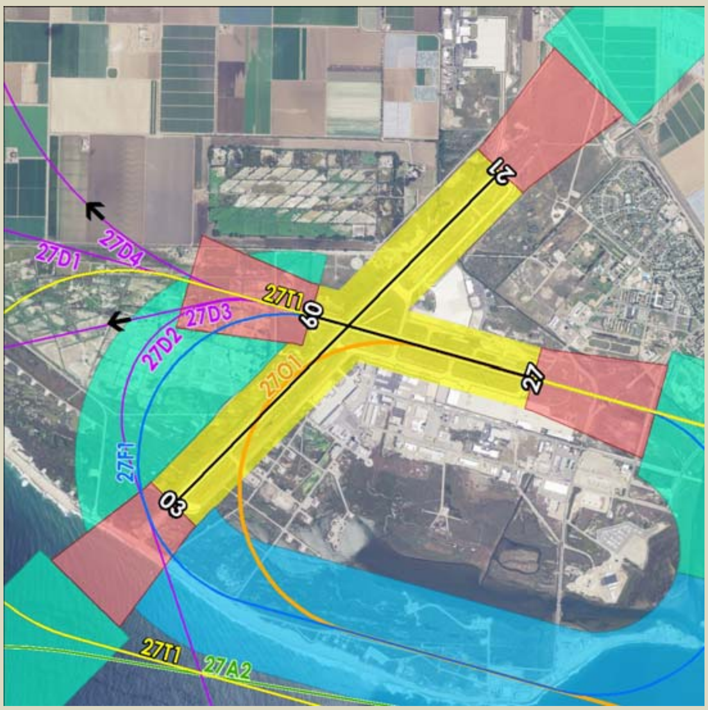
Figure 5-2
Prospective (CY2020) AICUZ Clear Zones and Accident Potential Zones

NBVC
Ventura County, California

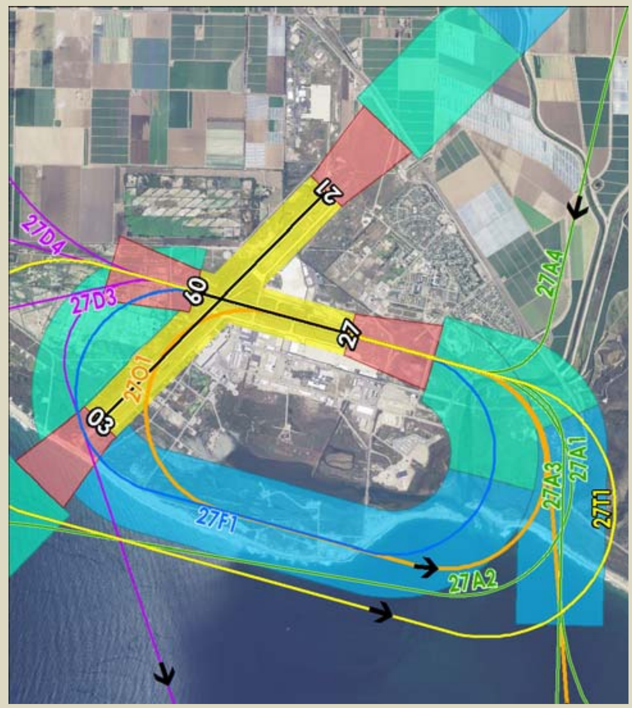
Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012;

RUNWAY 09 (APPROACH END) / RUNWAY 27 (DEPARTURE END)

A Clear Zone is the only required APZ for the approach end of Runway 09 (same location as Runway 27's departure end). This is because only 1 percent of the airfield's annual operations will occur on Runway 09 (approaches) and those operations do not meet the threshold of 5,000 annual operations; therefore, APZ I and APZ II are not required. Runway 27 departures also do not meet the 5,000 annual operations threshold; therefore, APZ I and APZ II are not required. However, APZ I and a closed-loop APZ II are depicted and associated with the FCLP flight track on Runway 27. A large portion of the clear zones extends off station on land northwest of the base. Additionally, a segment of Runway 27 APZ II impacts off station property southeast of the base.



Runway 09 (Approach End) / Runway 27 (Departure End)



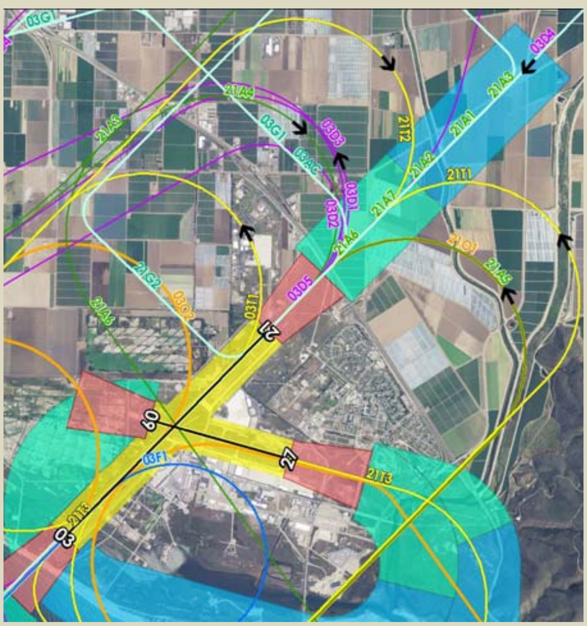
Runway 27 (Approach End)

RUNWAY 27 (APPROACH END)

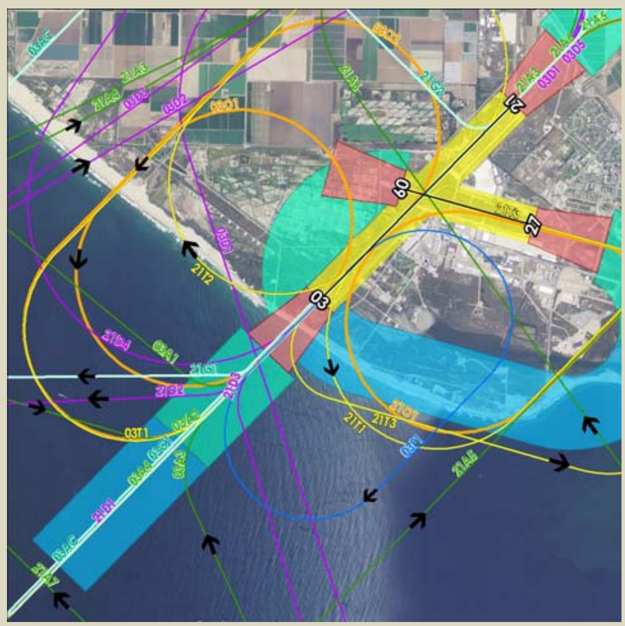
The approach end of Runway 27 (same location as Runway 09's departure end) has a Clear Zone and two APZ combinations: curving APZ I and APZ II, and a closed-loop APZ I and APZ II. The Clear Zone is required by AICUZ Instruction, and the curving APZ I and APZ II are required because arrival operations exceed 5,000 annually. The closed-loop APZ I and APZ II are required by FCLP operations. The FCLP tracks and non-pattern arrival tracks converge outside the Clear Zone, thus resulting in the two APZ combinations shown (the curving and FCLP APZs). Arrivals onto Runway 27 include straight-in, overhead break, the arrival portion of FCLP, and touch-and-go pattern operations. Of the nearly 6,200 annual arrival operations on Runway 27, over half are associated with the FCLP pattern operations conducted by the E-2. The quantity of FCLP operations requires an APZ II to apply to the entire FCLP flight track. This results in a curving APZ I on the departure end of the FCLP track. APZ I is curved to follow the FCLP track, which, in this case, departs the centerline within the Clear Zone. The Clear Zone is contained on-station, as well as the APZ II portion of the FCLP track. A minor portion of the curving APZ I and APZ II extend beyond the installation boundary. Additionally, a large portion of APZ I on the opposite end of the FCLP track falls outside the installation boundary.

Runway 21 (Approach End) / Runway 03 (Departure End)

The approach end of Runway 21 (same location as Runway 03's departure end) has a Clear Zone and a straight-out APZ I and APZ II. The Clear Zone is required by AICUZ Instruction, and APZ I is also required because arrival operations exceed 5,000 annually. NBVC Point Mugu projects over 7,800 arrivals for Runway 21 will occur on over ten flight tracks and will include several operations, such as overhead breaks, carrier breaks, straight-in arrivals, and the arrival portion of the GCA box pattern. Similar mode flight tracks converge within the APZ I and APZ II area; therefore, operations on those tracks were combined for APZ development purposes. The APZs align off the predominant straight-in arrival track. There is a mix of aircraft conducting operations, including the E-2, C-130, Kfir, Hunter, and transient fighters. The predominant aircraft and operations that contribute to the need for APZ I and APZ II are E-2s conducting straight-in arrivals and GCA box patterns. The Clear Zone is almost entirely contained within the installation boundary. APZ I and APZ II extend approximately 12,000 feet off the installation to the northeast.



Runway 21 (Approach End) / Runway 03 (Departure End)



Runway 21 (Departure End) / Runway 03 (Approach End)

Runway 21 (Departure End) / Runway 03 (Approach End)

The departure end of Runway 21 (same location as Runway 03's arrival end) has a Clear Zone and a straight APZ I and APZ II. The Clear Zone is required by AICUZ Instruction, and APZ I and APZ II are required because departure operations exceed 5,000 annually. The departure operations exceed 7,200 annually and include standard departures and departures associated with the GCA box pattern, and are primarily conducted by E-2s, C-130s, commercial and general aviation aircraft, and transient fighter aircraft. The predominant aircraft and operation that contribute to the need for APZ I and APZ II are E-2s conducting departures. Most of the Clear Zone is over the installation, and the remaining portions of the Clear Zone, APZ I, and APZ II are over the Pacific Ocean.

The number of annual arrival operations at Runway 03 (same location as Runway 21's departure end) does not require APZs; however, APZs apply to that area due to operations associated with the departures at Runway 21. Likewise, departures at Runway 03 are minimal and do not require APZs; however, APZs apply to that area due to operations associated with the arrivals at Runway 21. Operations occur on Runway 03; however, their annual combined operations are below the threshold for APZ consideration. The E-2, C-130, and general and commercial aviation aircraft are the primary aircraft utilizing Runway 03.

Summary

The acreages that fall within the Clear Zones and APZs for NBVC Point Mugu are provided in Table 5-1. It is important to note that portions of the APZs are on-station, off-station, and over land or over water. Approximately 4,487 acres are impacted by the prospective APZs for NBVC Point Mugu. Approximately 39 percent of the impacted area is within the installation boundary, and the remaining impacted areas are within Ventura County; however, 50 percent of the off-station APZ area is over the Pacific Ocean, resulting in less than 1,400 land acres impacted by APZs, a majority of which is the APZ combination to the northeast associated with the arrivals onto Runway 21, where land use is primarily agricultural. A smaller portion is attributed to the curving APZs associated with arrivals onto Runway 27, where APZ I and APZ II extend slightly over Highway 1 and the foothills of the coastal Santa Monica Mountains. The remaining off-station land impact is associated with the APZ I portion of FCLP track onto Runway 27 and the Clear Zone off the arrival end of Runway 09. A complete land use compatibility analysis of APZs is presented in Chapter 7, Land Use Compatibility Analysis and Recommendations.

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

SCENARIO	LOCATION	CLEAR ZONE LAND	CLEAR ZONE WATER[2]	APZ I LAND	APZ I WATER[2]	APZ II LAND	APZ II WATER[2]	TOTAL ACRES IMPACTED
		ACRES[1]						
Historic	On-Station	339	0	517	37	333	46	1,272
	Off-Station[3]	125	57	363	628	1,045	1,692	3,910
	Totals	464	57	880	665	1,378	1,738	5,182
		521		**1,545**		**3,116**		
Prospective	On-Station	340	0	554	61	702	87	1,744
	Off-Station[3]	120	54	538	344	724	963	2,743
	Totals	460	54	1,092	405	1,426	1,050	4,487
		514		1,497		2,476		

Notes:
[1] Acreage data calculated in 2014 in coordination with the development of the 2015 AICUZ Study for NBVC Point Mugu.
[2] The water boundary was defined according to the California Metropolitan Transportation Commission (2010).
[3] Off-station acreages include the Channel Islands Air National Guard area.

5.2.2 Comparison of Prospective and Historic Clear Zones and APZs

A comparison of the prospective and the historic Clear Zones and APZs shows similarities in their coverage. Figure 5-3 shows the similarities and differences in the historic and prospective scenario clear zones and APZs. Overall, the total area impacted has decreased by approximately 700 acres. The reduction is due to loss of APZ II coverage to the northeast and southwest (over the Pacific Ocean). Additionally, the dimensions of common Clear Zones and APZs were modified to adhere to the AICUZ Instruction and reflect advancements in GIS mapping tools and capabilities. Therefore, there are minor differences in overlapping Clear Zones and APZs.

Runway 09 (Approach End) / Runway 27 (Departure End)

For both scenarios, the Clear Zone on the approach end of Runway 09 is required, and the number of operations does not require APZs for Runway 09. However, for the prospective scenario, APZ I is applied to the departure end of Runway 27 and is associated with the closed-loop APZ for FCLP protection.

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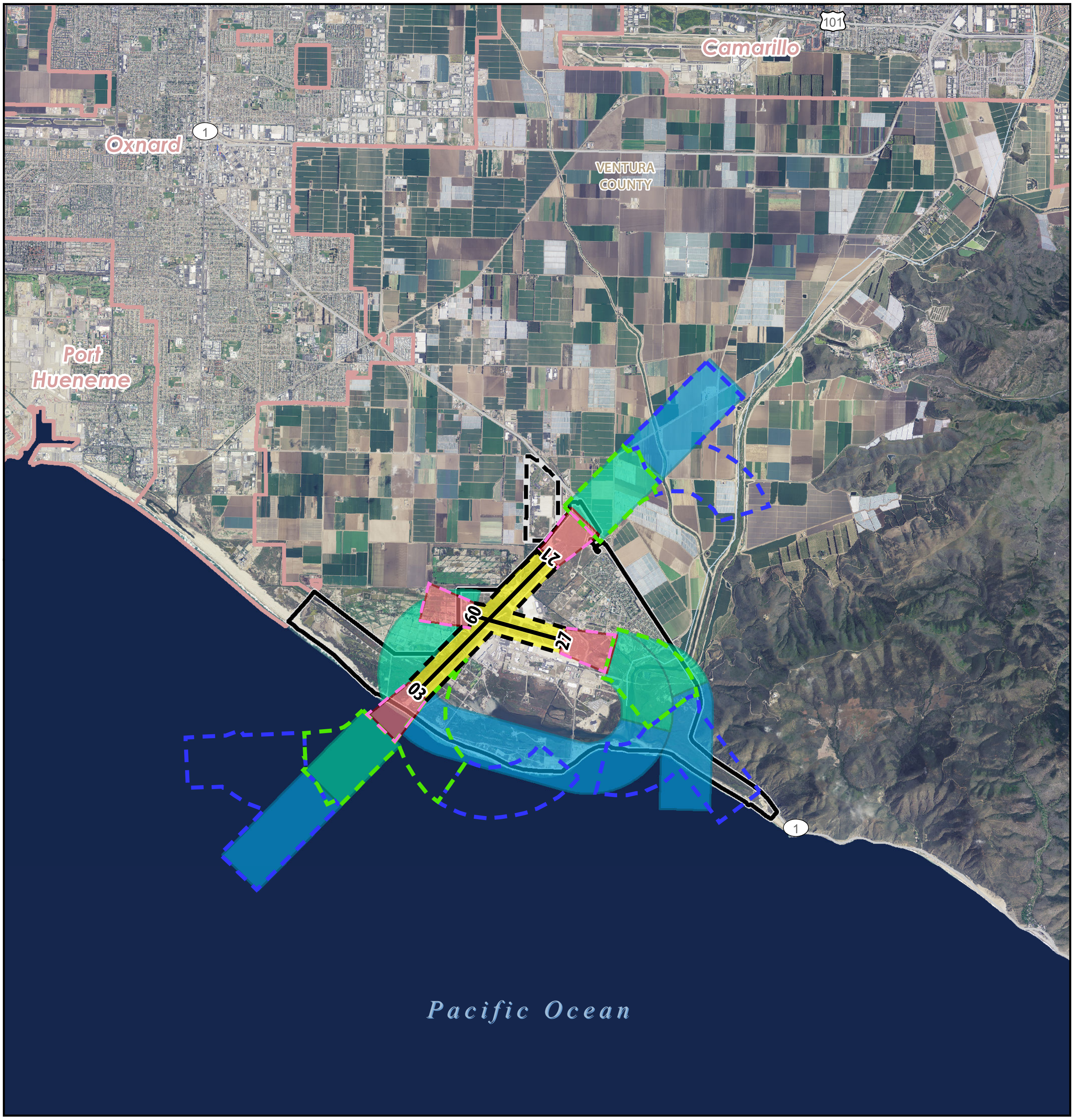


N
SCALE
0 1 Miles

21
09
27
03

Legend

NBVC Point Mugu

California Air National Guard

Runway

Municipal Boundary

Prospective (2020) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface

Historic (1992) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface

Figure 5-3
Comparison of Historic and Prospective (CY2020) AICUZ Clear Zones and APZs

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012;

Runway 27 (Approach End)

The coverage on the approach end of Runway 27 was provided in the 1992 AICUZ Study for overhead break arrivals and a FCLP pattern. In the prospective scenario, the flight track remains; however, APZs are slightly modified to follow updated flight tracks and provide protection over the entire FCLP track.

Runway 21 (Approach End) / Runway 03 (Departure End)

The coverage on the approach end of Runway 21 in the historic scenario was for several arrival flight tracks, including the curved APZ II that was attributed to a touch-and-go pattern flight track. In the prospective scenario, the flight track remains, and the straight-out APZs were retained with slight modifications, as described above. However, the prospective scenario projected minimal touch-and-go operations; therefore, that portion of the historic APZ did not apply to the prospective scenario. Tables 3-2 and 3-4 present the differences in pattern operations.

Runway 21 (Departure End) / Runway 03 (Approach End)

The historic APZ coverage on the approach end of Runway 03 was associated with arrivals (straight-out APZs) onto Runway 03 and the touch-and-go pattern operations (curved APZ) associated with Runway 21. As shown in Table 3-7, utilization for Runway 03 has decreased by almost half, from 23 percent for the historic scenario to 12 percent for the prospective scenario. The reduction resulted in the loss of APZs associated with arrivals onto Runway 03 in the prospective scenario. However, in the prospective scenario, due to the departures associated with Runway 21, the straight-out APZ coverage remains, with slight modifications as described above. The prospective scenario projects minimal touch-and-go operations; therefore, the portion of the historic APZ (curved APZ) does not apply to the prospective scenario. Tables 3-2 and 3-4 present the differences in pattern operations.

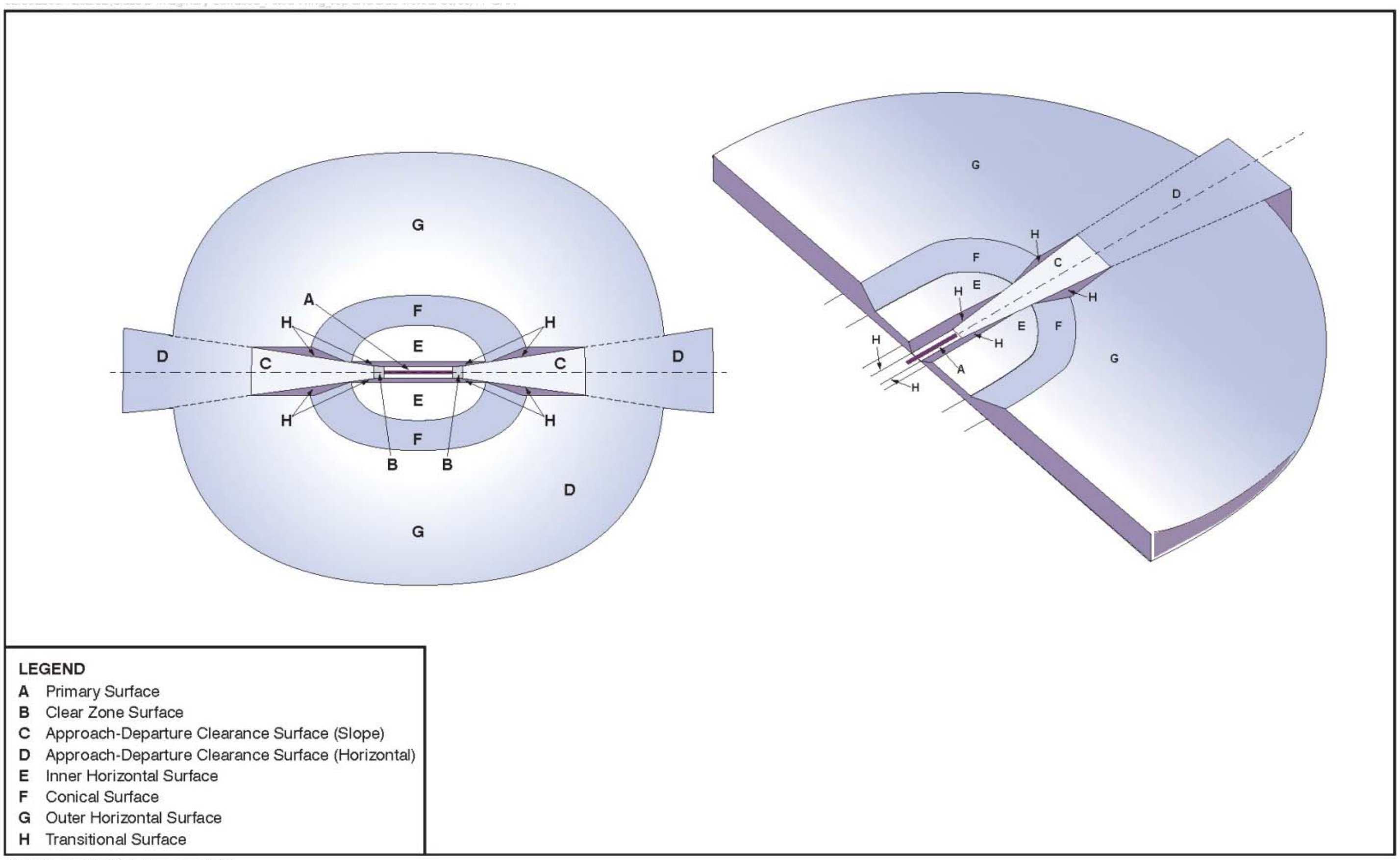
Summary

The acres impacted by Clear Zones and APZs in the 1992 AICUZ Study are provided in Table 5-1 and represent approximately 5,182 acres. The historic APZ footprint covered over 1,200 acres on-station and nearly 4,000 off-station; however, approximately 60 percent (2,377 acres) of the off-station APZ area was located over the Pacific Ocean, resulting in 1,533 impacted land acres.

The prospective scenario will impact approximately 695 less acres, specifically 151 less off-station over land acres, when compared to the historic scenario. This reduction is attributed to areas over the ocean and land areas to the northeast associated with the APZs for the approach on Runway 21 and, to a lesser extent, the APZs associated with arrivals on Runway 27. Overall, the change in APZs is attributed to the reduction in aircraft operations and, to a lesser extent, the flight tracks flown.

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. Fixed-wing runways and rotary-wing runways/helipads have different imaginary surfaces. Brief descriptions of the imaginary surfaces for fixed-wing Class B runways (runways at NBVC Point Mugu are all Class B runways) are provided on Figure 5-4 and in Table 5-2. 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.



SOURCE: UFC 3-260-01, November 2008

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

TABLE 5-2 IMAGINARY SURFACES – CLASS B FIXED-WING RUNWAYS

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

Sources: NAVFAC 1982 and DOD 2008

Imaginary surfaces for NBVC Point Mugu are depicted on Figure 5-5. As noted above, each runway has assigned imaginary surfaces; therefore, since NBVC Point Mugu has two runways, imaginary surfaces are applied to each runway, resulting in overlapping surfaces. The southern portion of the imaginary surfaces extend out over the coast line and the Pacific Ocean. The northern portion extends within the unincorporated areas of Ventura County, the city of Oxnard, and the city of Camarillo. The eastern portion of the imaginary surfaces extends out towards Laguna Peak and the Santa Monica Mountains.

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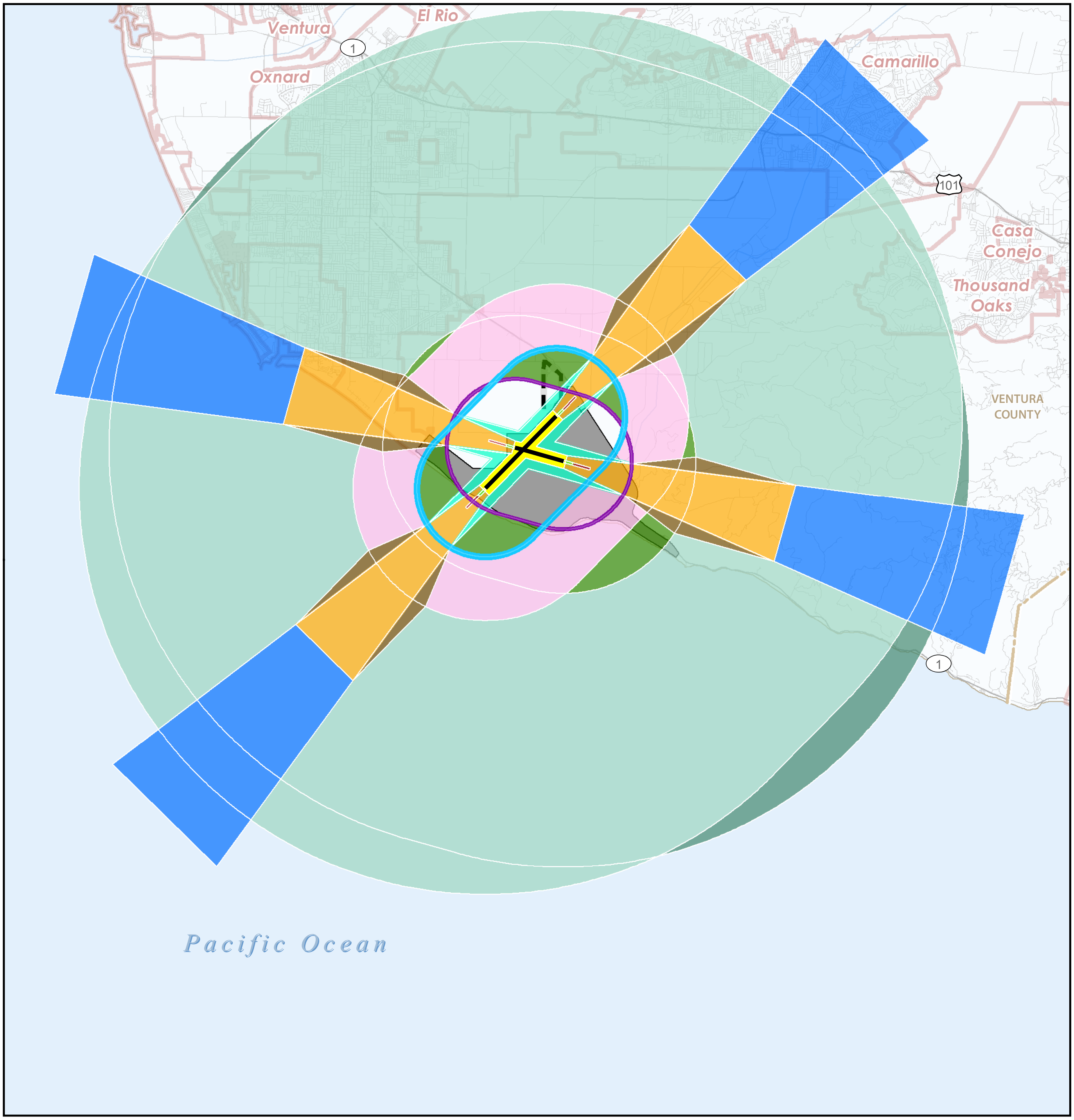
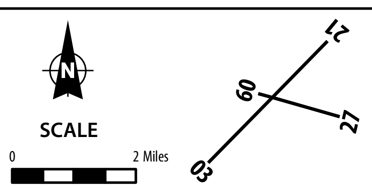




NBVC Point Mugu
California Air National Guard
Runway
Municipal Boundary
Waterbody
Highway
Street

Legend

Imaginary Surfaces

- App/Dept 500' Elevation
- App/Dept 50:1 Slope Ratio
- App/Dept Transitional Surface
- Conical Surface RWY 03/21
- Conical Surface RWY 09/27
- Inner Horizontal Surface RWY 03/21
- Inner Horizontal Surface RWY 09/27
- Main Transitional Surface
- Outer Horizontal Surface RWY 03/21
- Outer Horizontal Surface RWY 09/27
- Primary Surface
- Runway Clear Zone
- Runway End Zone

Figure 5-5

Imaginary Surfaces, Class B, Fixed-Wing Runway

NBVC

Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2014
ESRI 2012; Wyle 2014; Navy 2012;

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 NBVC Point Mugu, hazards to flight safety that should be avoided in the airfield vicinity, and measures to avoid potential pilot interferences.

5.4.1 Aircraft Mishaps

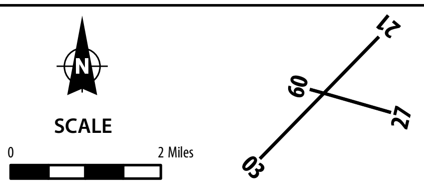
The Navy categorizes aircraft mishaps into three primary groups: Class A, B, or C. The classification system is based on the severity of injury to the individuals involved and the total property damage. The most severe is Class A, and the least severe is Class C (for reportable mishaps).

Mishaps have been reported at NBVC Point Mugu since the historic scenario (see Figure 5-6). Recorded mishaps include bird strikes and structural or engine failures. Loss of life occurred for two mishaps, and injuries and minor injuries to aircrew were reported for others. Aircraft involved in the mishaps include based and transient aircraft, such as the E-2, MK-58, Boeing 707, QF-4S+, and T-34.

5.4.2 Bird and Wildlife Aircraft Strike Hazards

Wildlife can be a significant hazard to flight operations. Birds and wildlife are drawn to different habitat types found in the airfield environment (edges, grass, brush, forest, water, and even the warm pavement of the runways). 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 modification can reduce the attraction of these land uses. To reduce this hazard, flight patterns and operations at NBVC Point Mugu are altered or limited during times of increased bird activity, usually around dawn and dusk. Additionally, NBVC Point Mugu employs a BASH coordinator whose objective is to mitigate and address BASH hazards.



Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Municipal Boundary
- Mishap

*Note: Mishap occured during a special event air show.

Figure 5-6
Aircraft Mishaps

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012;

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 person virtually blind. This is particularly dangerous at night when the flash can diminish the eye's adaptation to darkness. Partial recovery takes only a few minutes, but full recovery 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 flashblindness, 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 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 chapter discusses federal, state, and local planning authorities, regulations, and programs that encourage compatible land use.

This AICUZ Study presents data to encourage cooperative land use planning between NBVC and the surrounding communities so that future growth and development are compatible with the operational missions and operational impacts on adjacent lands are minimized. Although ultimate control over land use and development surrounding NBVC Point Mugu is the responsibility of local governments and landowners, through the provision of information in this AICUZ Study, the Navy encourages local governments to plan for compatible development.

6.1 PLANNING AUTHORITIES, POLICIES, REGULATIONS, AND PROGRAMS

NBVC Point Mugu's AICUZ footprint is located in the unincorporated area of Ventura County and the planning area for the City of Oxnard. To determine land use compatibility, the Navy examined both existing and planned land uses near the airfield. Development and control of land outside of the base boundary are beyond the jurisdiction of the Installation Commanding Officer. Development of this land is regulated by federal, state, and local general land use planning, ordinances, and regulations.

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

The local land use practices of local jurisdictions can impact NBVC Point Mugu's mission and must be considered to manage development within the AICUZ footprint. Land use planning in Ventura County and Oxnard directly influences the land area surrounding the airfield. The City of Camarillo and the City of Port Hueneme influence the region, but the current AICUZ footprint does not overlap their jurisdictions. Land use planning programs, General Plans, policies, councils, and commissions for local jurisdictions with the potential to influence land use in the vicinity of NBVC Point Mugu are discussed in this section.

While comprehensive planning allows jurisdictions to consider the impacts of current and future development, zoning is the legal tool for implementing a land use plan. Zoning regulates land use, density, and the height of structures, and can prohibit the creation of other hazards for military operations, including smoke, radio interference, and glare.

6.1.1 FEDERAL

The following are federal regulations and programs that provide NBVC the opportunity to guide development and land use within the vicinity of the base 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 environmental 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. Impacts of the action are generally documented in an Environmental Assessment or Environmental Impact Statement. 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 NBVC Point Mugu 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 CIRCULAR 1390.2: NOISE ABATEMENT AND CONTROL

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 DNL or less. Construction within a 65- to 75-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 [insolation], double-paned windows, solid core wood doors), and construction within an area exceeding a 75-DNL noise level 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. 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.

NAVY

DOD AICUZ Program

The DOD began the AICUZ Program in the early 1970s to help government entities and communities anticipate, identify, and promote compatible land use and development near military installations. The purpose of the AICUZ Program is to achieve compatibility between air installations and neighboring communities. To satisfy the purpose of the AICUZ Program, the military installation must work with the local community to encourage compatible development of lands adjacent to the installation. Under the AICUZ Program, the Navy has established guidelines that define high noise zones and APZs surrounding NBVC Point Mugu. This AICUZ Study is the latest update to NBVC's AICUZ Program, and local governments are encouraged to incorporate the new AICUZ footprint in their land use planning, and development practices.

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.

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). REPI program funding will support service agreements that, as authorized by 10 U.S.C. Section 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, 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 funding is not owned by the military or used for military training or testing.

6.1.2 State of California

The following are state regulations and programs that provide NBVC the opportunity to guide development and land use within the vicinity of the base and the AICUZ footprint.

Office of Planning and Research

The Governor's Office of Planning and Research was created by statute in 1970 (Chapter 1534) as the comprehensive statewide planning agency and the research staff for the Governor. The roles of the Office of Planning and Research include recommending and implementing state policies with regard to land use and growth planning.

> Section 65300 states; "Each planning agency shall prepare and the legislative body of each county and city shall adopt a comprehensive, long-term general plan for the physical development of the county or city, and of any land outside its boundaries which in the planning agency's judgment bears relation to its planning."

California State law requires each county and city to prepare and adopt a comprehensive and long-range plan for its physical development (Government Code Section 65300), called a “General Plan.” A General Plan contains a statement of development policies, including a diagram and text setting forth the objectives of the plan, as well as the adoption of Spheres of Influence (Government Code Section 56425). General plans are designed to serve as the jurisdiction’s blueprint for future decisions concerning land use infrastructure, public services, and resource conservation. Government Code Section 65302 lists seven elements that cities and counties must include in their General Plans: land use, circulation, housing, conservation, open space, noise, and safety. The noise and safety elements include an assessment of noise and safety hazards associated with existing aviation facilities and potential hazards posed by airport activities to surrounding land uses. “Spheres of Influence,” as used in the General Plans, are areas determined by the local planning authority to represent the "probable" ultimate boundary of a city. All specific plans, subdivisions, public works projects, and zoning decisions made by the city or county must be consistent with the General Plan (Government Code Section 65860).

To provide technical assistance to planning professionals, OPR publishes the Directory of California Planning Agencies (State of California Governor’s Office of Planning and Research 2012a)and the Annual Planning Survey Results (State of California Governor’s Office of Planning and Research 2012b). These publications replace the California Planners’ Book of Lists, which was discontinued in 2012.

California Environmental Quality Act

The California Environmental Quality Act (CEQA) requires local governments to consider potential environmental impacts of a project before they approve or deny the project. CEQA also requires that a planned project’s environmental impacts be publicly disclosed so the community can make informed comments. In addition, Government Code Section 65303 (2)(A) requires that information used by cities and counties for addressing the impacts of growth on military

> California natural resources Agency
>
> For more information regarding CEQA visit www.resources.ca.gov

readiness activities must be based upon the information that the military provides. Per CEQA Guidelines, Section 15064 (b), the CEQA analysis must rely upon a General Plan that includes the most recent AICUZ for NBVC Point Mugu.

CEQA Guidelines (Section 15064.7) assert that local governments may consider thresholds of significance “recommended by experts.” The United States Navy is an expert on the impacts experienced with regard to military readiness activities at NBVC Point Mugu. The AICUZ Study provided should be used by local jurisdictions to establish thresholds of significance.

In 2002, the California Legislature passed Assembly Bill 1108 amending CEQA with provisions for direct notification to the military for certain projects in specific locations. The NBVC CPLO is the contact for these notifications. The legislation delineates a “military impact zone” as land within 2 miles of military assets. Notification must be provided to the NBVC CPLO for projects in the military impact zone that require a General Plan amendment, projects of statewide, regional, or area-wide significance, or projects that must be referred to the Airport Land Use Commission.

The CEQA environmental review process is a viable method for incorporating the fundamentals of the AICUZ Study into the planning review process of a project. NBVC can comment on any CEQA project document to disclose the project’s impacts to the base, whether the impacts relate to safety or noise, or to disclose that the base may impact the project or those who will utilize the project.

California Coastal Commission

For more information regarding the CCC visit www.coastal.ca.gov

The California Coastal Act of 1976 (Public Resources Code Section 30000, et seq.) was enacted to “protect, maintain, and, where feasible, enhance and restore the overall quality of the coastal zone environment and its natural and artificial resources” (Public Resources Code Section 30001.5). The Coastal Act applies to the coastal zone, generally “extending seaward to the state’s outer limit of jurisdiction, including all offshore islands, and extending inland generally 1,000 yards from the mean high tide line of the sea” (Public Resources Code Section 30103). The Coastal Act’s policies (Public Resources Code Section 30200, et seq. and Section 30702, et seq.) are implemented through cooperative action between the California Coastal Commission, which regulates development within portions of the coastal zone and oversees coastal planning efforts along the entire coast, and local governments. A central feature of this joint action is the Local Coastal Program. The California Coastal Commission certifies the adequacy of Local Coastal Programs, which include relevant portions of local General Plans for jurisdictions in the coastal zone (State of California Governor’s Office of Planning and Research 2006).

Ventura County’s Coastal Area Plan and the Coastal Zoning Ordinance together constitute the Local Coastal Program for the unincorporated portions of Ventura County’s south coastal zone. The primary goal of the Local

Coastal Program is to ensure that the local government's land use plans, zoning ordinances, zoning maps, and implemented actions meet the requirements of, and implement the provisions and polices of, the California Coastal Act at the local level (Ventura County 2013a). In addition to being an element of Ventura County's Local Coastal Program, the Coastal Area Plan is also an Area Plan for the unincorporated coastal portions of Ventura County and is part of the County's General Plan. The land use designations in the Coastal Area Plan reflect the policies, existing and proposed land uses, existing General Plan land use designations, and zoning categories. NBVC Point Mugu is located in the South Coast section of the Ventura County Coastal Area Plan, which stretches from Oxnard city limits to the Los Angeles County northern boundary. The Ventura County Coastal Zoning Ordinance was last amended on September 16, 2008, and the amendments were certified by the California Coastal Commission on October 16, 2008 (Ventura County 2013a).

California Senate Bills 1468, 1462, and 375

California Government Code, Section 65302 (A)(2), (Senate Bill 1468), requires that the land use element of General Plans, "consider the impact of new growth on military readiness activities carried out by military bases, installations, and operating and training areas, when proposing zoning ordinances or designating land uses covered by the General Plan for land or other territory adjacent to those military facilities, or underlying designated military aviation routes and airspace" (State of California Legislature 2002). To ensure early notification to the military of proposed discretionary development projects within Military Operating Areas, California Government Code Sections 65352 (a)(5) and (6)(A), 65940, and 65944 (Senate Bill 1462) require the exchange of project-related information pertinent to military operations. Local planning agencies are required to notify and refer to the branches of the Armed Forces when any proposed action is within 1,000 feet of a military installation, beneath a low-level flight path, or within SUA. Once notified of a proposed action, the Navy can comment on the proposed action during the environmental and permitting review process and request a meeting with the public agency and the project applicant to discuss the potential alternatives, mitigation measures, and the effects of the proposed action on an affected installation (State of California Legislature 2004). The State of California provides an interactive web-based tool, the California Military Land Use Compatibility Analysis (http://cmluca.gis.ca.gov/), to determine if a project has the potential to affect areas important to military readiness.

Under Senate Bill 1468, the State of California Governor's Office of Planning and Research worked with federal, state, and local stakeholders to produce the California Advisory Handbook for Community and Military Compatibility Planning. The objective of this handbook is to, "provide guidance to cities, counties, property owners, developers, and military personnel on how best to encourage collaboration" (State of California Governor's Office of Planning and Research 2006). The handbook serves as an advisory document, with the goal of providing useful information for communities and the military to work together to reduce land use compatibility issues. The Governor's Office of Planning and Research also developed the Community and Military Compatibility Planning Supplement to the General Plan Guidelines to, "assist cities and counties in addressing military compatibility issues when developing, updating, or significantly amending their General Plans" (State of California Governor's Office of Planning and Research 2013). This document is a result of California Government Code, Section 65302 and 65352 (Senate Bills 1468 and 1462).

The Sustainable Communities and Climate Protection Act of 2008 (Sustainable Communities Act, Senate Bill 375, Chapter 728, Statutes of 2008) supports the State's climate action goals to reduce greenhouse gas emissions through coordinated transportation and land use planning with the goal of more sustainable communities. Senate Bill 375 sets planning requirements for transportation commissions, planning departments, agencies, plans, and projects, and requires that preferred growth scenarios be taken into account in CEQA environmental reviews. The aim of Senate Bill 375 is to support the Clean Air Act by reducing greenhouse gas emissions through improved transportation policy choices, compact development, and expanded transit services. This bill may encourage farmland conversion to create more compact development. NBVC can encourage local communities to develop in ways compatible with Senate Bill 375 and the AICUZ program.

Cortese-Knox-Hertzberg Local Government Reorganization Act

The Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000 (California Government Code Section 56000 et seq.) provides for Local Agency Formation Commissions (LAFCos) to form as independent agencies in each county in California (Ventura LAFCo 2015). The Act was a comprehensive revision of the Cortese-Knox Local Government Reorganization Act of 1985, which was a consolidation of past laws governing boundary changes. The Act establishes procedures for local government changes of organization, including city incorporations, annexations to a city or special district, and city and special district consolidations (Assembly Committee on Local Government 2011). The primary purposes of LAFCos are to discourage urban sprawl and encourage orderly formation and development of local agencies. LAFCos have powers under the Act to implement state law requirements and state and local policies relating to boundary changes for cities and most special districts, including Spheres of Influence, incorporations, annexations, reorganizations, and other changes of organization (Ventura LAFCo 2015).

California Department of Community Affairs, Bureau of Real Estate

The California Bureau of Real Estate prepares a subdivision Public Report for any proposed sale of five or more parcels. These reports are provided to the County Recorder’s Office for distribution to prospective buyers and are intended to provide notes of any negative aspects (such as the location of property in an area of increased aircraft noise) to first purchasers of property in a subdivision. The New Subdivision Filing List represents all new applications for public reports received by the California Bureau of Real Estate during a given month. The list is comprehensive for the state and is sorted alphabetically by county. The developer's name, address, and phone number are included in the list as they appeared on the application submitted to the California Bureau of Real Estate (State of California Department of Consumer Affairs, Bureau of Real Estate, n.d.).

California State University Channel Islands and Site Authority Legislation

The CSUCI campus is part of the California State University (CSU) system and is governed by the CSU Board of Trustees, as authorized by the State of California. The state has delegated local governmental authority to the Site Authority for the Community Development areas of the campus, as provided in Government Code 67470, signed by the Governor on September 25, 1998 (CSU 2000). The Site Authority serves as the local governing agency in all land use and development matters. The Board of Trustees has authority over the entire campus and owns and controls all campus acreage, including the academic/core campus and community development area. The campus includes all educational facilities and university services, roadways and parking areas, research and development facilities, housing, recreational and open space facilities, and retail/commercial uses. The Site Authority holds governmental powers, including those of a redevelopment agency, and provides for additional financing and support of the CSUCI university campus (CSU 2000). This authority is explicitly established in Government Code 67470 in order to support the development of the university. The Site Authority has the power to design, construct, and alter campus facilities, as well as operate, sell, lease, or otherwise regulate facilities (CSU 2000). Under the Site Authority Legislation, the Site Authority adopted a plan in 2000 for the reuse of the property as a university and other compatible uses.

Governor's Military Council

The Governor's Military Council was established in March of 2013 to better position the State of California to maintain and support its military operations. The Council includes retired admirals and generals from the United States Army, Marine Corps, Navy, Air Force, and Coast Guard, as well as the Adjutant General of the California National Guard. Business leaders with significant experience in the defense industry also serve on the Council. The Governor's Military Council provides insight to state leaders who develop strategies to support the military's presence in California. The Council also attests to the military's value to state and federal leaders considering cuts and realignments nationwide. Knowing that the threat of base realignment and closure is a possibility, the Council highlights the ongoing military value of California installations (State of California Governor's Office of Planning and Research 2013).

AIRPORT LAND USE COMPATIBILITY PLANS

The Public Utilities Code of the State of California, Sections 21670 et seq., requires the County Board of Supervisors to establish an Airport Land Use Commission. In accordance with Section 21675, the Ventura County Airport Land Use Commission developed and adopted an ACLUP for the county in July 2000. The ACLUP is an essential instrument the State of California provides in establishing compatible land use requirements. The ACLUP must be consistent with the safety and noise standards established in the AICUZ.

6.1.3 Regional Planning Agency

There are 25 regional planning organizations in California that provide planning support to their member governments. These organizations are Councils of Government or Association of Governments, which are comprised of member counties and cities in a given region working together to address regional issues such as land use, housing, environmental quality, and economic development. Elected officials from each of the member cities and counties comprise the governing boards of the Councils of Government/Association of Governments.

NBVC Point Mugu is located in the Southern California Association of Governments (SCAG) district. The SCAG is the largest Metropolitan Planning Organization in the nation (SCAG 2014). The SCAG region includes six counties (Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura) and 67 districts that represent 191 cities. SCAG Regional Council District 45 includes the cities of Camarillo, Oxnard, and Port Hueneme.

The SCAG develops long-range regional transportation plans, including sustainable communities' strategy and growth forecasts, land use, regional transportation improvement programs, regional housing needs allocations, and a portion of the South Coast Air Quality Management plans (SCAG 2014). SCAG acts as liaison between city and county elected officials, urban planners, and community organizations for regional planning and the development of policies and programs.

SCAG region includes six counties and 67 districts, which represent 191 cities. For more information about SCAG visit www.scag.ca.gov

6.1.4 VENTURA COUNTY

The lands to the north and east of NBVC Point Mugu are in the unincorporated area of Ventura County and, therefore, the development and use of these lands are controlled by Ventura County. The local planning authorities in Ventura County are the County Board of Supervisors, the Resource Management Agency, and the Planning Commission, which guide land use and development in the county.

The Board of Supervisors is made up of five members representing the five districts within the county. Under the authority of California Government Code (Section 65300), which requires counties to develop and implement comprehensive General Plans, the Board of Supervisors first adopted its General Plan on May 24, 1988. The General Plan was last amended on October 22, 2013. The General Plan sets goals, policies, and programs to guide future growth and development in the unincorporated area of Ventura County in a manner consistent with State of California legal mandates and requirements as well as with the general land use goals and objectives of the incorporated cities within its boundaries (Ventura County 2013c).

The primary goal of Ventura County's Resource Management Agency is to protect the health, safety and welfare of the general public through administration and enforcement of County ordinances, Board of Supervisors policies, and state and federal laws regarding land use and commercial and environmental regulation (Ventura County 2011). The Resource Management Agency includes the County's planning department.

For more information regarding the County's General Plan and land use policies, call (805) 654-2488 or visit www.ventura.org

The Planning Commission advises the Board of Supervisors on land use planning, compatibility, and other zoning matters. The Planning Commission considers General Plan amendments and specific plans, zone change requests, and subdivisions.

Ventura County uses zoning ordinances and other land use controls to implement the goals and objectives of the general plan. Examples include "Guidelines for Orderly Development," "Save Open-Space and Agricultural Resources" (SOAR) ordinances, and the Coastal Zoning Ordinance. Ventura County also has three types of growth boundaries to contain urban development and protect farmland: Spheres of Influence, SOAR, and City Urban Restriction Boundaries. These provisions were created to promote the orderly development of growth and to preserve vital agricultural lands and open-space.

The Ventura County Board of Supervisors and all City Councils within Ventura County have adopted the Guidelines for Orderly Development. These guidelines refine the original guidelines originally adopted in 1969 and maintain that urban development should be within incorporated cities whenever or wherever practical (Ventura County 2013c). The County's SOAR ordinance requires that any change to the County General Plan involving the "Agricultural," "Open Space," or "Rural," land use designations, or an amendment to a General Plan goal or policy related to those land use designations, be subject to countywide voter approval. The County's SOAR ordinance will remain in effect until January 1, 2020, unless repealed or modified by the countywide electorate (Ventura County 2013c).

Ventura County Transportation Commission

The Ventura County Transportation Commission is a regional transportation planning agency that works with the Ventura County Transportation Department and each of the cities within the county to prioritize transportation investments for Ventura County across a multi-year period. The Ventura County Transportation Department is responsible for planning, designing, funding, building, operating, and maintaining the County road system, which consists of approximately 544 miles of roadway, bridges, drainage, and related transportation facilities. The department also is responsible for the coordination of unincorporated area public transit needs and the provision of general transportation advice to the County Board of Supervisors (Ventura County 2013b).

For more information regarding the JLUS visit www.nbvcjlus.org

The Ventura County Transportation Commission also serves as the County Airport Land Use Commission. The Public Utilities Code of the State of California, Sections 21670 et seq., requires the County Board of Supervisors to establish an Airport Land Use Commission. In Ventura County, the Board of Supervisors designated the Transportation Commission to act as the Airport Land Use Commission. In accordance with Section 21675, the Ventura County Airport Land Use Commission developed and adopted an ACLUP for Ventura County in July 2000. The ACLUP is intended to protect and promote the safety and welfare of residents near the military and public use airports in the county by restricting incompatible land uses within the NBVC Point Mugu AICUZ footprint.

(Coffman Associates, Inc. 2000). The ACLUP included adopted airport land use polices with noise, safety, and height compatibility standards. The standards are meant to ensure that people and facilities are not concentrated in areas susceptible to high noise and aircraft accidents and that no structures or activities encroach upon or adversely affect the use of navigable airspace (Coffman Associates, Inc. 2000). The current ACLUP, updated in 2000, reflects the1992 AICUZ footprint for NBVC Point Mugu.

The Ventura County Transportation Commission has sponsored the NBVC Joint Land Use Study (JLUS), which started in September 2013 and was completed in late 2015. The JLUS is funded through a grant from the DOD Office of Economic Adjustment and contributions by the Ventura County Transportation Commission. The goal of the JLUS is to promote compatible land use that supports military training and operational missions. The JLUS aids in the understanding and introduction of AICUZ technical data into local planning and outreach programs. The partnership results in the identification of actions that the community and the Navy can take to promote compatible development and address current and future concerns.

Ventura Local Agency Formation Commission

The Ventura LAFCo was formed and operates under the provisions of state law (Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000) (Assembly Committee on Local Government 2014), as previously described. The Ventura LAFCo is the boundary agency in Ventura County that implements state law requirements and local policies relating to boundary changes for cities and most special districts, including Spheres of Influence, incorporations, annexations, reorganizations, and other changes of organization in the county. Ventura LAFCo's general objectives include: encourage the orderly formation and expansion of local government agencies; reserve agricultural land resources; and discourage urban sprawl (Ventura LAFCo 2015). The Ventura LAFCo is comprised of seven voting members, with representatives from the Ventura County Board of Supervisors, the various City Councils, and Boards of the independent special districts in the county. Ventura LAFCo authorities include: regulating boundary changes; establishing Spheres of Influence; conducting reviews of public services and special studies; initiating special district consolidations or dissolutions; and acting on out-of-agency service agreements between public agencies and between public agencies and private parties (Ventura LAFCo 2015).

For more information regarding the Ventura Local Agency Formation Commission visit www.ventura.lafco.ca.gov

Ventura Council of Governments

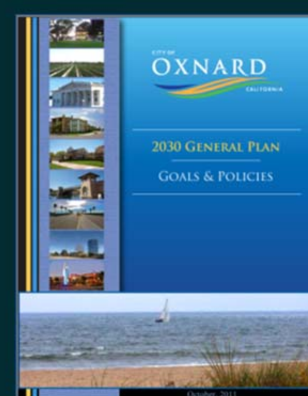
The Ventura Council of Governments is a voluntary joint powers authority representing Ventura County and its 10 cities (Camarillo, Fillmore, Moorpark, Ojai, Oxnard, Port Hueneme, San Buenaventura, Santa Paula, Simi Valley, Thousand Oaks). The Council's goal is to facilitate cooperative sub-regional and regional planning, coordination, and technical assistance on issues of mutual concern within Ventura County (Ventura Council of Governments, n.d.).

6.1.5 City of Oxnard

The lands north and west of NBVC Point Mugu, beyond the unincorporated area within the county, are in the incorporated areas of Oxnard, and the development and use of these lands are controlled by the City of Oxnard's land use policies and plans. This area includes lands within the city limits as well as areas within the City's sphere of influence. Ormond Beach, west of NBVC Point Mugu, is partially within the city limits, partially within the county unincorporated area, and completely within the sphere of influence.

The local planning authorities for the City of Oxnard are the City Council and the Planning Commission. The City Council is made up of the mayor and four members. The City Council, along with several city departments and commissions, especially the seven-member Planning Commission, make decisions on land uses policies, zoning, ordinances, commercial and environmental regulation compatibility, and other zoning matters.

The City's current General Plan, Oxnard General Plan 2030, was adopted on October 11, 2011. The plan provides guidance and recommendations to the City's staff, boards, advisory committees, and professional consultants on the development of the City of Oxnard and its sphere of influence. The General Plan outlines policies for the adoption of zoning ordinances and subdivision ordinances to serve as the primary implementation tools for the physical control and development within Oxnard's sphere of influence. The plan is also meant to encourage property owners and developers to pursue quality development and redevelopment, which is sensitive to the needs of the entire community and will enable the City to achieve its goals. Oxnard's planning horizon is the year 2030. The City's plan includes a military compatibility element (Chapter 7), which is focused on the City's geographic and functional relationship to NBVC Point Mugu facilities and operations. The purpose of the military compatibility element is to demonstrate the City's commitment to and support of current and future missions at NBVC Point Mugu, especially as related to noise generated by aircraft operations mobilization routes, and facility perimeter security. This element sets goals and establishes policies that consider the impact of Oxnard's development decisions on military readiness activities. The plan includes periodical review of the City's zoning ordinance, subdivision ordinance, and other infrastructure plans and programs to avoided encroachment and ensure the ordinances do not conflict with the continued viability of NBVC Point Mugu within the Navy's Military Influence Area (City of Oxnard 2011). Furthermore, the plan includes policies for communication and coordination with NBVC personnel, which include participating in public education programs, real estate disclosures, military compatibility planning training, and designating a military liaison.



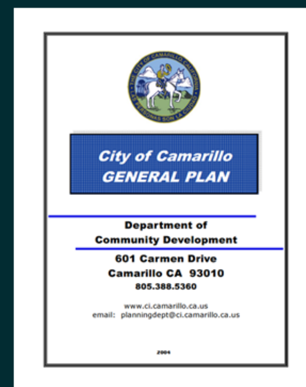
For more information regarding the City of Oxnard's General Plan and land use policies, call (805) 385-7858 or visit www.cityofoxnard.org

California Government Code requires that a noise element be included in the General Plan of each county and city in the state. Local government goals, objectives, and policies for noise control are established in the noise element of the General Plan and specific noise ordinances and codes.

Similar to Ventura County, the City of Oxnard adopted its own SOAR ordnance on November 3, 1998. The SOAR ordinances and initiatives establish City Urban Restriction Boundary lines around the city and require city voter approval before any land located outside the boundary lines can be developed under the City's jurisdiction for urban purposes (Ventura County 2014b).

6.1.6 City of Camarillo

Camarillo is located approximately 6 miles north of NBVC Point Mugu, and the AICUZ footprint does not currently overlap lands within the planning jurisdiction and/or designated Sphere of Influence. However, the lands north and northeast of NBVC Point Mugu are within the southern portion of a City of Camarillo area of interest, as defined on the City's General Land Use map. Since flight paths used by NBVC Point Mugu operators for arrivals, departures, and GCA box patterns overly portions of Camarillo and the use of Camarillo Airport by ATAC, the City of Camarillo is considered in NBVC Point Mugu's Military Influence Area. Therefore, the City's planning authority and the General Plan are discussed in this section.



For more information regarding the City of Camarillo's General Plan and land use policies, call (805) 388-5360 or visit www.ci.camarillo.ca.us

The local planning authorities for the City of Camarillo are the City Council, the Planning Commission, and the Department of Community Development. The City Council is made up of the mayor and four Council members and is the Community Development Commission. The Planning Commission is comprised of five City Council appointees. The Department of Community Development provides information and guidance to the Planning Commission and City Council. The Department of Community Development is also tasked with administering and implementing state and local planning and zoning laws, the City's General Plan and specific plans, and subdivision and sign ordinances, as well as assisting with the coordination of economic development activities (City of Camarillo 2014). The City's Department of Community Development is also involved with regional planning and open space and redevelopment programs that may influence lands surrounding NBVC Point Mugu.

The City's existing General Plan was adopted in 2004 and is intended to set forth goals, objectives, principles, and standards regarding coordinated future developments for the growth and change of the entire planning area. The City's plan includes noise and safety elements (Chapter 11 and 12) that focus on the City's geographic and functional relationship to NBVC Point Mugu flight operations. The safety element identifies NBVC Point Mugu as a source of potential aircraft safety issues within the community and cites the ACLUP for Ventura County, adopted July 7, 2000. The noise element discusses the proximity of NBVC Point Mugu noise contours to the southern boundary of the city and the potential noise impact from aircraft overflights. This element outlines measures to encourage a reduction in flight operations to manage the potential noise impacts, including establishing and maintaining a close relationship with NBVC to communicate noise complaints through the proper channels.

The City of Camarillo adopted the SOAR ordnance on November 3, 1998. The SOAR ordinances and initiatives establish City Urban Restriction Boundary lines around the city and require city voter approval before any land located outside the boundary lines can be developed under the City's jurisdiction for urban purposes (Ventura County 2014b).

6.1.7 City of Port Hueneme

Port Hueneme is approximately 4 miles northwest of NBVC Point Mugu, and the AICUZ footprint does not overlap lands within the planning jurisdiction and/or designated Sphere of Influence. However, similar to the City of Camarillo, the City of Port Hueneme is involved in regional planning and issues of mutual concern within Ventura County. Therefore, the City of Port Hueneme's planning authority is discussed in this section.

For more information regarding the City of Port Hueneme's General Plan and land use policies, call (805) 986-6553 or visit www.ci.port-hueneme.ca.us

The local planning authorities for the City of Port Hueneme are the City Council, the Department of Community Development, and the Planning and Zoning Department. The City Council is made up of the mayor and four Council members. The Department of Community Development is responsible for planning and zoning, economic development and business assistance, code compliance and parking enforcement, and is also responsible for affordable housing programs. The Planning and Zoning Department manages and implements the City's General Plan (City of Port Hueneme 2001), Local Coastal Plan, zoning ordinance, and subdivision ordinance (City of Port Hueneme, n.d.).

6.2 Other Land Use Programs and Tools

6.2.1 Zoning Regulations

In California, counties are fully zoned. Through zoning regulations, counties are authorized to create zoning districts that permit or prohibit certain property uses, construction standards, and development densities.

6.2.2 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.

6.2.3 California Building Code

Local building codes ensure noise attenuation recommendations from the AICUZ Program are addressed. Although building codes will not prevent incompatible development, they can minimize impacts to the utmost extent possible. The California Building Code, California Code of Regulations (CCR), Title 24, contains standards for allowable indoor noise levels associated with exterior noise sources of 45 CNEL. CCR Title 24 is published by the California Building Standards Commission and applies to all building occupancies (see Health and Safety Code Section 18908 and 18938) throughout the State of California.

The noise insulation standards established in CCR, Title 24, establish uniform minimum noise insulation performance standards to protect persons within new multi-family residential structures and hotels from the effects of noise. Once buildings are sound-insulated to the proper performance standards, they are not considered “noise impacted.” These minimum noise insulation performance standards require that the CNEL shall not exceed 45 dB in any habitable room, with all doors and windows closed.

Cities and counties are required by state law to enforce CCR Title 24 (Health and Safety Code Sections 17958, 17960, 18938[b], and 18948). Cities and counties may adopt ordinances with more restrictive requirements than provided by CCR Title 24 because of local climatic, geological, or topographical conditions. Such adoptions and a finding of need statement must be filed with the California Building Standards Commission (Health and Safety Code Sections 17958.7 and 18941.5). The City of Oxnard and the County of Ventura have adopted noise ordinances and enforce state building codes that require minimum sound insulation standards within designated noise sensitive buildings.

6.2.4 Capital Improvement Program

Capital Improvement Program (CIP) projects, such as the extension of potable water lines or 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. The General Plan Land Use element must address public facilities and associated CIPs; CEQA process must address impacts to public facilities; and LAFCo must address provisions of public facilities in its decisions. CIPs follow the analysis that occurs through these three processes. Local governments can coordinate CIP projects to avoid extending infrastructure into or near high noise zones or APZs.

6.2.5 Transfer of Development Rights Programs

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 greater density development. 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, historic 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 Programs

Local governments (or a land trust) can also establish purchase of development rights programs to manage growth and to preserve open space. A local government or agency provides landowners 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 (e.g., farming, timber production, or hunting). The local government may consider purchase of development rights for agricultural land within the AICUZ footprint.

6.2.7 Fee-Title Acquisition

When the operational integrity of an installation is threatened by incompatible land use and development, and if the local community is unwilling or unable to address the threat using their own authority, the Navy may seek to acquire interest in properties (acquisition) to protect their mission. The first priority for acquisition, whether in fee or by restrictive easement, is the Clear Zone. The second priority is the other APZs. Areas within high noise zones outside the Clear Zone and APZs may be considered for acquisition only when all avenues of achieving compatible use zoning or similar protection have been explored and the operational integrity of the installation is clearly threatened. Land can be purchased through negotiation and voluntary agreement or through condemnation procedures using the power of eminent domain.

6.2.8 Real Estate Disclosure

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.

7

LAND USE COMPATIBILITY ANALYSIS AND RECOMMENDATIONS

The information presented in this chapter of the AICUZ Study is intended for consideration by NBVC, government entities at the city, county, and state levels, surrounding communities, and other interested groups and interested 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. 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." Implementation of the recommendations is achieved over time through partnerships between NBVC 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 NBVC Point Mugu 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.

The prospective AICUZ footprint for NBVC Point Mugu (Figure 7-1) reflects CNEL 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 2 (CNEL 65-74) and Noise Zone 3 (CNEL 75 and above), as well as APZs (Clear Zone, APZ I, and APZ II) of the air installation. The Navy recommends that the prospective 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 Guidelines and Classifications

Certain land uses are incompatible with APZs and high noise zones, while other land uses may be compatible or compatible under certain conditions (compatible 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, churches, shopping centers, sports arenas) should not be placed in APZs.

OPNAVINST 11010.36C Recommendations

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

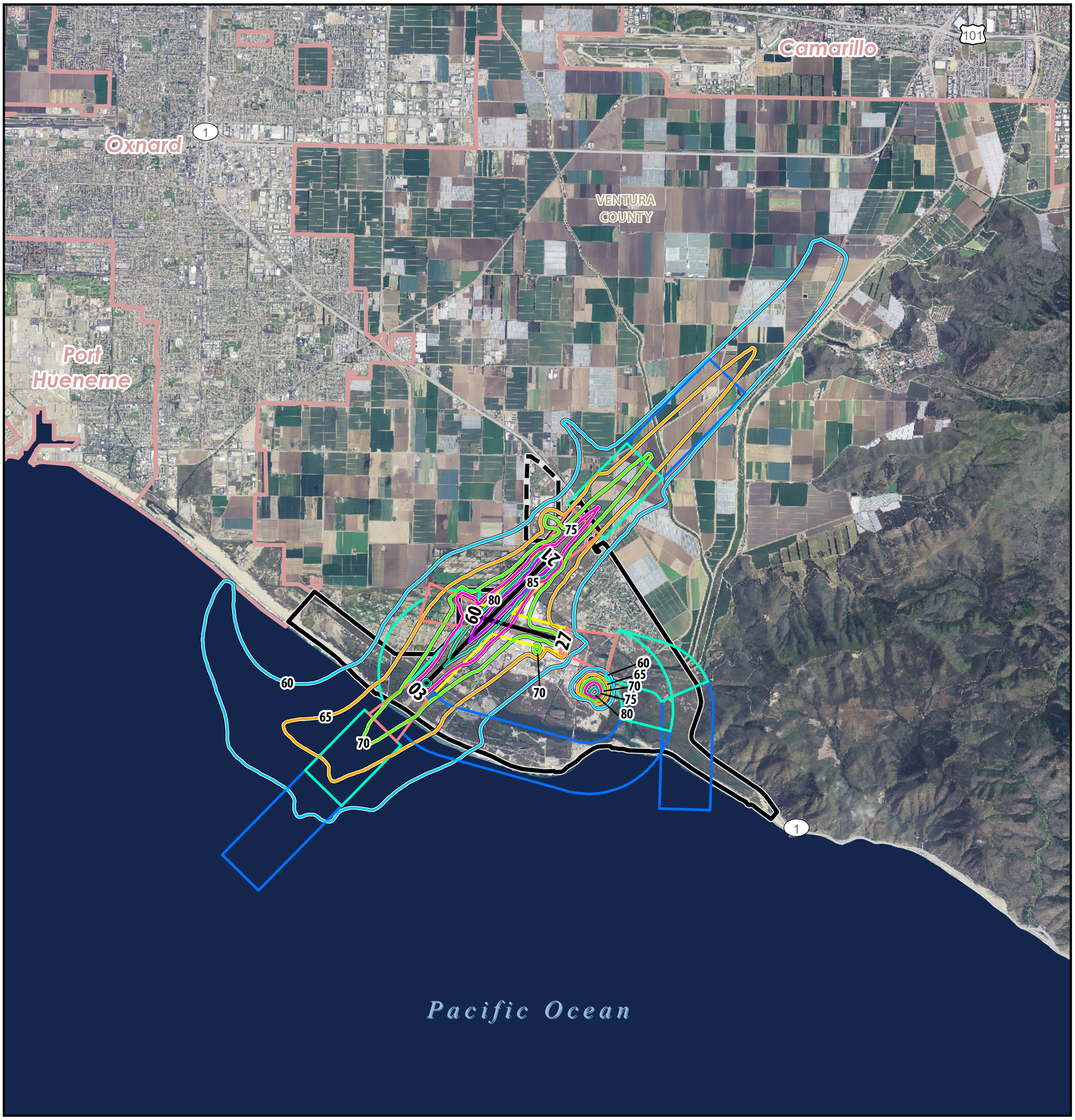
People-intensive uses (e.g., apartments, theaters, churches, shopping centers) should be placed outside APZs.

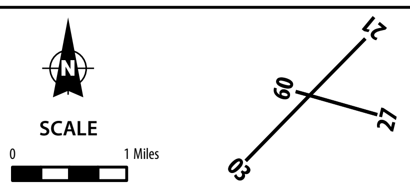
The land use compatibility analysis for NBVC Point Mugu is based on the Navy's land use compatibility recommendations, which are presented in Table 7-1, presented in Section 7.1.3, Standard Land Use Coding Manual. To determine land use compatibility within NBVC Point Mugu's prospective noise zones and APZs, the Navy examined existing land uses near the airfield.

7.1.1 Suggested Land Use Compatibility for Noise

As discussed in Section 4.1, Sound Measurements and Guidance, CNEL 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 CNEL measurements. Noise Zone 1 (60 to <65 dB CNEL) is an area of low or no impact. Noise Zone 2 (65 to <75 dB CNEL) is an area of moderate impact where some land use controls are recommended. Noise Zone 3 (≥75 dB CNEL) is the most impacted area where the greatest degree of compatible land use controls are recommended. In addition to noise zones, areas of concern may be defined where noise levels are not normally considered to be objectionable (less than CNEL 65), 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. It is noted that a portion of the population will be annoyed even by the lower levels of noise in Noise Zone 1.

Path: \\Prtbhp1\gis\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_7-1_Prospective_2020_AICUZ.mxd 1/7/2016





Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Municipal Boundary

Prospective (2020) AICUZ Noise Contour and dB CNEL Value

60 65 70 75 80 85

Prospective (2020) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface

Figure 7-1
2020 Prospective AICUZ Footprint

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012;

7.1.2 Suggested Land Use Compatibility for Accident Potential Zones

For land use planning purposes, recommended land use compatibility guidelines for Clear Zones and APZs are shown in Table 7-1. Local planning and zoning authorities may wish to implement different criteria than those included herein to reflect specific local conditions. Chief of Naval Operations approval is required prior to an installation's public support of any criteria other than that contained in OPNAVINST 11010.36C.

7.1.3 Standard Land Use Coding Manual

The Navy uses the Standard Land Use Coding Manual (SLUCM) classifications in OPNAVINST 11010.36C to assess compatibility with noise zones and APZs. The 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 NBVC Point Mugu'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 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ 1	APZ 2	65 TO 69 CNEL	70 TO <75 CNEL	≥75 TO 79 CNEL	80 TO 84 CNEL
10	Residential							
11	Household units	NA	NA	NA	N[28]	N[28]	N	N
11.11	Single units; detached	N	N	Y[2]	N[28]	N[28]	N	N
11.12	Single units; semidetached	N	N	N	N[28]	N[28]	N	N
11.13	Single units; attached row	N	N	N	N[28]	N[28]	N	N
11.21	Two units; side-by-side	N	N	N	N[28]	N[28]	N	N
11.22	Two units; one above the other	N	N	N	N[28]	N[28]	N	N
11.31	Apartments; walk up	N	N	N	N[28]	N[28]	N	N
11.32	Apartments; elevator	N	N	N	N[28]	N[28]	N	N
12	Group quarters	N	N	N	N[28]	N[28]	N	N
13	Residential hotels	N	N	N	N[28]	N[28]	N	N
14	Mobile home parks or courts	N	N	N	N	N	N	N
15	Transient lodgings	N	N	N	N[28]	N[28]	N[28]	N
16	Other residential	N	N	N	N[28]	N[28]	N	N
20	Manufacturing[3]							
21	Food and kindred products; manufacturing	N	N	Y[4]	Y	Y[29]	Y[30]	Y[31]
22	Textile mill products; manufacturing	N	N	Y[4]	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[29]	Y[30]	Y[31]
24	Lumber and wood products (except furniture); manufacturing	N	Y[5]	Y[5]	Y	Y[29]	Y[30]	Y[31]
25	Furniture and fixtures; manufacturing	N	Y[5]	Y[5]	Y	Y[29]	Y[30]	Y[31]
26	Paper and allied products; manufacturing	N	Y[5]	Y[5]	Y	Y[29]	Y[30]	Y[31]

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

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

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES[1]			NOISE LEVELS			
					NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ 1	APZ 2	65 TO 69 CNEL	70 TO <75 CNEL	≥75 TO 79 CNEL	80 TO 84 CNEL
50	Trade							
51	Wholesale trade	N	Y[5]	Y[5]	Y	Y[29]	Y[30]	Y[31]
52	Retail trade – building materials, hardware, and farm equipment	N	Y[8]	Y[8]	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	25	30	N
54	Retail trade – food	N	N	Y[11]	Y	25	30	N
55	Retail trade – automotive, marine craft, aircraft, and accessories	N	Y[12]	Y[12]	Y	25	30	N
56	Retail trade – apparel and accessories	N	N	Y[13]	Y	25	30	N
57	Retail trade – furniture, home furnishings, and equipment	N	N	Y[13]	Y	25	30	N
58	Retail trade – eating and drinking establishments	N	N	N	Y	25	30	N
59	Other retail trade	N	N	Y[9]	Y	25	30	N
60	Services[14]							
61	Finance, insurance, and real estate services	N	N	Y[15]	Y	25	30	N
62	Personal services	N	N	Y[16]	Y	25	30	N
62.4	Cemeteries	N	Y[17]	Y[17]	Y	Y[29]	Y[30]	Y[31,37]
63	Business services (credit reporting; mail, stenographic reproduction; advertising)	N	N	Y[18]	Y	25	30	N
63.7	Warehousing and storage services	N	Y[19]	Y[19]	Y	Y[29]	Y[30]	Y[31]
64	Repair services	N	Y[20]	Y[20]	Y	Y[29]	Y[30]	Y[31]
65	Professional services	N	N	Y[18]	Y	25	30	N
65.1	Hospitals, other medical facilities	N	N	N	25	30	N	N

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES[1]			NOISE LEVELS			
					NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ 1	APZ 2	65 TO 69 CNEL	70 TO <75 CNEL	≥75 TO 79 CNEL	80 TO 84 CNEL
65.16	Nursing homes	N	N	N	N[28]	N[28]	N	N
66	Contract construction services	N	Y[20]	Y[20]	Y	25	30	N
67	Governmental services	N	N	Y[11]	Y[28]	25	30	N
68	Educational services	N	N	N	25	30	N	N
69	Miscellaneous	N	N	Y[18]	Y	25	30	N
70	Cultural, entertainment and recreational							
71	Cultural activities (& churches)	N	N	N	25	30	N	N
71.2	Nature exhibits	N	Y[21]	Y[21]	Y[28]	N	N	N
72	Public assembly	N	N	N	Y	N	N	N
72.1	Auditoriums, concert halls	N	N	N	25	30	N	N
72.11	Outdoor music shells, amphitheaters	N	N	N	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	N	N	N	Y[33]	Y[33]	N	N
73	Amusements- fairgrounds, miniature golf, driving ranges; amusement parks, etc.	N	N	Y	Y	Y	N	N
74	Recreational activities (including golf courses, riding stables, water recreation)	N	Y[20, 21]	Y[20, 21]	Y[28]	25	30	N
75	Resorts and group camps	N	N	N	Y[28]	Y[28]	N	N
76	Parks	N	Y[20, 21]	Y[20, 21]	Y[28]	Y[28]	N	N
79	Other cultural, entertainment and recreation	N	Y[17, 20]	Y[17, 20]	Y[28]	Y[28]	N	N
80	Resource production and extraction							
81	Agriculture (except livestock)	Y[6]	Y[22]	Y[22]	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[34]	Y[35]	N	N
82	Agricultural related activities	N	Y[22, 24]	Y[22, 24]	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 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ 1	APZ 2	65 TO 69 CNEL	70 TO <75 CNEL	≥75 TO 79 CNEL	80 TO 84 CNEL
83	Forestry activities[25]	N	Y[24]	Y[24]	Y[34]	Y[35]	Y[36]	Y[36, 37]
84	Fishing activities[26]	N[26]	Y[24]	Y[24]	Y	Y	Y	Y
85	Mining activities	N	Y[24]	Y[24]	Y	Y	Y	Y
89	Other resource production and extraction	N	Y[24]	Y[24]	Y	Y	Y	Y
90	Other							
91	Undeveloped Land	Y	Y	Y	NA	NA	NA	NA
93	Water areas	N[27]	N[27]	N[27]	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 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.

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES[1]			NOISE LEVELS			
					NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ 1	APZ 2	65 TO 69 CNEL	70 TO <75 CNEL	≥75 TO 79 CNEL	80 TO 84 CNEL

12. Maximum FAR of 0.14 in APZ 1 and 0.28 in APZ 2.
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.

TABLE 7-1 LAND USE COMPATIBILITY RECOMMENDATIONS

LAND USE		ACCIDENT POTENTIAL ZONES[1]			NOISE LEVELS			
					NOISE ZONE 2		NOISE ZONE 3	
SLUCM NO.	NAME	CLEAR ZONE	APZ 1	APZ 2	65 TO 69 CNEL	70 TO <75 CNEL	≥75 TO 79 CNEL	80 TO 84 CNEL

36. Residential buildings not permitted.
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 NBVC Point Mugu. The AICUZ footprint is the basis for the land use compatibility analysis. As previously noted, NBVC Point Mugu's AICUZ footprint is located in the unincorporated areas of Ventura County and within the Planning Area boundary for the City of Oxnard (Figure 7-1). Therefore, land use within the off-installation AICUZ footprint is under the jurisdiction of those governments.

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 NBVC Point Mugu, along with the land use compatibility assessment, are presented below.

7.2.1 LAND USE SURROUNDING NBVC POINT MUGU

"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 General Plans, which are the primary policy documents that guide local land use and development.

VENTURA COUNTY

Any lands in Ventura County that are not incorporated within a city boundary are unincorporated. The lands surrounding NBVC Point Mugu and within the AICUZ footprint are generally unincorporated lands within Ventura County. Based on Ventura County's General Land Use map, six basic land use designations are utilized for Ventura County, as described below (Ventura County 2013c).

Urban: Depicts existing and planned urban centers, including commercial and industrial uses as well as residential uses where the building intensity is greater than one principal dwelling unit per 2 acres.

Existing Community: Identifies existing urban residential, commercial, or industrial enclaves located outside Urban designated areas.

Rural: Identifies areas with low-density and low-intensity land uses, such as residential estates with parcel sizes 2 acres or greater and other rural uses that are maintained in conjunction with agricultural and horticultural uses or in conjunction with keeping farm animals for recreational purposes.

Agricultural: Applied to irrigated land that is suitable for cultivating crops and raising livestock.

Open Space: Encompasses any parcel or area of land or water that is unimproved and devoted to an open space use, as defined under Section 65560 of the State Government Code.

State or Federal Facility: Applied to federal (such as NBVC Point Mugu) or state facilities, excluding forest and park lands, over which Ventura County has no or limited land use authority.

Existing land uses and points of interest surrounding NBVC Point Mugu are described below and shown on Figure 7-2. The dominant land use surrounding NBVC Point Mugu is designated agricultural (AG), with a mix of open space (OS) and agricultural-urban reserve (AUR). The agricultural (AG) designation includes rural residential uses, such as single-family dwellings, mobile homes, and farmworker housing. These residences are on parcels that are greater than 2 acres and are maintained in conjunction with primary agricultural and horticultural uses. The open space (OS) designation located west/northwest of the airfield includes two large parcels of land utilized for game preserve and private hunting clubs. The Point Mugu Game Reserve is a 315-acre parcel, and the Ventura County Game Reserve is 575 acres, both of which are overlapped by portions of the AICUZ footprint. Agricultural-urban reserve (AUR) land is located west of the airfield and abuts the Oxnard-Ormond Beach area.

The developed land uses near NBVC Point Mugu include neighborhood mixed-use (NMU), light industrial (ILT), and commercial (COM). There are commercial trade and manufacturing land uses directly north of NBVC Point Mugu along State Route 1/Pacific Coast Highway and East Hueneme Road. This land use is mainly associated with produce and greenhouse nursery production and organics processing.

State facility land use associated with the CSUCI campus is located northeast of the airfield and just outside the AICUZ noise contours. There is also an existing community land use in the same area, which includes the Villa Calleguas and Casa de Esperanza apartment complexes, as well as a Center for Children and Family facility.

Ventura County Coastal Area

Ventura County's Coastal Area Plan was developed for the unincorporated coastal portions of the county, and is also part of the General Plan. The land use designations in the Coastal Area Plan are illustrated on Figure 7-3. As depicted, the southern portion of NBVC Point Mugu is within the Coastal Area Plan and is designated coastal open space (COS). The land area northwest of the installation boundary is within the City of Oxnard coastal area. Land west of airfield includes agricultural (AG) and recreation (REC) land uses along State Route 1/Pacific Coast Highway. The recreation (REC) uses are associated with Point Mugu State Park hiking trails, campsites, and other outdoor recreational features within the La Jolla Valley, Mugu Canyon, and Hueneme Canyon. The open space (OS) land uses further east towards Solromar are associated with the Santa Monica Mountains National Recreation Area.

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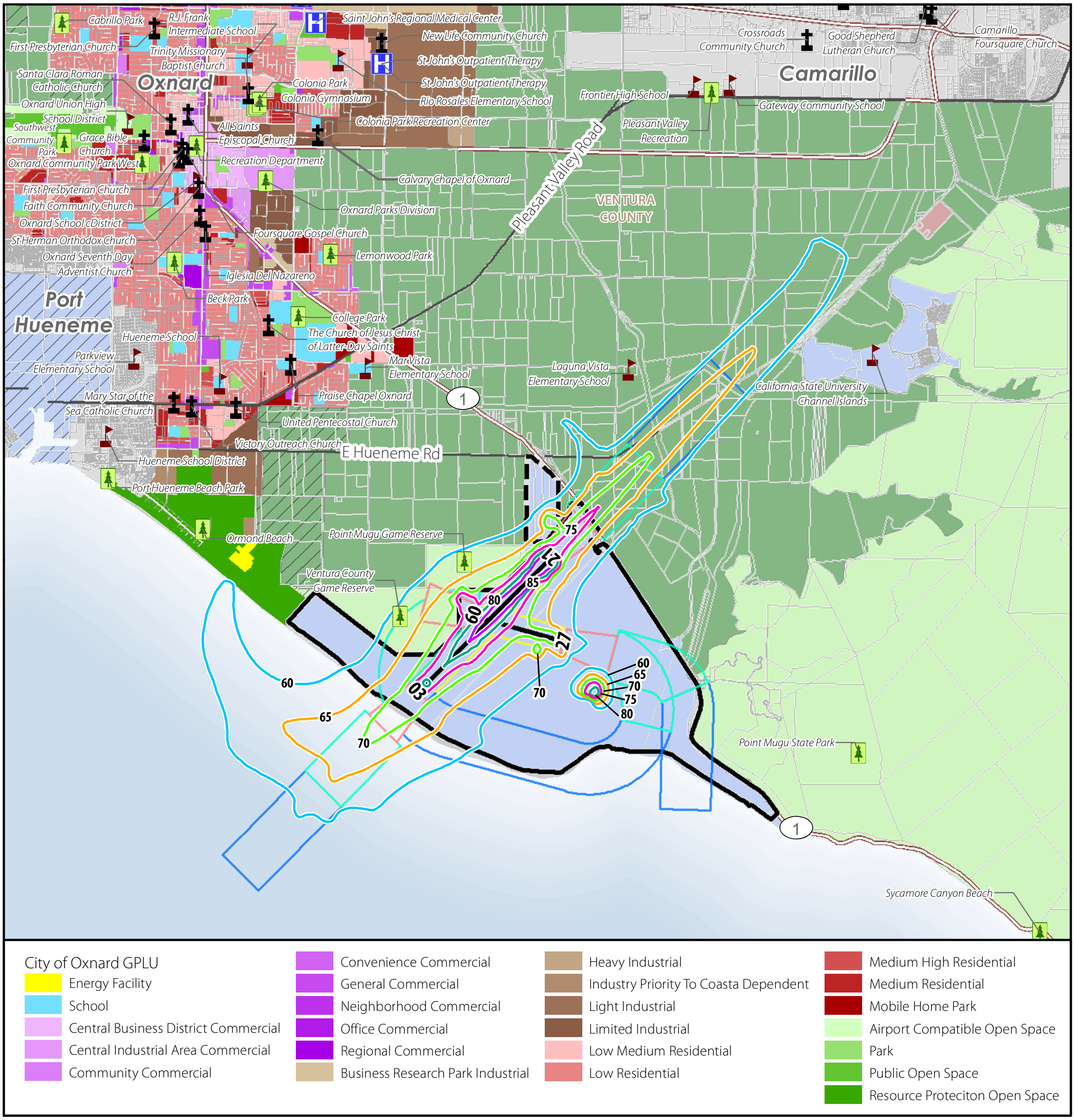
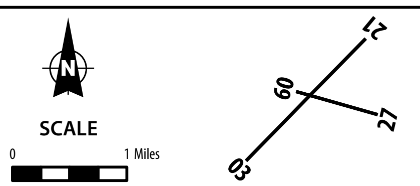
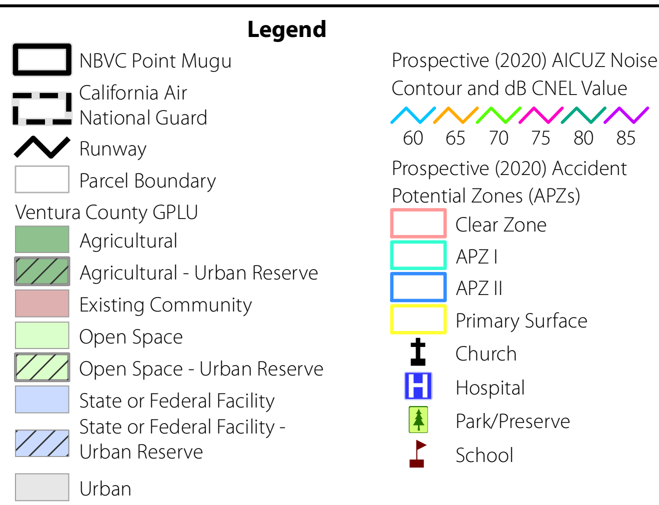




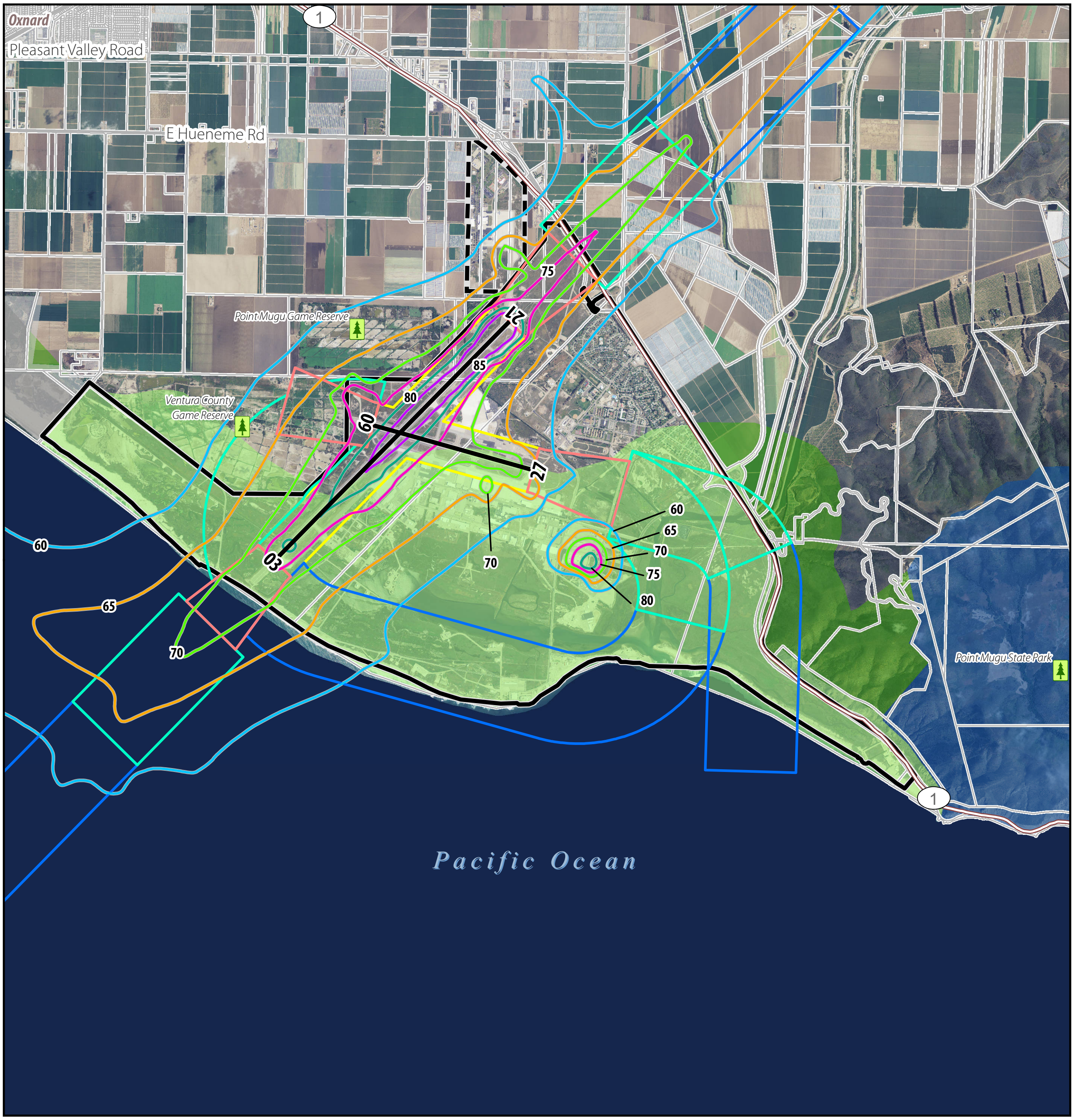


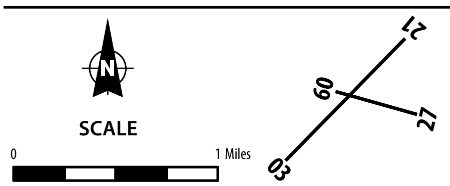
Source:
Service Layer Credits: USDA NAIP, 2014
ESRI 2012; Wyle 2014; Navy 2012; City of Oxnard Planning Department, 2014; Ventura County Resource Management Agency Information Systems, 2012
Google Earth Points of Interest, accessed 01/2015

Figure 7-2
2020 Prospective AICUZ Footprint with Land Use, City of Oxnard and County of Ventura

NBVC
Ventura County, California

Path: \\prtbhp1\GIS\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_7-3_Coastal_Area_LU.mxd 1/6/2016





Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Parcel Boundary

Coastal Land Use

- Agriculture
- Open Space
- Recreational
- Urban

Prospective (2020) AICUZ Noise Contour and dB CNEL Value

60 65 70 75 80 85

Prospective (2020) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface
- Park/Preserve

Figure 7-3

Ventura County Coastal Area Land Use Map

NBVC

Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012; Ventura County Resource Management Agency Information Systems, 2012
Google Earth Points of Interest, accessed 01/2015

Overall, the existing land uses around NBVC Point Mugu are compatible with base operations and include a pattern of low development intensity with a mix of agricultural (AG), open space (OS), and agricultural-urban reserve (AUR). Table 7-2 provides the total composition of all County land uses within the AICUZ footprint. From a land use compatibility standpoint, some of the residential and other uses (e.g., cultural and recreational) surrounding the airfield are currently incompatible in certain APZs and noise zones. An evaluation of specific land use compatibility concerns are discussed in Section 7.2.3, Compatibility Concerns.

TABLE 7-2 VENTURA COUNTY LAND USES WITHIN THE AICUZ FOOTPRINT (ACRES)

LAND USE	CLEAR ZONE	APZ I	APZ II	NOISE ZONE 1 (60 TO <65 dB CNEL)	NOISE ZONE 2 (65 TO <75 dB CNEL)	NOISE ZONE 3 (≥75 dB CNEL)
Agricultural	0.4	335.1	482.1	1,230.4	509.7	2.4
Open Space	95.6	194.3	95.2	332.5	285.1	3.8
State or Federal Facility	345.0	633.8	846.7	705.2	937.7	497.1
Water	73.1	345.7	1,039.9	1,533.6	543.4	0
Total	**514.0**	**1,508.9**	**2,463.9**	**3,801.8**	**2,275.8**	**503.4**

Sources: Wyle 2014; Navy 2013e; Ventura County 2012
Notes: Author calculations include base property or bodies of water.
Agricultural (AG) land use includes single-family residential dwellings.

CITY OF OXNARD

City of Oxnard
Residential Density

Rural = 1-4 du/acre
Very Low = 1-2 du/acre
Low = 1-7 du/acre
Low-Medium = 7-12 du/acre
Medium = 12-18 du/acre
High = 18-30 du/acre
Mobile Home 1 = 1-7 du/acre
Mobile Home 2 = 7-12 du/acre

Source: City of Oxnard 2011
Note: du/acre = residential dwelling units per one acre

The northwest boundary of NBVC Point Mugu abuts the Oxnard municipal boundary, and other lands in that area are within the City of Oxnard's Sphere of Influence for land use planning. Land use patterns in Oxnard feature a broad range of land uses with varying densities. Figure 7-2 illustrates the composite AICUZ map with the Oxnard land uses.

Residential and commercial development extends to the Sphere of Influence along the northern, eastern, and western portions of the boundary. Business research parks and industrial land uses occupy the northeastern corner of the city along Ventura Freeway and Gonzales Road. Residential developments are scattered throughout the city, with concentrated pockets east and northeast of NBVC Point Mugu along Pacific Coast Highway. Residential developments located in the southern portion of the city, closest to the airfield, include Villa Capri, Cypress Gardens, Southwinds, Tierra Vista, and Pleasant Valley. The lands outside the Sphere of Influence, but within the planning area and to the east, are designated agricultural (AG) land uses. The areas beyond the growth boundary are protected by a greenbelt agreement between the cities of Oxnard and Camarillo and Ventura County that prevents expansion of the Oxnard Sphere of Influence. Therefore, the only options for new development in the Oxnard are infill of existing vacant parcels within the city boundary, vertical development, and Ormond Beach.

Ormond Beach comprises approximately 595 acres south of Hueneme Road and is located just beyond the 60 CNEL noise contour for NBVC Point Mugu. The area is designated as Resource Protection (RP) on the City's General Land Use map; however, the area is important to note due to its substantial development potential and pressure on the City of Oxnard to convert agricultural land outside of the Sphere of Influence to residential uses, both of which could cause incompatible development with the aircraft operations.

7.2.2 Zoning Surrounding NBVC Point Mugu

> Zoning is a system of land use regulations that controls the physical development of land.

"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 General Plan. While the General 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 lands surrounding NBVC Point Mugu have zoning classifications that mostly reflect the land uses. Establishing and/or enforcing zoning ordinances is the desired method to address AICUZ guidelines and compatibility at the airfield.

Ventura County

Ventura County zoning surrounding NBVC Point Mugu includes agricultural exclusive (AE), open space (OS), coastal open space (COS), coastal agricultural (CA), rural agricultural (RA), and limited residential planned development (RPD). The predominant classification is agricultural exclusive (AE), which extends north to Camarillo and west to Oxnard (Figure 7-4). The commercial zoning districts are primarily along the State Route 1/Pacific Coast Highway frontages and the corridor intersections.

Under the Non-Coastal Zoning Ordinance (Table 7-3), agricultural (AG), open space (OS), rural agricultural (RA), and residential (R1/R2) zones allow single-family dwellings and second dwelling units. In addition, the agricultural, open space, and rural zones allow farmworker dwelling units and animal caretaker dwelling units by Zoning Clearance. Both the Non-Coastal and Coastal Zoning Ordinances allow mobile homes and manufactured homes as single-family dwellings, second dwellings, and animal caretaker or farmworker dwellings (Ventura County 2013c).

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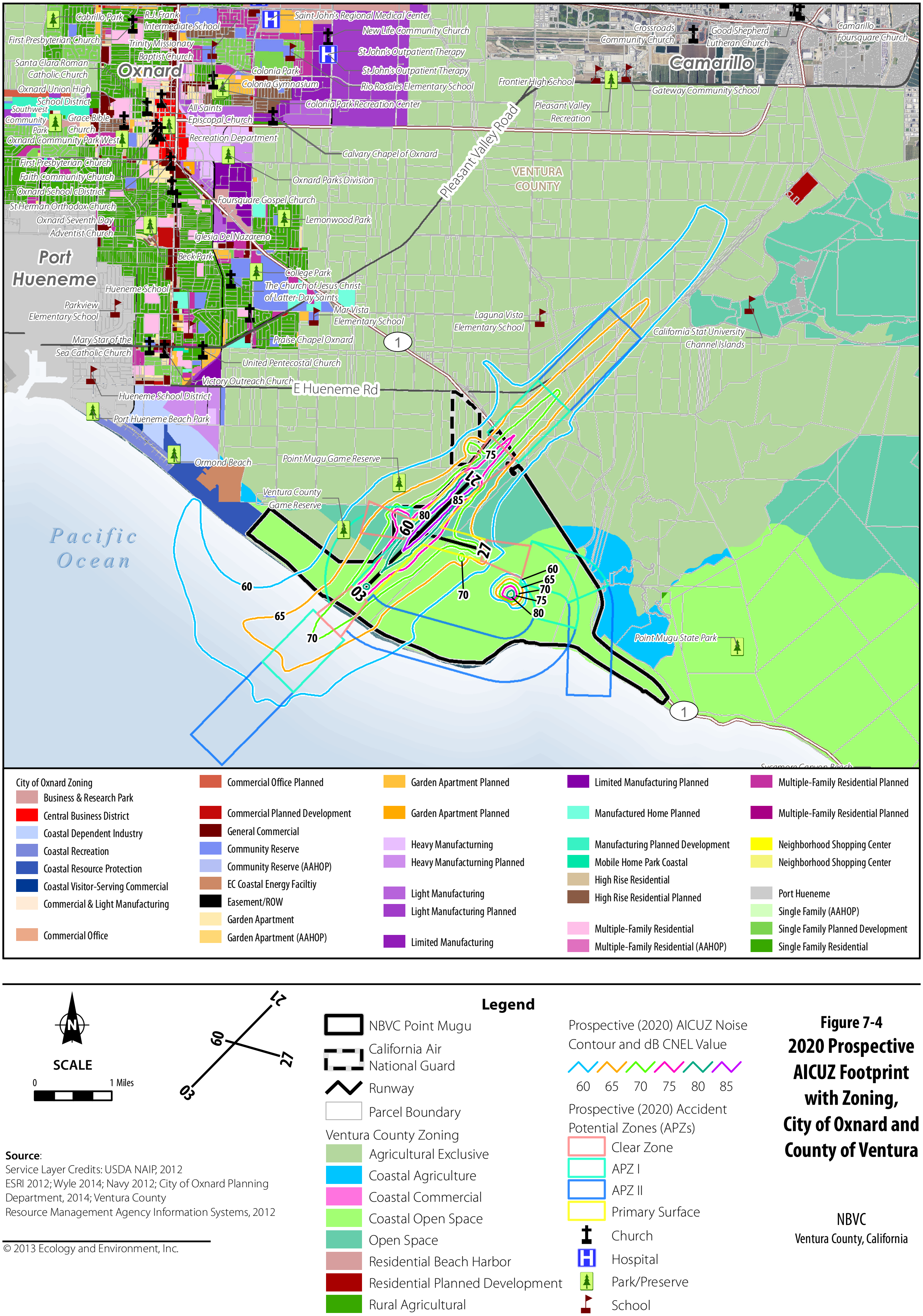

Figure 7-4
2020 Prospective AICUZ Footprint with Zoning, City of Oxnard and County of Ventura

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012; City of Oxnard Planning Department, 2014; Ventura County Resource Management Agency Information Systems, 2012

TABLE 7-3 VENTURA COUNTY ZONING DESIGNATIONS

NON-COASTAL ZONING		
RO (Single Family Estate)	CO (Commercial Office)	OS (Open Space)
R1 (Single Family Residential)	C1 (Neighborhood Commercial)	AE (Agricultural Exclusive)
R2 (Two Family Residential)	CPD (Commercial Planned Development)	RA (Rural Agricultural)
RPD (Residential Planned Development)	M1 (Industrial Park)	RE (Rural Exclusive)
RHD (Residential High Density)	M2 (Limited Industrial)	M3 (General Industrial)
COASTAL ZONING		
CR1 (Coastal One-Family Residential)	COS (Coastal Open Space)	CRPD (Coastal Residential Planned Development)
CR2 (Coastal Two-Family Residential)	CA (Coastal Agriculture)	CC (Coastal Commercial)
RB (Residential Beach)	CR (Coastal Rural)	CM (Coastal Industrial)
RBH (Residential Beach Harbor)	CRE (Coastal Rural Exclusive)	

Source: Ventura County 2013c

Table 7-4 provides the total composition of all the zoning within the NBVC Point Mugu AICUZ footprint. From a land use compatibility standpoint, agricultural (AG), open space (OS), rural agricultural (RA), and residential (R1/R2) zones allow single-family dwellings and second dwelling units, which are incompatible in certain APZs and noise zones. An evaluation of specific land use compatibility is provided in Section 7.2.3, Compatibility Concerns.

TABLE 7-4 VENTURA COUNTY ZONING WITHIN THE AICUZ FOOTPRINT (ACRES)

LAND USE	CLEAR ZONE	APZ I	APZ II	NOISE ZONE 1 (60 TO <65 dB CNEL)	NOISE ZONE 2 (65 TO <75 dB CNEL)	NOISE ZONE 3 (≥75 dB CNEL)
Agricultural Exclusive (AE)	2.6	418.8	482.1	1,516.6	721.6	2.8
Coastal Agricultural (CA)	0	24.3	85.6	0	0	0
Coastal Open Space (COS)	167.9	591.0	856.3	490.8	600.9	154.2
Open Space (OS)	270.4	129.0	0	260.6	409.9	346.4
Water	73.1	345.7	1,039.9	1,533.6	543.4	0
Total	**514.0**	**1,508.9**	**2,463.9**	**3,801.8**	**2,275.8**	**503.4**

Sources: Wyle 2014; Navy 2013e; Ventura County 2012
Notes: Author calculations include base property or bodies of water.
Agricultural and Open Space includes single-family residential dwellings.

LAND CONSERVATION ACT PARCELS AND GREENBELTS

Ventura County has established agricultural preserves under the State's Williamson Act. As a result of these land use controls, large areas of agricultural land surrounding NBVC Point Mugu are designated as Land Conservation Act (LCA) parcels and are removed from consideration for urban development. Owners of the agricultural land have entered into a LCA contract, agreeing to maintain the land as agriculture for a 10- or 20-year period in exchange for a reduction in their property taxes. If the LCA contract is not renewed, the land will remain zoned as agricultural. Figure 7-5 identifies LCA parcels surrounding the airfield within Ventura County.

Greenbelts are voluntary agreements between the County Board of Supervisors and one or more city regarding development of agricultural and/or open space areas beyond city limits. As part of the agreement, cities will not annex any property within a greenbelt and the County will restrict development to uses consistent with existing agricultural zoning. In addition, the County will not permit development within these areas. Greenbelts protect open space and agricultural lands and reassure property owners within these areas that lands will not be prematurely converted to agriculturally incompatible uses (Ventura County 2014d). Greenbelt designated lands result in the preservation of open space buffers between entities and benefit the Navy in preventing incompatible development north of NBVC Point Mugu. The first greenbelt, between the cities of Ventura and Santa Paula, was adopted by the County in 1967 (Ventura County 2013d). There are now seven greenbelts in the county (Figure 7-5).

CITY OF OXNARD

Oxnard is not directly impacted by the AICUZ footprint. However, historically, portions of Ormond Beach were impacted by the 60-65 dB CNEL contour and the area still has potential for noise complaints. Furthermore, NBVC Point Mugu's imaginary surfaces overlie areas of Oxnard. The zoning within the area closest to the AICUZ boundary includes coastal resource protection (RP), coastal energy facility (EC), community reserve (CR), heavy manufacturing (M-2), coastal recreation (RC), coastal dependent industry (CDI), and heavy manufacturing planned development (M-2-PD). Ormond Beach is also designated as a planning reserve (PR) for potential future urban use in the City of Oxnard's General Plan. It has also been the subject of many specific plan attempts to add residential and more urbanized development. Figure 7-4 illustrates Oxnard zoning near the AICUZ boundary.

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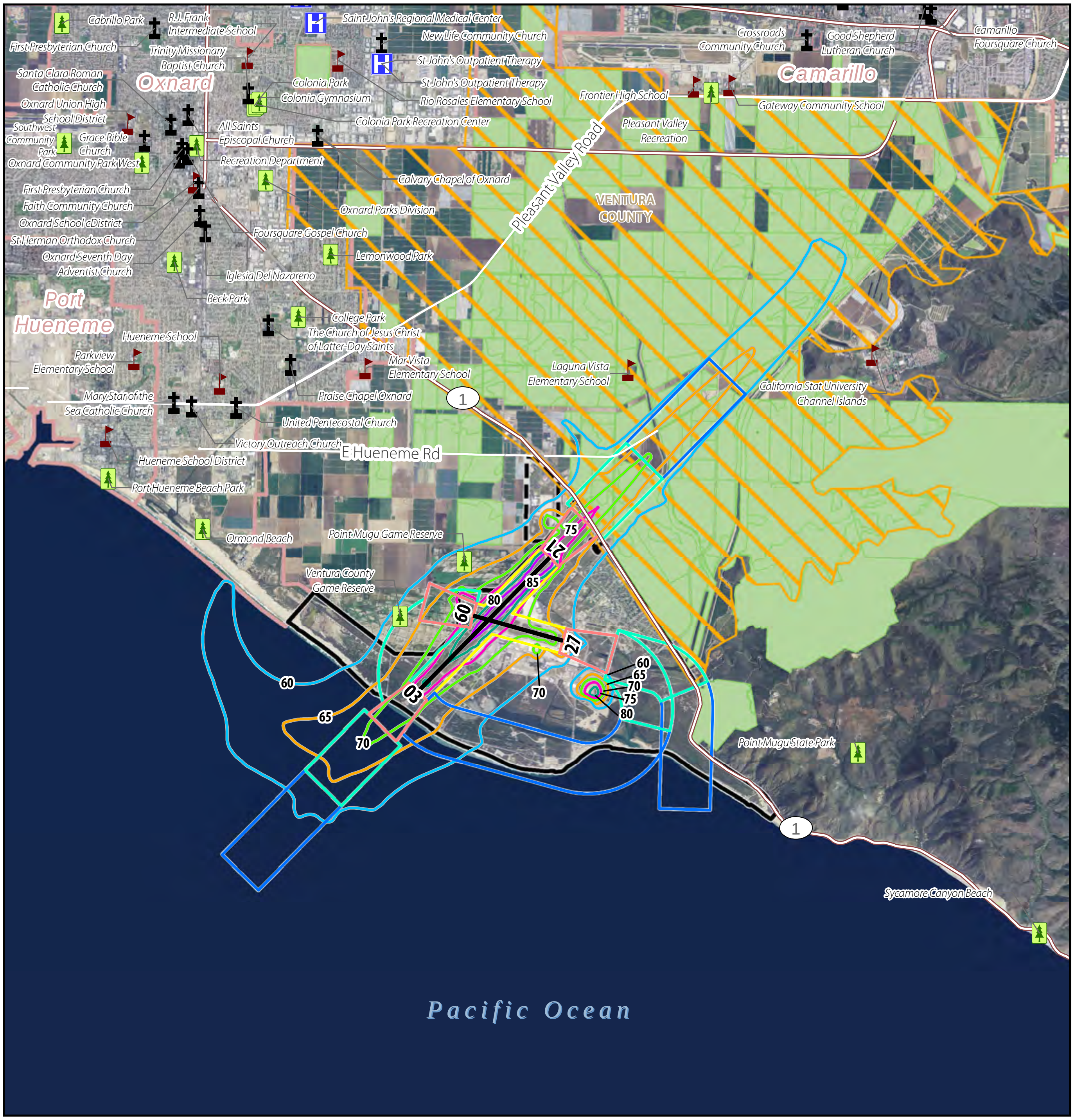

SCALE	0 — 1 Miles

Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Municipal Boundary
- LCA Parcels
- Oxnard-Camarillo Greenbelt
- Church
- Hospital
- Park/Preserve
- School

Prospective (2020) AICUZ Noise Contour and dB CNEL Value

60 65 70 75 80 85

Prospective (2020) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012; Ventura County Resource Management Agency Information Systems, 2012
Google Earth Points of Interest, accessed 01/2015

Figure 7-5
2020 Prospective AICUZ Footprint with City and County Land Conservation Act Parcels and Greenbelt Lands

NBVC
Ventura County, California

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 NBVC Point Mugu's mission that incompatible land uses are identified and minimized, where possible, and to promote compatible land uses within the AICUZ footprint. In determining land use compatibility within the AICUZ footprint, the Navy examined existing and future land use patterns near the airfield. Table 7-1, presented in Section 7.1.3, Standard Land Use Coding Manual, 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.

For analysis purposes, the area surrounding NBVC Point Mugu is divided into three main areas: north, east, and west. The existing compatibility issues in these areas are discussed in the sections below and illustrated on corresponding figures. In addition, general compatibility concerns associated with conditional uses, future plans, and development pressures are discussed. Recommendations are presented in Section 7.3, NBVC Point Mugu AICUZ Study Recommendations, and address specific land use compatibility issues identified.

To analyze whether existing land use is compatible with aircraft operations, the 2020 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 Ventura County. Analyzing future compatibility was conducted in a similar manner, while also considering County zoning and the City of Oxnard's planning and growth boundaries.

As previously stated, the AICUZ footprint for NBVC Point Mugu has been reduced in size and/or has reduced noise exposure areas when compared to the historic AICUZ footprint. For Oxnard, this change has placed land areas previously impacted by the AICUZ noise contours outside of the AICUZ footprint and has reduced the potential noise exposure areas. However, lands within Ventura County that are outside the installation boundaries are still within the AICUZ footprint. Therefore, a thorough land use compatibility analysis is necessary to account for the changing nature of land uses and growth patterns surrounding the installation.

Figures 4-3 and 5-3 in Chapters 4 and 5 of this AICUZ Study compare baseline and historic noise contours and APZs with the prospective noise contours and APZs.

Noise contours and/or APZs impact areas off installation in all directions. However, the majority of the AICUZ footprint extends northwest and west of the installation. The 2020 noise contours that extend off the installation range from 65 to 75 dB CNEL, which pose a compatibility concern with specific types of land use. In addition, there are incompatible land uses and existing compatibility concerns within APZs.

Overall, land use compatibility concerns for NBVC Point Mugu are minimal to moderate due to the strong local land use controls and zoning boundaries to contain urban development, protect farmland, and prevent incompatible development (e.g., Ventura County Airport Land Use Compatibility Plan, Coastal Zoning Ordinance, Guidelines for Orderly Development, SOAR ordinances, City Urban Restriction Boundaries, Spheres of Influence, LCAs, and Greenbelts Guidelines.)

CONCERNS NORTH OF NVBC POINT MUGU

Almost all of the parcels within the AICUZ footprint are zoned agricultural (AG)/open space (OS), which are compatible uses, but also permit the construction of potentially incompatible residential uses. The majority of the existing incompatible land uses within the area north of NBVC Point Mugu are single-family residential dwellings (mobile homes and farmworker housing) located in the agricultural zone. The Navalair Court mobile home park (APN #2320051065) is located along Naval Air Road, adjacent to the NBVC Point Mugu Perimeter Road. The 2.81-acre parcel includes approximately 30 manufactured homes located immediately adjacent to the northern end of Runway 03/21 and within APZ I and the 60-65 dB CNEL noise zone (Figure 7-6). 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 approximately 10 du/acre. The Navy views any residential use within APZ I as an incompatible land use.

Other general compatibility concerns include encroachment from local jurisdictions within the agricultural (AG) and open space (OS) zoning in Ventura County through Conditional Use Permits (CUPs). CUPs can allow residential uses, including detached single-family residences and mobile home parks, bed and breakfast inns, community centers, family day care centers, schools, government buildings, and libraries. Such development would most likely occur on parcels between the cities of Oxnard and Camarillo where the majority of the agricultural exists. Future conversion of agricultural land to residential and more intensive land uses could be incompatible within APZ and high noise zones. The siting of structures that could penetrate the primary surface surrounding the airfield is also a compatibility concern.

SOAR and LCA Protections

As previously discussed, large areas of agricultural land north of NBVC Point Mugu are under SOAR and LCA parcel designation protections (Figure 7-5) and are removed from consideration for urban development. SOAR boundaries and the LCA parcel designations provide the installation with important protections from encroaching urban development by ensuring the agricultural (AG)/open space (OS) zoning of the parcels. However, if the LCA contracts are not renewed or the SOAR ordinances is repealed or modified, the protection on the lands could be removed and the land would be under the general agricultural zoning controls, which allow residential development with a CUP. Due to the increased need for housing and the high price of land in the incorporated cities of Ventura County, there are increased pressures to develop the areas protected by these initiatives. For these reasons, there is a realistic potential for future incompatible development in the unincorporated agricultural areas north and northwest of the airfield within the planning areas of interest for Oxnard and Camarillo.

Camarillo Area of Interest

The southeast corner of Camarillo is positioned under NBVC Point Mugu flight paths and just northeast of the 60 dB CNEL noise contour. Land use in this area primarily consists of open space (OS), with some high-density and medium-density residential. There is the potential for increased pressure for residential development, as well as noise complaints from residents living in this area.

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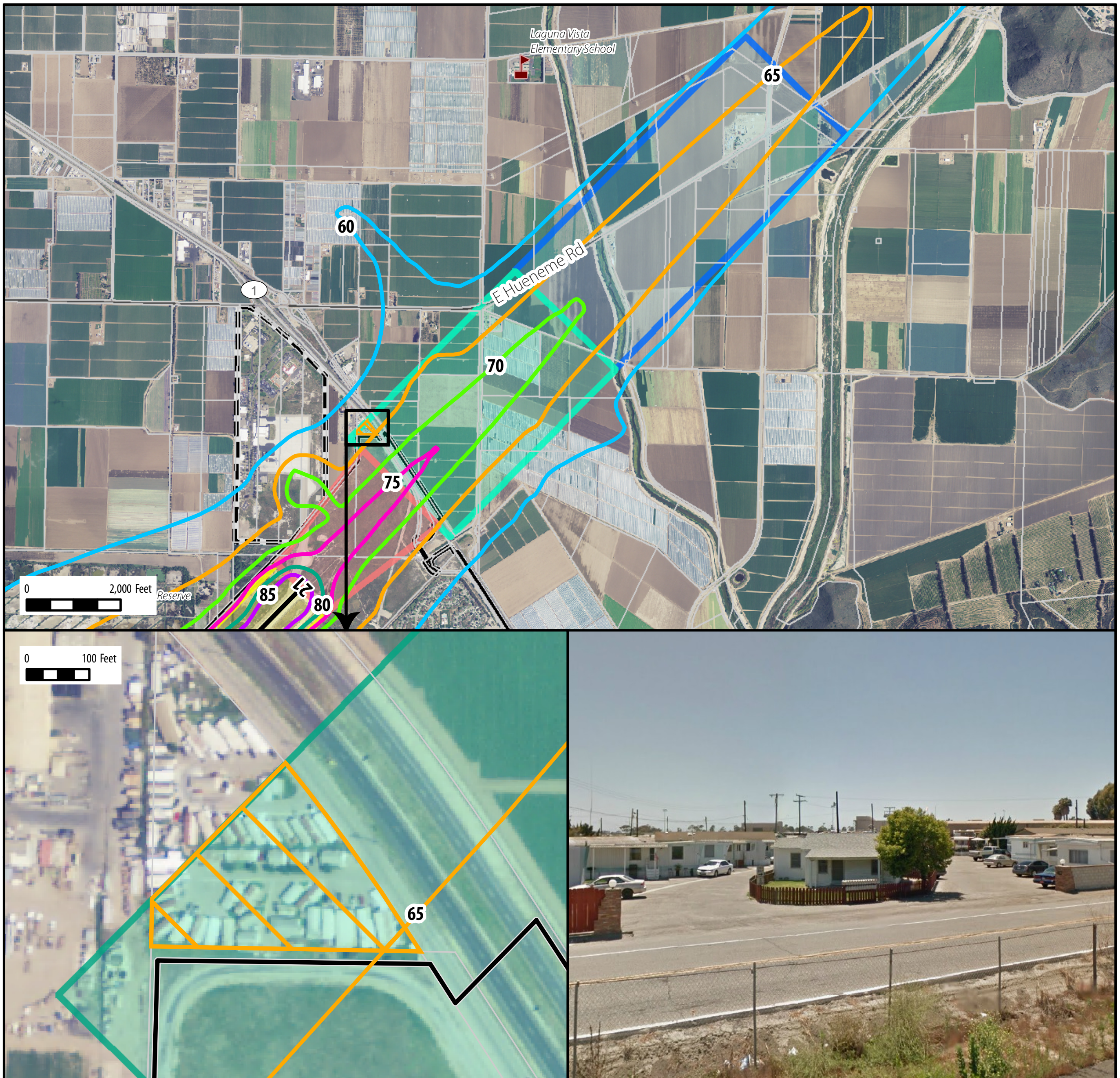


Summary of Concern: The Navalair Court mobile home park (APN #232005106) is located along Naval Air Road. The 2.81-acre parcel includes approximately 30 manufactured homes located within Runway 03/21 APZ I and the 60-65 dB CNEL noise zone. The density of this residential development exceeds 2 du/acre and there are upwards of 10 du/acre. The AICUZ Instruction views any residential use within APZ I as an incompatible land use.

Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Park/Preserve
- School
- Parcel Boundary
- Incompatible Land Uses

Prospective (2020) AICUZ Noise Contour and dB CNEL Value

60 65 70 75 80 85

Prospective (2020) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface

Figure 7-6
Compatibility Concerns North

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2014
ESRI 2012; Wyle 2014; Navy 2012; Ventura County Resource Management Agency Information Systems, 2012
Google Earth Points of Interest, accessed 01/2015

California State University Channel Islands Campus

Historically, portions of the CSUCI campus were impacted by 60-65 dB CNEL noise contours from NBVC Point Mugu. The 2020 noise contours are just outside the western boundary of the campus (Figure 7-2). However, there is the potential for western and southern expansion of the campus, which could bring people-intensive uses and buildings within the AICUZ footprint.

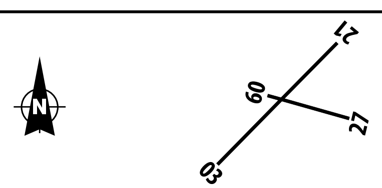
CONCERNS EAST OF NVBC POINT MUGU

There are six residential dwellings east of NBVC Point Mugu that pose an existing compatibility concern. These residences are on Laguna Peak Access Road near the intersection of Caryl Drive and Pacific Coast Highway in unincorporated Ventura County. These residences are within APZ I of Runway 09/27 and appear to exceed the recommended two du/ac density level for APZ I (Figure 7-7). The dwellings are single-story, wood frame, ranch style homes clustered on two parcels (APN 2390050185 and APN 2390040045). The land is part of the historic Rancho Guadalasca at the western base of the Santa Monica Mountains and is adjacent to Pacific Coast Highway. The AICUZ Instruction states that residential uses within APZ I and above the recommended density level are an incompatible land use.

Other general compatibility concerns include the potential for new residential or other incompatible development along the portion of the Pacific Coast Highway within APZ II. These lands are zoned coastal open space (COS) and coastal agricultural (CA), which may allow residential development under a CUP. Within the AICUZ footprint, conversion of agricultural land and open spaces to residential or other intensive land uses could be incompatible with APZ II and noise recommendations and should be monitored. Development and siting of structures in this area that could penetrate the primary surface surrounding the airfield is also a compatibility concern.

Path: \\Prtbhp1\gis\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_7-7_CompatibilityConcern_East.mxd 1/7/2016

Summary of Concern: There are six residential dwellings located on Laguna Peak Access Road near Caryl Drive in the historic range of Rancho Guadalasca in unincorporated Ventura County. These residences are within APZ I of Runway 09/27 and exceed the recommended 2 du/acre density level for APZ I. Residential use within APZ I exceeding 2 du/acre is an incompatible land use and strongly discouraged.



Legend

- NBVC Point Mugu
- Runway
- Park/Preserve
- Parcel Boundary
- Incompatible Land Uses

Prospective (2020) AICUZ Noise Contour and dB CNEL Value

60 65 70 75 80 85

Prospective (2020) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface

Figure 7-7
Compatibility Concerns East

NBVC
Ventura County, California

Source:
Service Layer Credits: USDA NAIP, 2014
ESRI 2012; Wyle 2014; Navy 2012; Ventura County Resource Management Agency Information Systems, 2012
Google Earth Points of Interest, accessed 01/2015

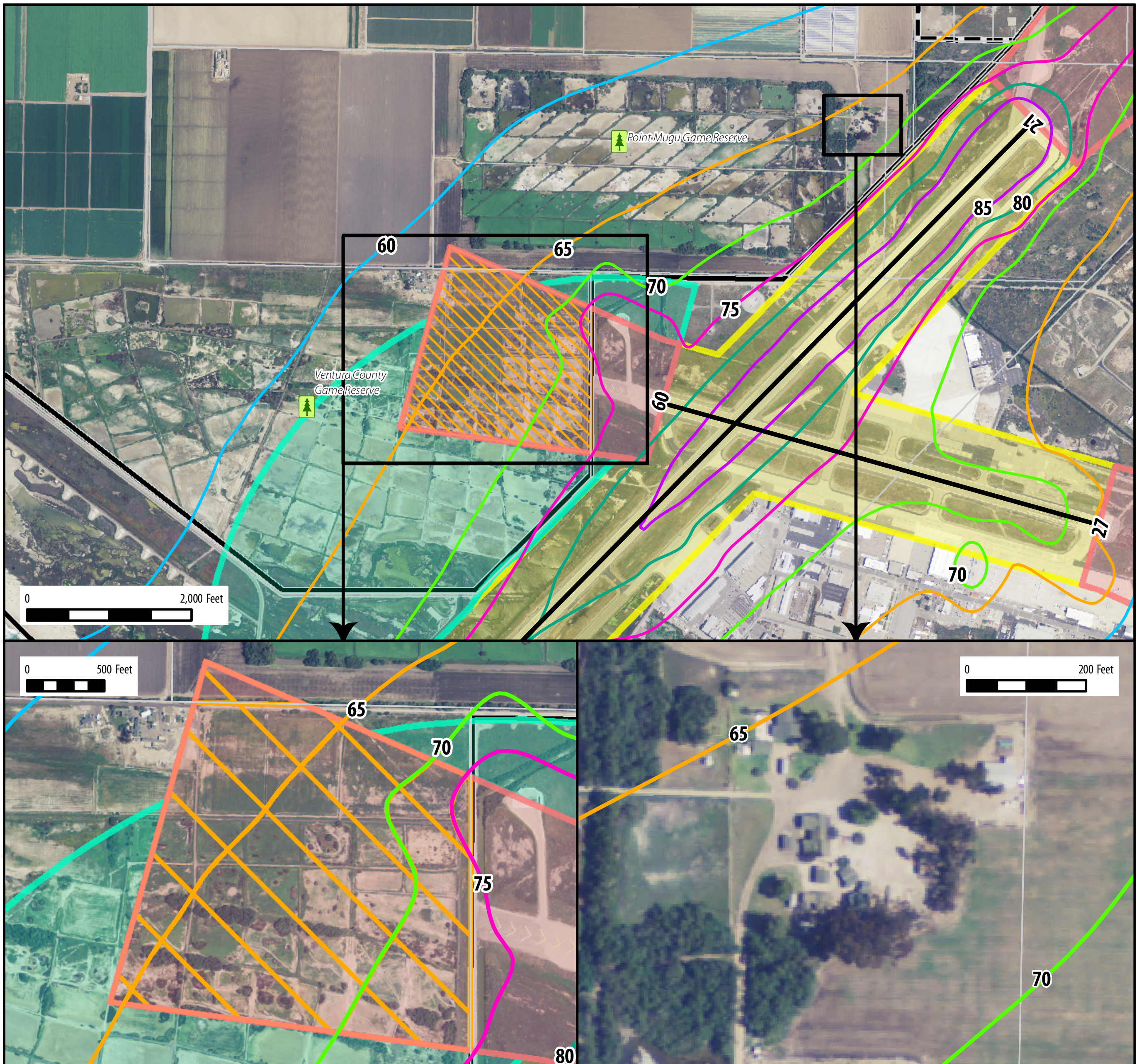
CONCERNS WEST OF NVBC POINT MUGU

The Ventura County Game Reserve (APN 2390020010) and Point Mugu Game Reserve (APN 2390010020) parcels are adjacent to NBVC Point Mugu's western boundary and are impacted by the Clear Zone of Runway 09/27 and high noise zones (Figure 7-8). The Ventura County Game Reserve is 575 acres, while the Point Mugu Game Reserve is 315 acres; both are zoned as agricultural (AG)/open space (OS). These preserves are private gun and hunting clubs that utilize the land for recreational purposes (primarily duck hunting). There are limited onsite buildings and structures associated with each preserve, with the majority of the land is vacant and consisting of man-made duck ponds. The tax assessor's property use description for both parcels is "sport facility."

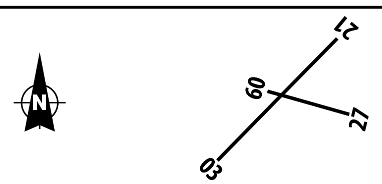
Runway 09/27's Clear Zone extends 3,000 feet beyond the runway onto the preserves and encompasses approximately 95 acres of private property. The Clear Zone has the highest potential for accidents and should be free of any structures. The Clear Zone does not appear to impact any structures, only some staged materials, fencing, and what appears to be a small shooting range at the Ventura County Game Reserve. It is recommended that the Navy own and maintain all land within the Clear Zone to guarantee that it remains vacant and protected from incompatible development. According to the Navy guidelines, agricultural land uses are the only permitted use within a Clear Zone. However, the lands within the Clear Zone are used for recreation purposes, which is not compatible and strongly discouraged. Furthermore, Ventura County agricultural (AG) and open space (OS) zoning provides for special use permits that could allow construction of inhabited dwellings on the properties within the Clear Zone.

Other existing compatibility concerns are the portions of the preserves with onsite buildings and residences within the 65 and 75 dB CNEL noise contour (Figure 7-8). There are also limited areas within the preserves that are exposed to 75+ dB CNEL contours. There are 10 structures in the northern portion of the Ventura County Game Reserve parcel along Casper Road (2950 Casper Road) that are within the 60-65 dB CNEL noise zone, and there appears to be three to four residential structures in the northeast corner of the Point Mugu Game Reserve that are within the 65-70 dB CNEL. Residential uses within the 65-70 dB CNEL noise zone and above are incompatible. However, if the community determines that the use must be allowed, then appropriate Noise Level Reduction (NLR) design and construction standards must be incorporated into the structures. NLR ratings assess a building's ability to block outdoor noise impacts. Typically, these are outlined in local zoning and building codes and, when applicable, building permits are granted once acceptable NLR ratings are demonstrated.

Path: \\Prtbhp1\gis\Seattle\Navy\Pt_Mugu_AICUZ\Maps\MXDs\2015\Figure_7-8_CompatibilityConcern_West.mxd 1/7/2016



Summary of Concern: Portions of the private gun and hunting clubs, Ventura County Game Preserve (APN: 2390020010) and the Point Mugu Game Preserve (APN: 2390010020), west of NBVC lie within the 65 and 75 dB DNL noise contour, including residential structures. Residential uses are incompatible in 65 dB CNEL and above. In addition, the Clear Zone of Runway 09/27 impacts approximately 95 acres of the preserves. It is recommended that the Navy should own and maintain all the land within the airfield Clear Zone to guarantee that these designated areas remain vacant and protected from incompatible development.



Legend

- NBVC Point Mugu
- California Air National Guard
- Runway
- Park/Preserve
- Parcel Boundary
- Clear Zone Impacting Private Property

Prospective (2020) AICUZ Noise Contour and dB CNEL Value

60 65 70 75 80 85

Prospective (2020) Accident Potential Zones (APZs)

- Clear Zone
- APZ I
- APZ II
- Primary Surface

Source:
Service Layer Credits: USDA NAIP, 2012
ESRI 2012; Wyle 2014; Navy 2012; Ventura County Resource Management Agency Information Systems, 2012
Google Earth Points of Interest, accessed 01/2015

Figure 7-8
Compatibility Concerns West

NBVC
Ventura County, California

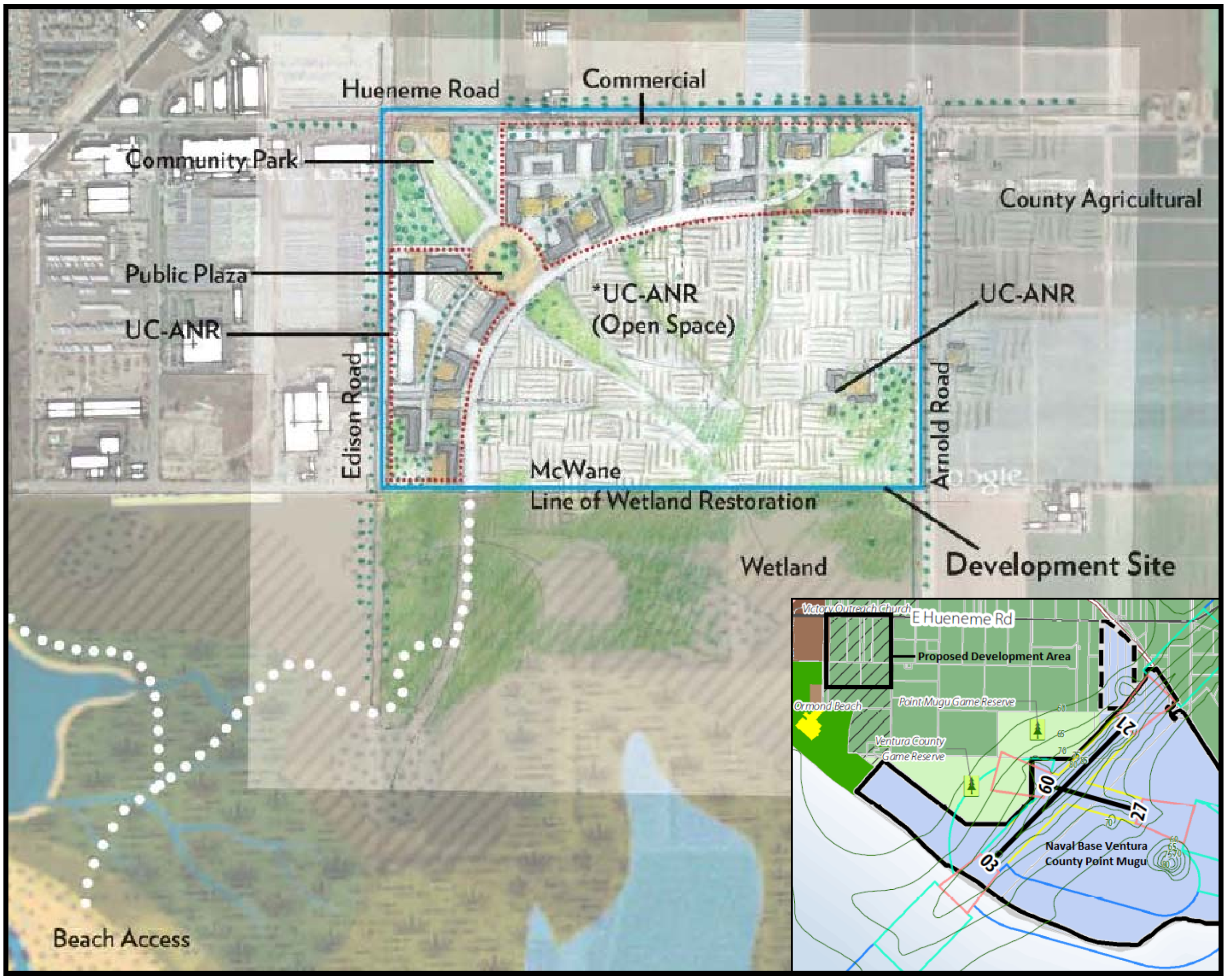
Ormond Beach

Historically, portions of Ormond Beach, located in the southeastern corner of Oxnard and within the City's planning area and Sphere of Influence, were impacted by 60-65 dB CNEL noise contours from NBVC Point Mugu. However, with the reduction in the noise contours, the 60 dB CNEL no longer overlays the area. Ormond Beach is now located beyond the 60 dB CNEL noise contour. Due to the area's substantial development potential and demand for additional housing in Oxnard, future development is likely and could bring incompatible development within the imaginary surfaces for runways at NBVC Point Mugu. Ormond Beach has been the subject of many Specific Plans to add residential and more urbanized development. While this area is outside of noise thresholds for compatible uses, residential development, including the construction of homes and schools, within Ormond Beach may be subject to noise disturbance from overflights at the airfield.

The City of Oxnard has proposed specific development plans for Ormond Beach (Figure 7-9), including the SouthShore Specific Plan (over 300 acres, located north of Hueneme Road), which includes residential development of over 1,500 housing units, and the South Ormond Beach Specific Plan (approximately 600 acres, located south of Hueneme Road), which would include commercial and light industrial development. In June 2011, the City of Oxnard approved the first of the two specific plan projects, the SouthShore Specific Plan. The SouthShore Specific Plan projects were officially in the entitlement process within the City of Oxnard and had an accompanying Environmental Impact Report. The SouthShore project area is located approximately 3 miles west of NBVC Point Mugu and proposes a mix of uses, including residential, schools, commercial and light industrial, and parks and recreation. However, the Environmental Defense Center filed a lawsuit in July 2011 on behalf of themselves, the Sierra Club, and the Environmental Coalition of Ventura County challenging the decision (Environmental Defense Center 2011). The decision on the second project is still pending. In order for development to proceed, the areas must be annexed to the City of Oxnard by Ventura County.

Another development plan involving Ormond Beach is a Concept Plan prepared by the California Coastal Conservancy. A presentation on the Ormond Beach proposed development plan was provided to the Oxnard City Council on October 21, 2014. The City Council approves of the Concept Plan, but it has no official sponsor (i.e., neither the landowner nor the Coastal Conservancy has plans to attempt to entitle the Concept Plan). The Concept Plan does not have an accompanying Environmental Impact Report. The Concept Plan has no policy or regulatory authority since it is not an official City plan. The Navy has concerns with the Concept Plan because it conflicts with a proposed REPI project on the same site.

Ormond Beach and its plans reflect developer pressure to convert agricultural and open space land outside of the Sphere of Influence into residential uses. As developable land within the Sphere of Influence becomes limited, the City of Oxnard is more likely to approve agricultural land conversion for projects. In addition, development within the area may create additional pressure to convert adjacent agricultural parcels to residential uses, thereby further encroaching upon NBVC Point Mugu.



Source: University of California: Division of Agriculture and Natural Resources 2014

FIGURE 7-9 ORMOND BEACH PROPOSED DEVELOPMENT AREA

7.3 NBVC Point Mugu AICUZ Study Recommendations

Federal, state, and local governments, businesses, real estate professionals, and citizens, along with the Navy, all play an important role 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 NBVC personnel, as well as local governments and agencies, businesses, and private citizens, to implement to meet the 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 NBVC 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.

Broad-Based Recommendations

- Maintain routine communication with local, state, and regional governments to be aware of any land use changes and to ensure the Navy's input is offered in the early stages of any long-range planning initiatives.
- Continue to attend public hearings (meetings) and provide comments on actions that affect AICUZ planning for NBVC Point Mugu, including land use studies, CIP projects, General Plan updates, and other land development regulation updates/amendments.
- Continue to engage in the CEQA environmental review process and provide comments on any CEQA document to disclose impacts to the NBVC Point Mugu mission, whether they relate to safety or noise, or to disclose to local decision makers that the base may impact a project or future residents of a project.
- Provide community decision makers with the information and educational materials necessary to make informed decisions regarding the impact of their actions on mission readiness.
- Develop a package of AICUZ outreach materials, including community presentations and educational brochures, on military training activities and the Navy's mission.
- Provide updated datasets and the updates from the AICUZ Study to the local jurisdictions to ensure an awareness and understanding of the changes and how they may impact their local community.
- Coordinate with LAFCo in an effort to ensure that future annexations and designations/amendments of Spheres of Influence do not negatively impact NBVC Point Mugu mission activities.
- Provide local real estate professionals with AICUZ-related materials and maps showing military training routes, MOAs, AICUZ boundaries, and high-impact areas.
- Coordinate with the Ventura County Airport Land Use Commission (i.e. Ventura County Transportation Commission) to update their ACLUP based on the 2020 AICUZ footprint and changing local conditions.
- 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.
- Continue to record and assess noise complaints via the established noise complaint management system.
- Continue participation in the ongoing NBVC JLUS implementation efforts, and propose an amendment to the JLUS to incorporate a new AICUZ footprint and analysis.

- Execute existing REPI funding and pursue additional REPI funding to provide buffers for the base and to ensure long-term compatibility through the REPI program.
- Incorporate the appropriate findings of the AICUZ Study into the NBVC Integrated Natural Resources Management Plan and the Installation Development Plan to address noise and safety concerns.

Specific Recommendations to Address the Areas of Concern

- To address the existing incompatible land use associated with the manufactured home park in APZ I for Runway 03/21, the Navy should communicate with the property owner to prevent further density increases, ensure the renters are properly informed about the potential safety and noise risk, and request that the Navy be provided the opportunity to purchase the development rights if and when the property is sold. The Navy shall be cognizant of the regulatory challenges and coordinate actions with the County in respect to site specific regulations for closure of a mobile home park, which include obtaining a discretionary permit and providing relocation assistance. If unable to purchase development rights and/or property, approach property owners for potential partnering to ensure compatible land uses.
- Implement viable land use policies with local jurisdictions to foster SB1462.
- To address the potential future incompatible land uses associated with the future conversion of agricultural land to residential and more intensive land uses within APZ and high noise zones, the Navy should monitor the expiration and renewal of LCA contracts as well as requests for CUPs within the AICUZ footprint.
- Request that the Ventura County Planning Department notify the NBVC CPLO when reviewing and approving CUP-related to parcels within the AICUZ footprint.
- Monitor any proposed changes or legislative initiatives related to the SOAR ordinances for Ventura County and the Cities of Oxnard and Camarillo.
- As a member of the campus Master Plan Committee, continue to monitor and proactively communicate with CSUCI campus officials to stay informed on the future expansion of the campus, which could bring people-intensive uses and buildings within the AICUZ footprint.
- Monitor and identify proposed capital improvements near the CSUCI campus.
- Periodically meet with Ventura County and the City of Camarillo to discuss any proposed infrastructure extensions associated with the CSUCI campus.
- To address the existing incompatible land use associated with the six residential dwellings within APZ I for Runway 09/27, the Navy should communicate with the property owners to prevent further development; ensure the buyers/renters are properly informed about the potential safety and noise impacts; and request the opportunity to purchase the development rights if and when the properties are sold.
- To address the existing incompatible land use associated with the Ventura County Game Reserve and Point Mugu Game Reserve parcels within the Clear Zone for Runway 09/27, the Navy should take steps to acquire

real estate control of this area, either through a conservation partner and/or negotiating land use control with the private land owner, such as development easements and/or acquisition.

- Proactively engage the City of Oxnard Planning Department to ensure compatible land uses in Ormond Beach within the NBVC Point Mugu AICUZ footprint.
- Request that the City of Oxnard notify the NBVC CPLO when reviewing discretionary permits within the AICUZ footprint.
- Continue to monitor and attend public meetings regarding the development of Ormond Beach and provide comments on the actions that affect AICUZ planning for NBVC Point Mugu.
- Continue to monitor the City of Oxnard's annexation actions within Ventura County and the potential expansion of their Sphere of Influence.
- Proactively engage the City of Camarillo Planning Department to maintain land uses compatible with the 60 CNEL within the NBVC Point Mugu AICUZ footprint.

7.3.2 State and Community 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 base.

- Local governments should actively inform and request input from the installation regarding land use decisions that could impact the operational integrity of NBVC Point Mugu.
- Local governments, in coordination with the military, should establish protocols to notify NBVC regarding proposed developments to ensure adequate time to comment on proposed development prior to public review.
- Implement the JLUS completed by the Ventura County Transportation Commission (to develop growth management strategies that balance the interests of the community and the Navy.
- Ventura County Airport Land Use Commission should update the ACLUP to incorporate the noise contours and APZs presented in this AICUZ Study.
- Ventura County should evaluate and review all capital improvement projects in proximity to the airfield to determine potential direct and indirect impacts that such improvements may have on the AICUZ footprint.
- Ventura County should continue to monitor and/or amend building codes to require noise attenuation techniques for new construction within the AICUZ footprint.
- The Ventura LAFCo should communicate any proposed boundary changes for cities' Spheres of Influence, incorporations, and/or annexations to encourage compatible land uses and policies.

- Ventura County should provide disclosure notification for all real estate transactions for properties surrounding NBVC Point Mugu. Ventura County should consider establishing a real estate disclosure district around the airfield to enforce disclosure regulations.
- California Coastal Conservancy should consider partnership opportunities with the Navy, via REPI (see Section 6.1.1, Federal, for REPI discussion), to prevent AICUZ-related incompatible development and to protect coastal resources.
- Lending institutions should consider whether to limit financing for real estate purchases or construction that is incompatible with the AICUZ Program.
- Real estate professionals, in coordination with NBVC, should continue to ensure that prospective buyers or lessees have all the available information concerning the noise environment and APZs prior to purchasing or leasing property near the airfield.
- Real estate professionals should provide information about the AICUZ Study on their websites and provide a link to the NBVC website for information on aircraft operations.
- Citizens considering purchasing, renting, or leasing properties near NBVC Point Mugu 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.
- Citizens should provide sufficient and accurate information when registering a noise complaint with NBVC Point Mugu.

8

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APPENDIX A

DISCUSSION OF NOISE AND ITS EFFECT ON THE ENVIRONMENT

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

FINAL

WR 13-11
January 2014

APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE,

FINAL

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

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Prepared for:

Cardno TEC, Inc.
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903

Prepared by:

Wyle Laboratories, Inc.
Environmental and Energy
Research & Consulting (EERC)

200 12th Street S, Suite 900
Arlington, VA 22202
703.413.4700

128 Maryland Street
El Segundo, CA 90245
310.322.1763

Project Team:

Project Manager & Co-Author:	Joseph J. Czech
Co-Author:	Kenneth J. Plotkin, Ph.D.
Co-Author:	Ben H. Sharp, Ph.D.
Principal-In-Charge:	Jawad Rachami

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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, Bioacousitcis, and Biomechanics
CNEL	Community Noise Equivalent Level
$CNEL_{mr}$	Onset-Rate Adjusted Monthly Community Noise Equivalent Level
dB	Decibel
dBA	A-Weighted Decibels
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.

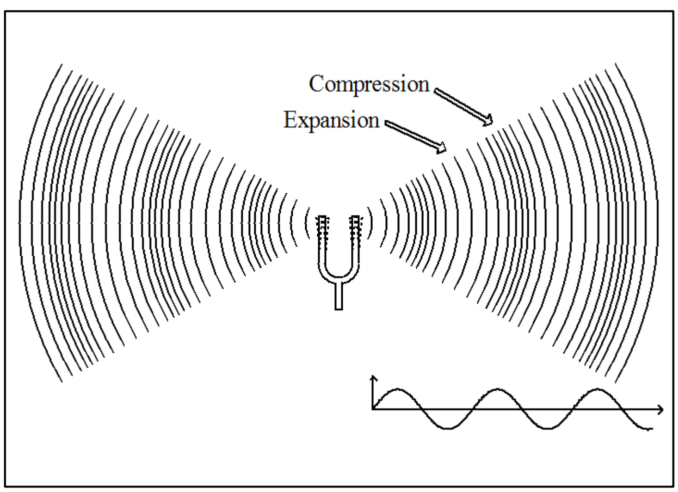


Figure A-1. Sound Waves from a Vibrating Tuning Fork

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 dB + 60 dB = 63 dB, and

80 dB + 80 dB = 83 dB.

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

60.0 dB + 70.0 dB = 70.4 dB.

Because the addition of sound levels is different than that of ordinary numbers, 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.

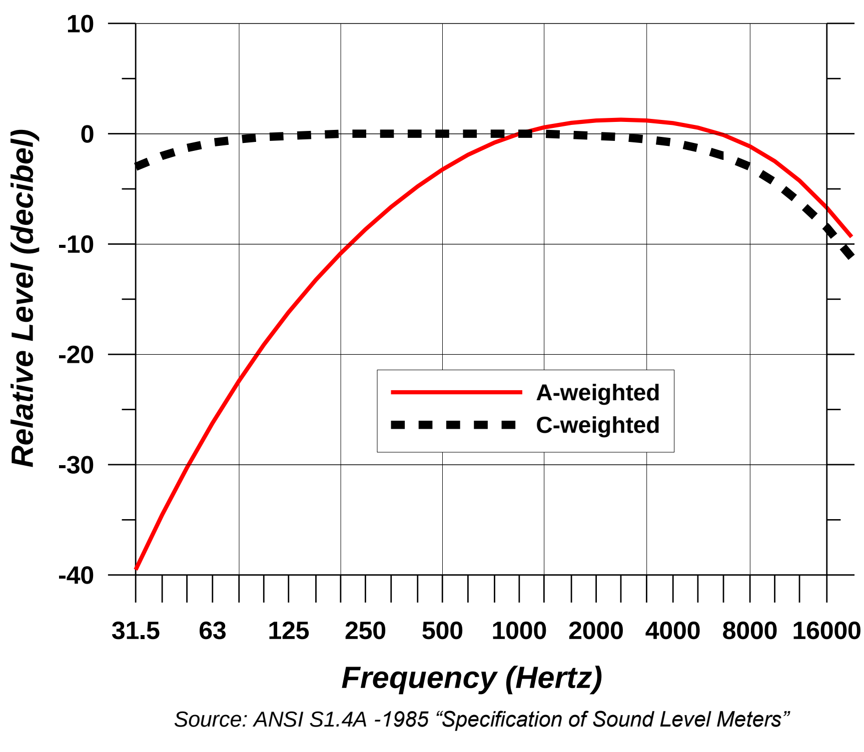


Figure A-2. Frequency Characteristics of A- and C-Weighting

A.1.2 Sound Levels and Types of Sounds

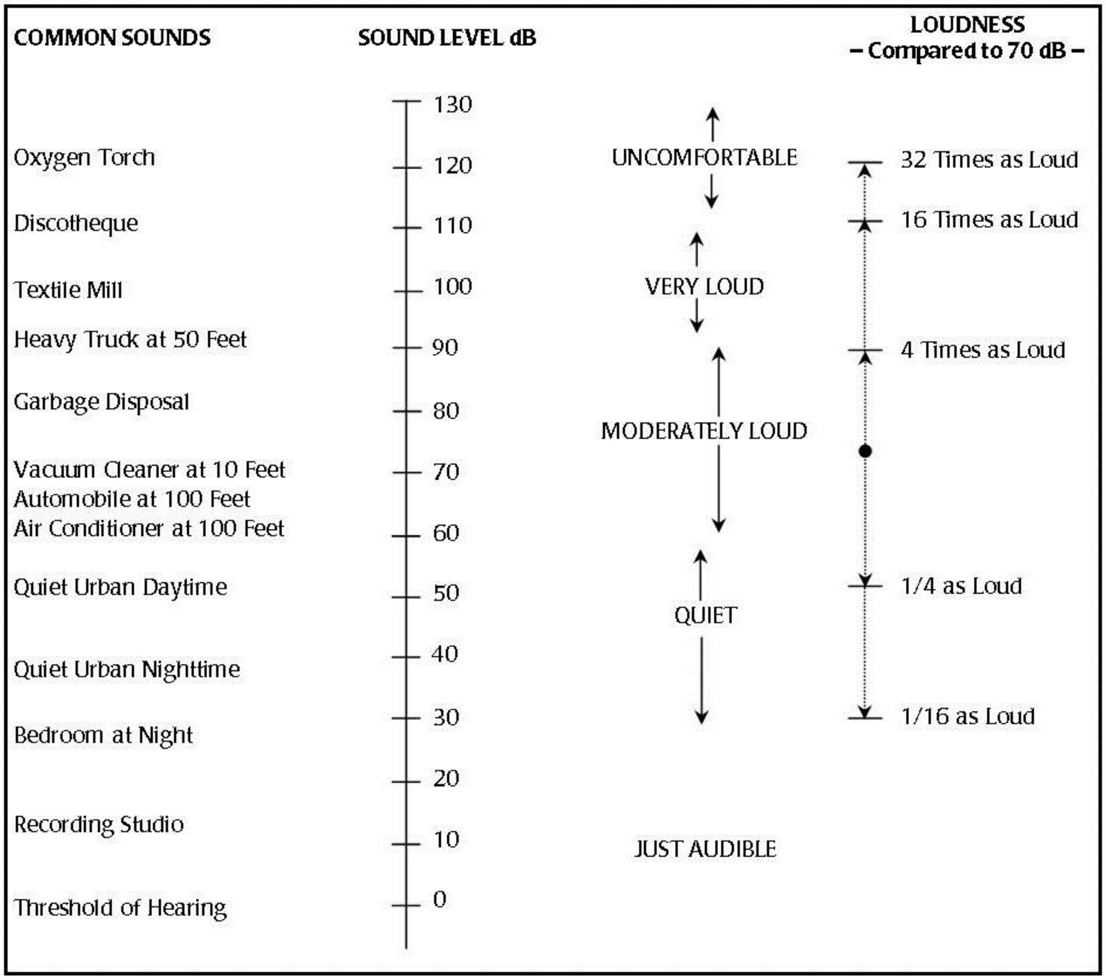
Most environmental sounds are measured using A-weighting. They're called A-weighted sound levels, and sometimes use the unit dBA or dB(A) rather than dB. When the use of A-weighting is understood, the term "A-weighted" is often omitted and the unit dB is used. Unless otherwise stated, dB units refer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

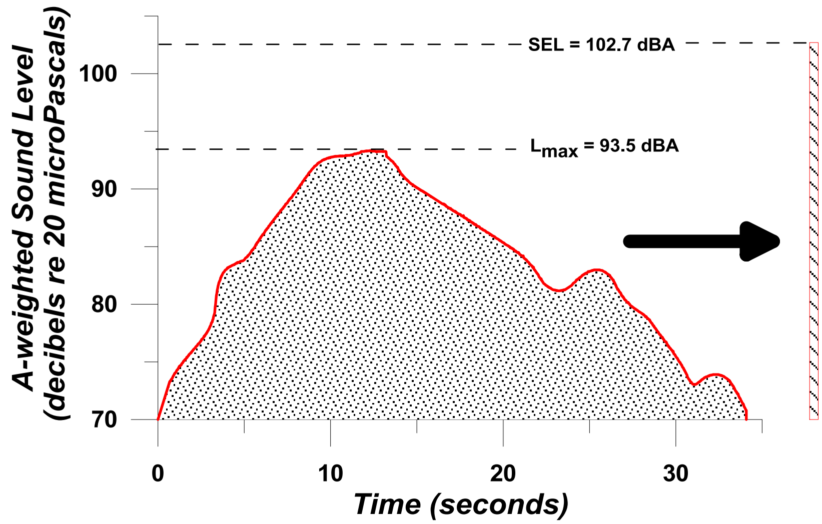


Sources: Harris 1979; Federal Interagency Committee on Aviation Noise (FICAN) 1997.

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.

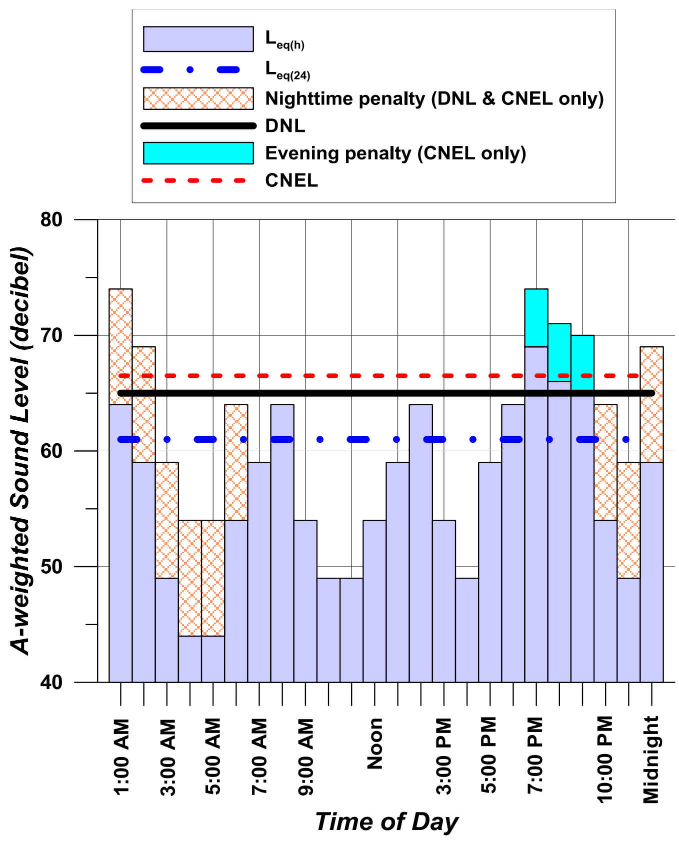
A.2.2 Cumulative Events

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.

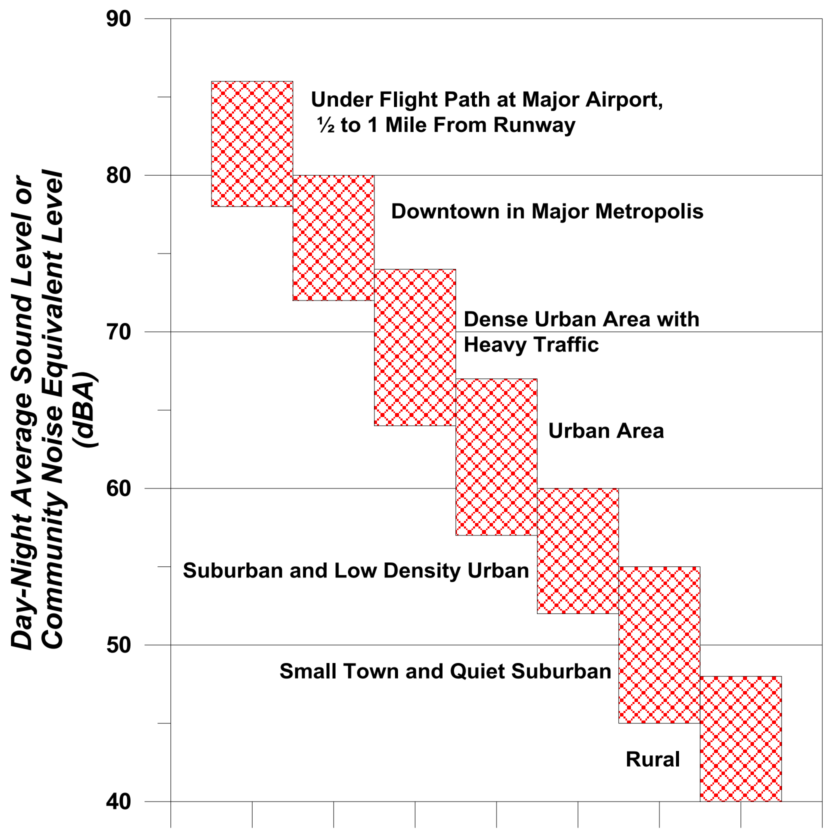
Figure A-5 gives an example of DNL and CNEL using notional hourly average noise levels ($L_{eq(h)}$) for each hour of the day as an example. Note the $L_{eq(h)}$ for the hours between 10 p.m. and 7 a.m. have a 10 dB penalty assigned. For CNEL the hours between 7p.m. and 10 p.m. have a 4.8 dB penalty 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-airspeed 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 NA90L_{max}(10). The period of time can be an average 24-hour day, daytime, nighttime, school day, or any other time period appropriate to the nature and application of the analysis.

NA 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).

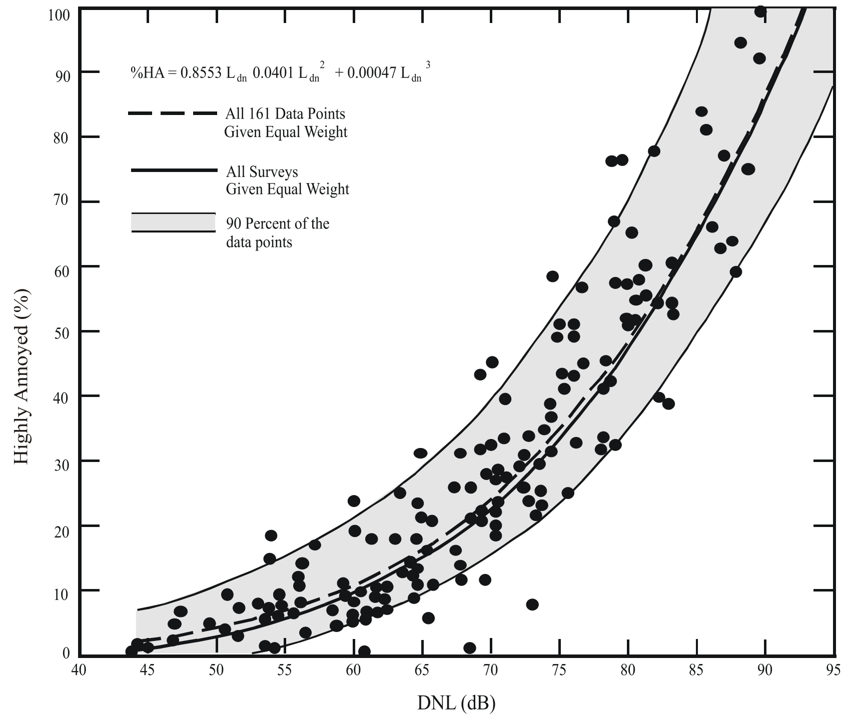


Figure A-7. Schultz Curve Relating Noise Annoyance to DNL (Schultz 1978)

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.

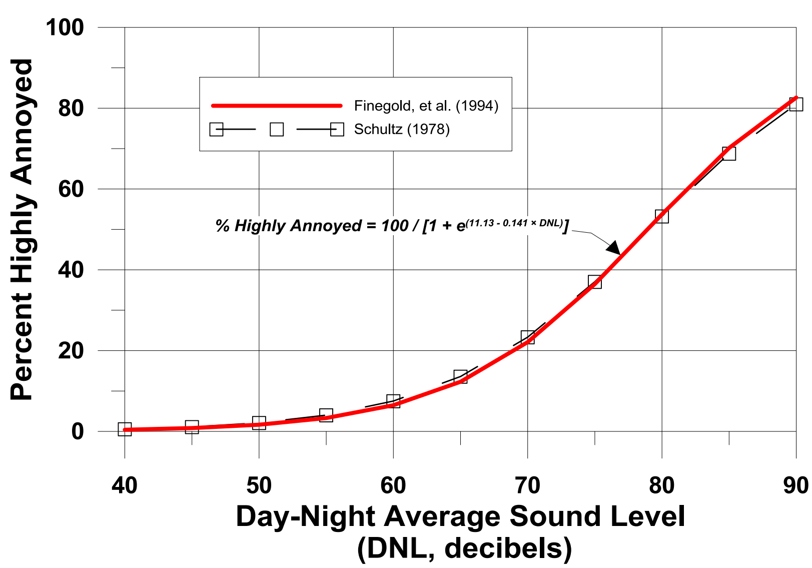


Figure A-8. Response of Communities to Noise; Comparison of Original Schultz (1978) with Finegold et al (1994)

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
Feeling about the necessity or preventability of the noise;
Judgement of the importance and value of the activity that is producing the noise;
Activity at the time an individual hears the noise;
Attitude about the environment;
General sensitivity to noise;
Belief about the effect of noise on health; and
Feeling of fear associated with the noise.

Physical Variables
Type of neighborhood;
Time of day;
Season;
Predicitabiltiy of the noise;
Control over the noise source; and
Length of time individual is exposed to a noise.

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

Source: Miedema 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.

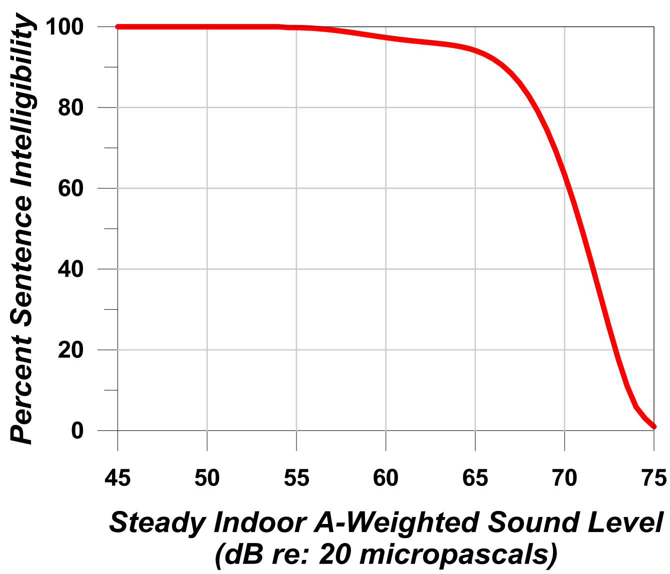


Figure A-9. Speech Intelligibility Curve (digitized from USEPA 1974)

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

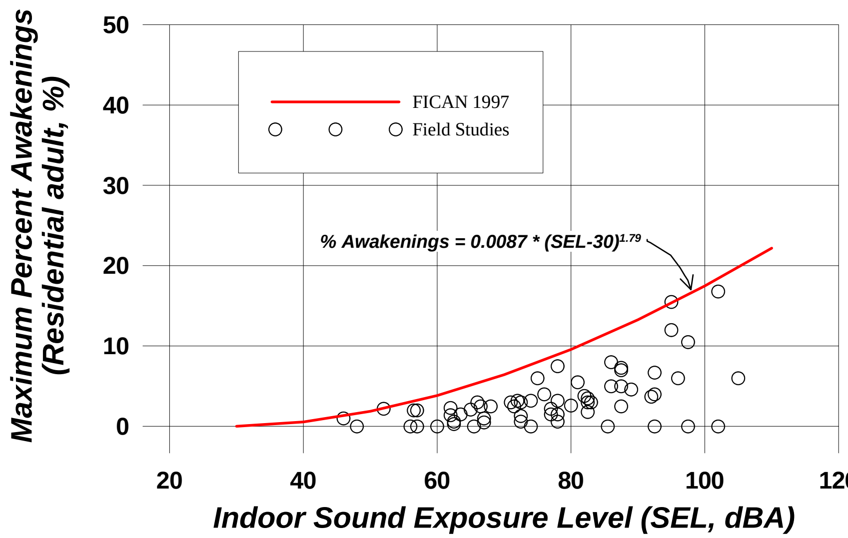
Recent Sleep Disturbance Research – Field and Laboratory Studies

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 FICON 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 NIPTS 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 NIPTS over time and hearing sensitivity is termed the Average NIPTS, or Ave. NIPTS for short. The Ave. NIPTS 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. NIPTS is estimated as an average over all people exposed to the noise. The actual value of NIPTS 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 NIPTS exceeded by 10% of the population, which is included in the Table A-5 in the "10th Percentile NIPTS" 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 NIPTS 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)*	10th Percentile NIPTS (dB)*
75-76	1.0	4.0
76-77	1.0	4.5
77-78	1.6	5.0
78-79	2.0	5.5
79-80	2.5	6.0
80-81	3.0	7.0
81-82	3.5	8.0
82-83	4.0	9.0
83-84	4.5	10.0
84-85	5.5	11.0
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 $L_{eq(16)}$, the OR was 0.93. For road traffic noise, measured by the full day $L_{eq(24)}$, 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.

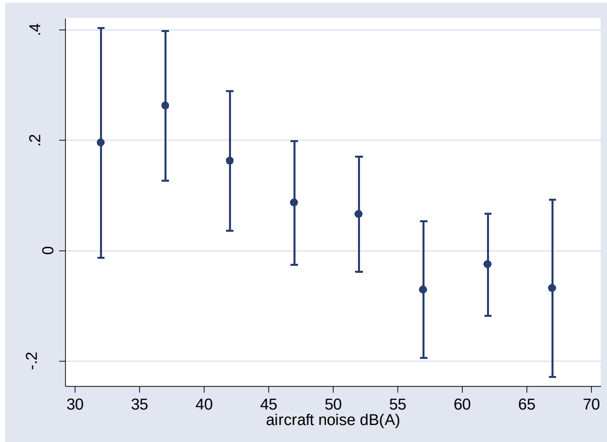


Figure A-11. RANCH Study Reading Scores Varying with L_{eq}

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.

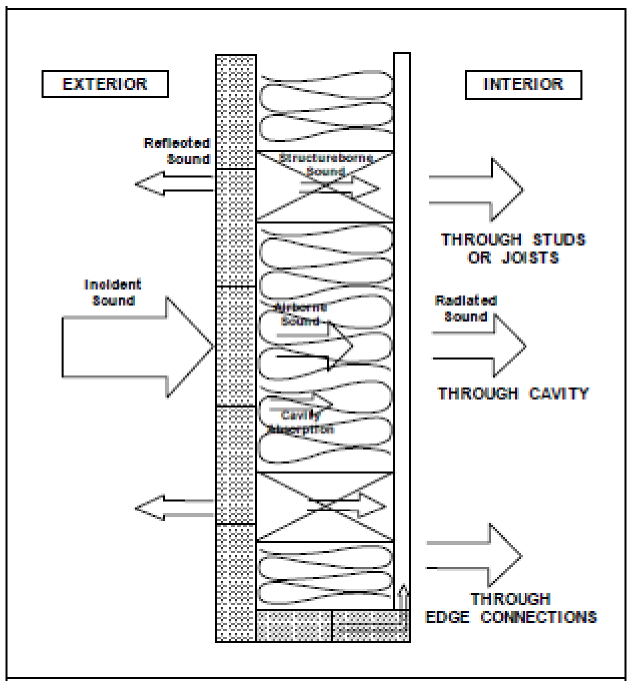


Figure A-12. Depiction of Sound Transmission through Built Construction

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

	RMS Acceleration (m/s/s)		
Frequency (Hz)	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.

A.3.10 Noise Effects on Terrain

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

A.3.11 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. Manci 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 Manci et al. (1988), the foundation of information created from that focus does not necessarily correlate or provide information specific to the impacts to wildlife in areas overflown by aircraft at supersonic speed or at low altitudes.

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

Animal species differ greatly in their responses to noise. Noise effects on domestic animals and wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system, and most likely include the masking of auditory signals. Masking is defined as the inability of an individual to hear important environmental signals that may arise from mates, predators, or prey. There is some potential that noise could disrupt a species' ability to communicate or could interfere with behavioral patterns (Manci et al. 1988). Although the effects are likely temporal, aircraft noise may cause masking of auditory signals within exposed faunal communities. Animals rely on hearing to avoid predators, obtain food, and communicate with, and attract, other members of their species. Aircraft noise may mask or interfere with these functions. Other primary effects, such as ear drum rupture or temporary and permanent hearing threshold shifts, are not as likely given the subsonic noise levels produced by aircraft overflights.

Secondary effects may include non-auditory effects such as stress and hypertension; behavioral modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects, and include population decline and habitat loss. Most of the effects of noise are mild enough that they may never be detectable as variables of change in population size or population growth against the background of normal variation (Bowles 1995). Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) also influence secondary and tertiary effects, and confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith et al. 1988). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci et al. 1988).

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife "flight" due to noise. 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 Manci 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. Manci 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 (Manci et al. 1988). Some studies have reported such primary and secondary effects as reduced milk production and rate of milk release, increased glucose concentrations, decreased levels of hemoglobin, increased heart rate, and a reduction in thyroid activity. These latter effects appear to represent a small percentage of the findings occurring in the existing literature.

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

Cattle

In response to concerns about overflight effects on pregnant cattle, milk production, and cattle safety, the U.S. Air Force prepared a handbook for environmental protection that 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; Manci 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 (Manci 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 Manci et al. 1988).

Studies accomplished near the Channel Islands were conducted near the area where the space shuttle launches occur. It was found that there were some response differences between species relative to the loudness of sonic booms. Those booms that were between 80 and 89 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 Manci et al. 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

Manci et al. (1988), reported a reduction in reproductive success in some small territorial passerines (i.e., perching birds or songbirds) after exposure to low-altitude overflights. However, it has been observed that passerines are not driven any great distance from a favored food source by a nonspecific disturbance, such as aircraft overflights (U.S. Forest Service 1992). Further study may be warranted.

A 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, Manci et al. (1988) found that most raptors did not show a negative response to overflights. When negative responses were observed they were predominantly associated with rotor-winged aircraft or jet aircraft that were repeatedly passing within 0.5 mile of a nest.

Ellis et al. (1991), performed a study to estimate the effects of low-level military jet aircraft and mid- to high-altitude sonic booms (both actual and simulated) on nesting peregrine falcons and seven other raptors (common black-hawk, Harris' hawk, zone-tailed hawk, red-tailed hawk, golden eagle, prairie falcon, bald eagle). They observed responses to test stimuli, determined nest success for the year of the testing, and evaluated site occupancy the following year. Both long- and short-term effects were noted in the study. The results reported the successful fledging of young in 34 of 38 nest sites (all eight species) subjected to low-level flight and/or simulated sonic booms. Twenty-two of the test sites were revisited in the following year, and observations of pairs or lone birds were made at all but one nest. Nesting attempts were underway at 19 of 20 sites that were observed long enough to be certain of breeding activity. Reoccupancy and productivity rates were within or above expected values for self-sustaining populations.

Short-term behavior responses were also noted. Overflights at a distance of 150 m or less produced few significant responses and no severe responses. Typical responses consisted of crouching or, very rarely, flushing from the perch site. Significant responses were most evident before egg laying and after young were "well grown." Incubating or brooding adults never burst from the nest, thus preventing egg breaking or knocking chicks out of the nest. Jet passes and sonic booms often caused noticeable alarm; however, significant negative responses were rare and did not appear to limit productivity or 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 (Cottereau 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 Manci et al. (1988), summarized a few studies of reptile responses to noise. Some reptile species tested under laboratory conditions experienced at least temporary threshold shifts or hearing loss after exposure to 95 dB for several minutes. Crocodilians in general have the most highly developed hearing of all reptiles. Crocodile ears have lids that can be closed when the animal goes under water. These lids can reduce the noise intensity by 10 to 12 dB (Wever and Vernon 1957). On Homestead Air Reserve Station, Florida, two crocodilians (the American alligator and the spectacled caiman) reside in wetlands and canals along the base runway suggesting that they can coexist with existing noise levels of an active runway including 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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Environmental and Energy
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200 12th Street South
Suite 900
Arlington, VA 22202

128 Maryland Street
El Segundo, CA 90245

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