# AICUZ Study Update *for*

# Naval Air Station Whidbey Island's Ault Field and Outlying Landing Field Coupeville, Washington

## Final Submission

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for

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## List of Acronyms and Abbreviations

AB ... Afterburner
AC ... Acre
AGL ... Above Ground Level
AICUZ ... Air Installations Compatible Use Zones
AIMD ... Aircraft Intermediate Maintenance Detachment
ANSI ... American National Standards Institute
APZ ... Accident Potential Zone
ASUW ... Anti-surface Warfare
ASW ... Anti-submarine Warfare
ATCAA ... Air Traffic Control Assigned Airspace
ATC ... Air Traffic Control
AUW ... Advanced Undersea Weapon
BASH ... Bird Aircraft Strike Hazard
BRAC ... Base Realignment and Closure
CFR ... Code of Federal Regulations
CNEL ... Community Noise Equivalent Level
CNO ... Chief of Naval Operations
CP&LO ... Community Plans and Liaison Officer
COMNAVAIRPAC ... Commander Naval Air Forces, U.S. Pacific Fleet
CVWP or COMVAQINGPAC ... Commander Electronic Attack Wing U.S. Pacific
CPRW or CPRW 10 ... Commander Patrol and Reconnaissance Wing Ten
CY03 ... Calendar Year 2003
CY13 ... Calendar Year 2013
CZ ... Clear Zone
C4SIR ... Command, Control, Communications, Computers, Surveillance, Intelligence, Reconnaissance
dB ... Decibel
dBA ... A-weighted Decibels
DME ... Distance Measuring Equipment
DNL ... Day-night Average Sound Level
DOD ... Department of Defense
DU ... Dwelling Units
EA ... Environmental Assessment
EIS ... Environmental Impact Statement
EMI ... Electromagnetic Interference
ESHP ... Effective Shaft Horsepower
FAA ... Federal Aviation Administration
FAR ... Floor Area Ratio
FCLP ... Field Carrier Landing Practice
FL ... Flight Level
FLOLS ... Frensel Lens Optical Landing Systems
FM ... Frequency Modulation
GCA ... Ground Controlled Approach
HARM ... High Speed Anti-Radiation Missile
HF ... High Frequency
HERO ... Hazards of Electromagnetic Radiation to Ordnance
HIRL ... High Intensity Runway Lighting
ICAP III ... Improved Capability
IFLOLS ... Improved Frensel Lens Optical Landing System
IFR ... Instrument Flight Rules
Ldn ... Day-night Average Sound Level (Mathematical Symbol)

## List of Acronyms and Abbreviations (Concluded)

$L_{max}$ .......... Maximum Noise Level
LSO .......... Landing Signal Officer
MEDVAC .......... Medical Evacuation
MF .......... medium frequency
MHz .......... Megahertz
MIDS .......... Multifunctional Information Distribution System
MIL .......... Maximum Thrust Without Afterburner
MILCON .......... Military Construction
MOA .......... Military Operating Areas
MOVLAS .......... Manually Operated Visual Landing Aid System
MSL .......... Mean Sea Level
N/A .......... not available
NAS .......... Naval Air Station
NASWHIDBEYINST .......... NAS Whidbey Island Instruction
NAVFAC .......... Naval Facilities Engineering Command
NAVSAFCEN .......... Naval Safety Center
NC .......... Compressor Speed
NEPA .......... National Environmental Policy Act
NLR .......... Noise Level Reduction
NM .......... Nautical Mile
NOTAM .......... Notice to Airmen
NS .......... Naval Station
N1 .......... Engine One
N2 .......... Engine Two
OBS .......... On-board System
ODO .......... Operations Duty Officer
OLF .......... Outlying Landing Field
OPNAVINST .......... Chief of Naval Operations Instruction
PUD .......... Planned Unit Development
RAICUZ .......... Range Air Installations Compatible Use Zones
RCW .......... Revised Code of Washington
RPM .......... Revolutions Per Minute
SAR .......... Search and Rescue
SEL .......... Sound Exposure Levels
SLUCM .......... Standard Land Use Coding Manual
STC .......... Sound Transmission Class
SUA .......... Special Use Airspace
TACAN .......... Tactical Air Navigation
TDZL .......... Touchdown Zone Lights
TERPS .......... Terminal Instrument Procedures
TIGER .......... Topographically Integrated Geographic Encoding and Referencing
TJS .......... Tactical Jamming System
UGA .......... Urban Growth Area
UFC .......... Unified Facilities Criteria
UHF .......... ultra high frequency
VHF .......... very high frequency
VFR .......... Visual Flight Rules
VIP .......... Very Important Person
VR .......... Visual Route
WX .......... Weather

## Background

All airports attract development. Housing is constructed for airport employees who want to live near by, and businesses are established to cater to the airport. As development encroaches upon the airfield, more people experience the noise and accident potential associated with aircraft operations. Incompatible development, a form of encroachment, has become commonplace on privately owned lands in the vicinity of military air installations.


*An aviation structural mechanic signals the starting of the number two engine to the pilot of a P-3 Orion at (NAS) Whidbey Island's Ault Field. This AICUZ Study Update includes the Navy's air installations in Island County, Washington–NAS Whidbey Island's Ault Field and Outlying Landing Field (OLF) Coupeville.*

This Air Installations Compatible Use Zones (AICUZ) Study Update includes the Navy's air installation in Island County, Washington—Naval Air Station (NAS) Whidbey Island's Ault Field and OLF Coupeville. The study examines various airfield planning parameters related to aircraft operations, noise, and safety, and it provides recommendations that can be used to further promote compatible land use surrounding the airfield.

An AICUZ study was originally prepared and approved for NAS Whidbey Island's Ault Field and OLF Coupeville in 1977 and an update approved by the office of the Chief of Naval Operations in 1986. Island County and the City of Oak Harbor subsequently evaluated the AICUZ recommendations and enacted compatible land use provisions into their zoning ordinances.

## Noise

As part of this AICUZ Study Update, a noise study was conducted. The noise study contains calendar year 2003 (CY03) and calendar year 2013 (CY13) noise contours for aircraft operations associated with the use of the two Navy airfields and the proposed transition from the EA-6B to the new EA-18G aircraft. A comparison of these noise contours and those used in the 1986 AICUZ reveals that the areas impacted by noise both on-station and off-station have generally seen modest changes.

## Safety

Accident Potential Zones (APZs) are based on historical accident and operations data throughout the Services and the application of margins of safety within these areas (which have been determined to be probable impact areas) if an accident were to occur. This study updates the APZs associated with operations at NAS Whidbey Island and OLF Coupeville and compares them with the APZs contained in the 1986 study. Due to changes in operations and updated operator descriptions of flight tracks, changes in APZs have occurred.

## Land Use

The majority of non-Navy owned lands within the updated AICUZ footprint are included within existing local community enacted AICUZ related land controls. This AICUZ protection includes compatible land use zoning, sound reduction provisions in the building code, and noise fair disclosure provisions for rental and purchase of real estate within the airfield environs that are commendable.

## Recommendations

The following recommendations promote continued compatible development and prevent incompatible development and potential encroachment resulting from changes in land use controls/zoning regulations.

1. Maintain a Community Plans and Liaison Officer (CP&LO) in the continued implementation of the AICUZ program at NAS Whidbey Island.

2. Continue the extensive public awareness and intergovernmental coordination and cooperation in AICUZ implementation with local, regional, and state government agencies.

3. Seek the update of current local planning and zoning ordinances to reflect compatible land use related to APZs outlined in this study.

4. Support maintaining aircraft noise related compatible land use and zoning provisions, reflected in current local government land use and zoning provisions and contours, as currently enacted by Island County and the City of Oak Harbor.

5. Seek implementation of AICUZ land use compatibility recommendations with the Town of Coupeville.

# 1.0 Introduction

All airports attract development. Housing is constructed for airport employees who want to live near by, and businesses are established to cater to the airport. As development encroaches upon the airfield, more people experience the noise and accident potential associated with aircraft operations. Incompatible development, a form of encroachment, has become commonplace on privately owned lands in the vicinity of military air installations.

*This AICUZ Study Update includes the Navy's air installations in Island County, Washington–Naval Air Station (NAS) Whidbey Island's Ault Field and Outlying Landing Field (OLF) Coupeville.*

The primary goal of the Department of Defense's (DOD) Air Installations Compatible Use Zones (AICUZ) Program is to protect the health, safety, and welfare of those living near a military airfield while preserving the operational capability of the airfield. The AICUZ program works to meet this goal and to achieve land use compatibility by recommending land uses that will be compatible with noise levels, accident potential, and flight clearance requirements associated with aircraft operations.

This AICUZ Study Update includes the Navy's air installations in Island County, Washington–Naval Air Station (NAS) Whidbey Island's Ault Field and Outlying Landing Field (OLF) Coupeville. The study provides an analysis of noise and safety impacts based on an existing condition for calendar year 2003 (CY03) and on a projected condition for calendar year 2013 (CY13). The analysis uses operations numbers, flight track, and flight procedure information provided by NAS Whidbey Island. The analysis also uses information obtained from sources such as the surrounding communities, the State of Washington, and the U.S. Census Bureau.

The CY13 projected condition represents the noise and safety impacts at Ault Field and OLF Coupeville currently projected to occur once the Navy fully transitions from the EA-6B to the EA-18G aircraft.[1] Additionally, the projected condition takes into account the elimination of C-12 aircraft operations at NAS Whidbey Island.[2] Ultimately, the CY13 projected condition noise and safety impacts are used to create updated AICUZ footprints for each airfield.

This section of the study provides background on the AICUZ Program. Section 2.0 describes the air installations and local airspace. Section 3.0 discusses aircraft types and aircraft operations at the air installations. Section 4.0 presents aircraft noise zones–how noise zones are determined, what changes have occurred, and what mitigation measures have been implemented by the Navy. Section 5.0 discusses aircraft safety issues, including height and obstruction clearance requirements, accident potential zones (APZs), and pilot safety. Section 6.0 presents AICUZ footprint maps and guidelines for compatible land use. Section 7.0 evaluates the compatibility of surrounding land uses with aircraft operations at Ault Field and OLF Coupeville. Section 8.0 provides land use compatibility strategies and specific recommendations that the Navy and NAS Whidbey Island can implement to continue to promote land use compatibility consistent with the recommendations of the AICUZ Program.

[1] EA-6Bs are scheduled to begin retirement in 2010 and are expected to be completely phased out by 2013.

[2] The C-12F was phased out in 2004.

## 1.1 Background

In the early 1970s, DOD established the AICUZ Program to balance the need for aircraft operations and community concerns over aircraft noise and accident potential. The key to the program's success is found in intergovernmental coordination, which occurs once the reports are published and released to the public. An active local command effort to work with surrounding communities to prevent incompatible development in the vicinity of military airfields is the foundation of the program's success.

The primary goal of the AICUZ Program is to protect the public's health, safety, and welfare and to maintain the operational capability of military airfield operations. To meet this goal, the Navy has identified the following components of the AICUZ Program:

a. To develop, and periodically update, a study and accompanying map for each air installation to quantify and depict aircraft noise zones and APZs;

b. To coordinate with federal, state, and local officials to encourage compatible land use development around the air installation;

c. To inform the local community of the importance of maintaining the Navy's ability to conduct aircraft operations; and

d. To review operations and implement operational changes in noise abatement strategies that would reduce noise impacts while ensuring mission requirements.

Under the AICUZ Program, DOD identifies noise zones as a land use planning tool for local planning agencies. DOD describes the noise exposure using the Day-Night Average Sound Level (DNL). The DNL metric averages noise events that occur over a 24-hour period. Aircraft operations conducted at night (10:00 p.m. to 7:00 a.m.) are weighted because people are more sensitive to noise during sleeping hours, when ambient noise levels are lower. The DNL contours are displayed on a map and grouped to form noise zones that show the level of noise exposure in the surrounding communities.

DOD also identifies APZs as a planning tool for local planning agencies. APZs are areas where an aircraft mishap is most likely to occur. They do not reflect the probability of an accident. APZs follow departure, arrival, and flight pattern tracks and are based on analysis of historic data. The AICUZ includes three APZs—the Clear Zone, APZ I, and APZ II. The Clear Zone extends 3,000 feet beyond the runway end and has the highest potential for accidents. APZ I generally extends 5,000 feet beyond the Clear Zone, and APZ II extends 7,000 feet beyond APZ I. APZs may also bend along flight paths to reflect operations more effectively. An accident is more likely to occur in the Clear Zone than in either APZ I or APZ II.

Land use development should be compatible with noise zones and APZs around a military airfield. The Federal Aviation Administration (FAA) and DOD also encourage local communities to restrict development or land uses that could endanger aircraft in the vicinity of the airfield, including the following:

- Lighting (direct or reflected) that would impair pilot vision;
- Towers, tall structures, and vegetation that penetrate navigable airspace or are to be constructed near the airfield;
- Uses that would generate smoke, steam, or dust;
- Uses that would attract birds, especially waterfowl; and
- Electromagnetic interference with aircraft communications, navigation, or other electrical systems.

## 1.2 Purpose, Scope, and Authority

The Navy implemented the AICUZ Program at NAS Whidbey Island to encourage, through local cooperation, compatible development in and around the two Navy airfields located in Island County, Washington. The program was initiated locally with the Navy's adoption of a 1977 AICUZ Study for NAS Whidbey Island's Ault Field and OLF Coupeville.

The authority for the establishment and implementation of the AICUZ Program is derived from:

- U.S. DOD, *Instruction 4165.57, Air Installations Compatible Use Zones,* November 8, 1977;
- Chief of Naval Operations Instruction (OPNAVINST) *OPNAV Instruction 11010.36B, Air Installations Compatible Use Zones (AICUZ) Program,* December 19, 2002;
- U.S. DOD, *Unified Facilities Criteria (UFC) 3-260-01 Airfield and Heliport Planning and Design,* November 1, 2001; and
- U.S. Department of Transportation, FAA Regulations, *Code of Federal Regulations (CFR), Title 14, Part 77, Objects Affecting Navigable Airspace,* 1992.

## 1.3 Need for NAS Whidbey Island's Ault Field and OLF Coupeville

The Navy needs to ensure the continued ability of Ault Field and OLF Coupeville to support mission requirements while promoting the compatible growth and development of the surrounding community. The Navy refers to this condition as sustainable readiness and cites the following reasons for continued use of the airfields:

- The world remains a dangerous place.
- The nation needs forces at a high state of readiness.
- Readiness is obtained only with continual high-quality training and modernization.
- Forces need to "train as they fight."
- The American public expects victory and near-flawless performance in peacekeeping and battle.
- Section 5062 Title 10 U.S. Code directs the Chief of Naval Operations (CNO) to train all Naval forces for combat.

The need for fully operational airfields is integral to the air station's mission. "The Mission of the NAS Whidbey Island is to provide the highest quality facilities, services and products to the naval aviation community and all organizations utilizing the NAS on Whidbey Island."[3]

The station currently supports 19 active-duty squadrons and two reserve squadrons. The squadrons fall under Commander Electronic Attack Wing U.S. Pacific (COMVAQWINGPAC), Commander Patrol and Reconnaissance Wing Ten (CPRW 10), and the Fleet Logistics Support Wing. The base also supports over 50 tenant commands/organizations that have a broad range of missions, including strategic communications support and aviation electronic warfare training.

NAS Whidbey Island is also the Navy's only all-weather airfield north of San Francisco and west of Chicago that is able to support a full range of fleet and Alaskan activities. The air station administers over 2,200 square miles of airspace, available 24 hours per day/365 days per year. The airspace allows

[3] NAS Whidbey Island website at www.naswi.navy.mil.

for training over the Pacific Ocean, unique mountainous terrain similar to the Korean Peninsula and Central Europe, and target ranges.

In addition, NAS Whidbey Island plays an important role in the economy of the surrounding community. Over 10,000 military personnel, civilians, and dependents work and/or live at the air station. The air station contributes $500 million directly to the local economy.[4] Thus, the continued use of the installation and its assets, including OLF Coupeville and the Seaplane Base, are important not only to the Navy and nation, but to the local community as well.

## 1.4 Responsibility for Compatible Land Use

Air installations and local government agencies with planning and zoning authority share the responsibility for preserving land use compatibility near an air installation. Cooperative action by both parties is essential to prevent land use incompatibility and encroachment. If local governments choose not to implement land development controls within the airfield environment, or are incapable of doing so, the Navy may acquire property rights to protect its operational integrity. However, this alternative is seldom exercised in already developed areas owing to budget limitations.

NAS Whidbey Island has a twofold responsibility within the AICUZ Program. First, it seeks to reduce aircraft noise impacts, to the extent practicable without compromising flight safety or operational capability, through operational guidance and procedures. Second, the air installation command works with state and local planning officials to implement the objectives of the AICUZ Program and strives to educate and inform the local civilian community of the mutual benefits of an effective AICUZ Program.

The local governments have the responsibility to protect the health, safety, and welfare of their respective residents. The primary land use focus is on Island County, Washington. Since the adoption of the 1977 AICUZ Study and subsequent analysis, Island County and the incorporated City of Oak Harbor have been proactive in recognizing components of the Ault Field and OLF Coupeville AICUZ footprints, and in regulating development around the airfields by means of AICUZ ordinance addendums to their overall zoning ordinances.

## 1.5 Community Authority

Island County and its unincorporated municipalities' land use and zoning actions can continue contributing to compatible land uses in the airfields' environs. The Revised Code of Washington (RCW) (primarily Chapters 36.70, 36.70A, 36.70B, and 36.70C) provides the authority under which Island County and its unincorporated municipalities may implement planning policies and adopt a zoning ordinance[5]. Chapter 36.70 of the RCW, titled Planning Enabling Act, is summarized as follows:

"The purpose and intent of this chapter is to provide the authority for, and the procedures to be followed in, guiding and regulating the physical development of a county or region through correlating both public and private projects and coordinating their execution with respect to all subject matters utilized in developing and servicing land, all to the end of assuring the highest standards of environment for living, and the operation of commerce, industry, agriculture and recreation, and assuring maximum economies and conserving the highest degree of public health, safety, morals and welfare."

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[4] Washington State Office of Financial Management, *Economic Impacts of Military Bases in Washington, NAS Whidbey in Island County*, July 2004.

[5] The Revised Code of Washington can be found at http://www.leg.wa.gov/RCW.

In addition to a zoning ordinance, the county and the City of Oak Harbor have adopted other regulations that affect land use compatibility around airfields, including a fair disclosure ordinance and noise reduction requirements in its building code.[6] The Town of Coupeville has also adopted a zoning ordinance.

## 1.6 Changes that Require an AICUZ Study Update

Operational and training requirements, aircraft mix, tempo of aviation activity, maintenance procedures, and community development seldom remain static. Therefore, to maintain currency, AICUZ studies are updated periodically. Since the development of the 1977 AICUZ Study for NAS Whidbey Island's Ault Field and OLF Coupeville, all of these variables have changed. Previous AICUZ efforts and related studies at NAS Whidbey Island include the following:

1977 AICUZ Study for NAS Whidbey Island's Ault Field and OLF Coupeville:

- Study approved for implementation by CNO.
- Study established AICUZ areas for airfields and strategies for compatible land use.

1986 AICUZ Study Update for NAS Whidbey Island's Ault Field and OLF Coupeville:[7]

- Update approved by CNO.
- Based on 1986 Noise Study.[8]

1994 Noise Study:[9]

- Update to 1986 AICUZ noise contours. An AICUZ update did not follow at this time. Island County and the City of Oak Harbor's zoning regulations include noise contours that were based on this study.

2004 Noise Study:[10]

- Serves as basis for noise portion of this AICUZ Study Update.

[6] Detailed discussion of Island County planning, zoning, and other regulations as they relate to the airfields is contained throughout Sections 7.0 and 8.0 of this report.
[7] Reid, Middleton, and Associates, Inc., and Environmental Planning and Design, *NAS Whidbey Island AICUZ Update*, 1986.
[8] Harris, Miller, Miller, and Hanson, *Aircraft Noise Survey, NAS Whidbey Island,* 1986.
[9] Wyle Laboratories, *Wyle Report 94-13 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington*, 1994.
[10] Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington*, 2004.

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# 2.0 Installations and Airspace

This section provides descriptions of NAS Whidbey Island's Ault Field and OLF Coupeville and an overview of the positive impacts the air station has on the economy. In addition, it describes the local and regional airspace used by NAS Whidbey Island aircraft for training/operations.

## 2.1 Location

NAS Whidbey Island's Ault Field and OLF Coupeville are located on the northern end of Whidbey Island, Washington, as shown in Figure 2-1, the Regional Location Map. Accessible by State Route 20, Whidbey Island is approximately 1 1/2 hour's drive time north of Seattle, Washington, and 2 hours' south of Vancouver, British Columbia. The island is within the Puget Sound basin. The Cascade Mountains are located to the east of the island, and the Olympic Mountains are located to the west—peaks on these mountains reach nearly 14,000 feet.

*Two EA-6B Prowlers assigned to the "Cougars" of Electronic Attack Squadron One Three Nine (VAQ-139) fly in formation around Washington's Mount Rainier during a routine training mission. At 14,410 feet, Mount Rainier is the most prominent peak in the Cascade Range.*

NAS Whidbey Island borders the City of Oak Harbor, as depicted in Figure 2-2, the Vicinity Map. OLF Coupeville, located 9.8 miles south-southeast of the Ault Field control tower and 3 miles south of the Town of Coupeville, is also shown. The Seaplane Base is located to the southeast of NAS Whidbey Island. The Seaplane Base functions primarily as a community support and housing area.

While precipitation is synonymous with the Seattle and Tacoma area, Whidbey Island sees a significantly lower amount per year. The island is located in the rain shadow of the Olympic Mountains[1]. As a result, while it rains an average of 200 inches per year on the coast of the Olympic Peninsula, it rains only 22 inches per year in Oak Harbor. As for temperatures, the average daytime temperature is mid 70s in the summer and 40 to 45 degrees Fahrenheit in the winter. Short cold snaps do occur in the winter, with temperatures in the 15 to 20 degree range.

[1] In the Pacific Northwest, summers are generally warm and dry and winters are cool and stormy. Winter weather on Whidbey Island is dominated by the Olympic Mountains, located 20 miles to the southwest, across the Strait of Juan de Fuca. The mountains "intercept" incoming Pacific storms, force tremendous lift and torrential rains on their windward side, and create a huge downdraft to their lee and Whidbey Island. This lee trough often takes the form of a swirling area of slightly lower pressure that simultaneously inhibits rainfall. Thus, the same storm system that produces light winds and steady rain over much of the Puget Sound typically produces only a light, windblown drizzle at NAS Whidbey Island.

## 2.2 Mission and Vision

"The mission of the NAS Whidbey Island is to provide the highest quality facilities, services and products to the naval aviation community and all organizations utilizing the NAS on Whidbey Island."[2]

NAS Whidbey Island's vision is to step boldly into the future as the premier NAS, a vital element of the Navy, DOD, and multinational infrastructure in the northwest. The air station strives to be a leader in the following:

- Personal Excellence, Integrity, and Dedication
- Maintenance, Logistic, and Training Support
- Innovation and Technology
- Mission Support for Regular, Reserve, and Joint Operations
- Environmental Stewardship
- Quality of Life for Our People and Community

## 2.3 Description of Naval Air Installations

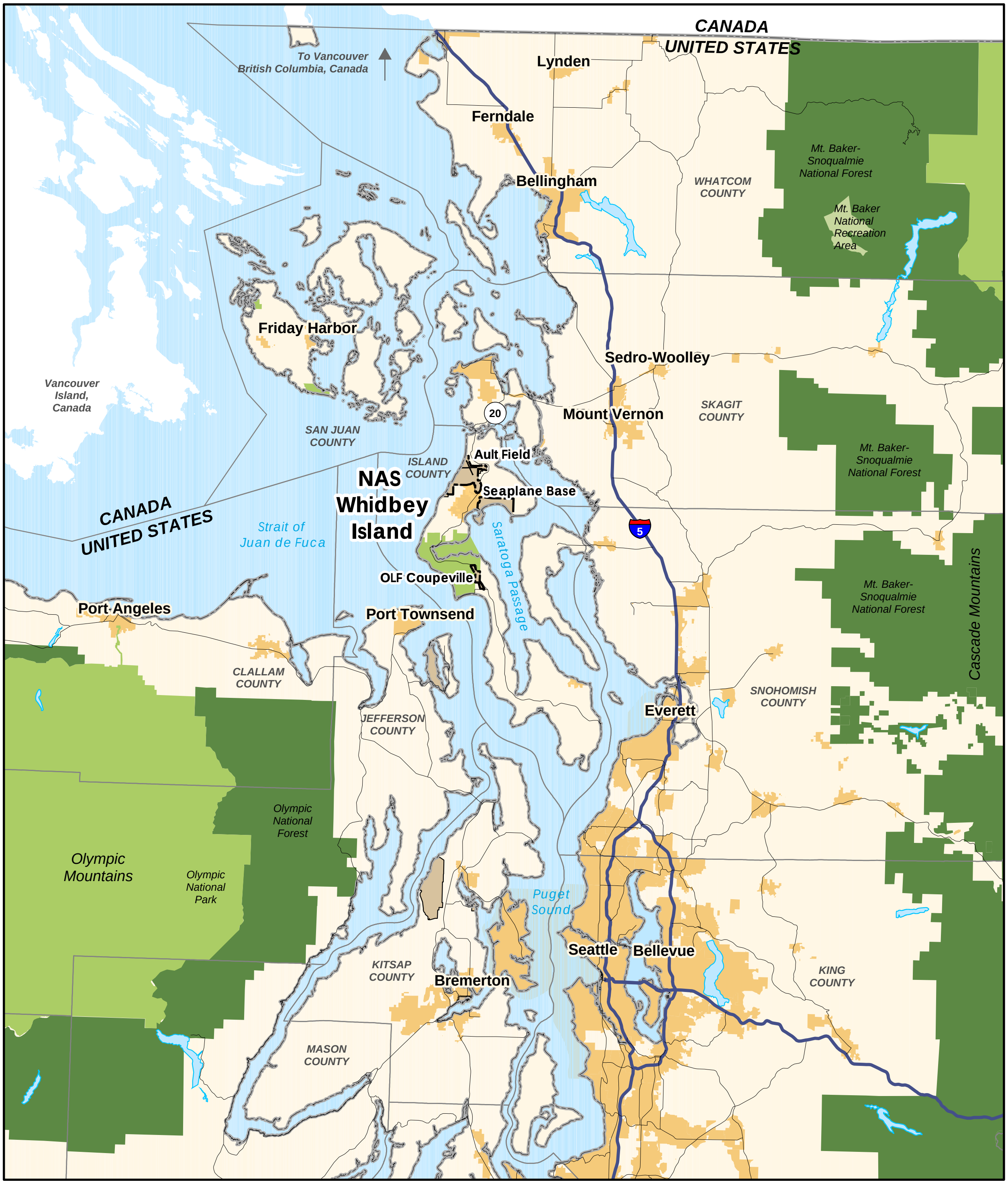
NAS Whidbey Island real estate holdings total 55,605 acres. NAS Whidbey Island's Ault Field covers 4,253 acres, OLF Coupeville covers 677 acres, and the Seaplane Base covers 2,820 acres.[3] Additionally, NAS Whidbey Island manages 423 acres at Lake Hancock[4] and 47,432 acres at the Boardman Target Range in Oregon.

*NAS Whidbey Island's Ault Field is shown above. Additional air station land holdings are OLF Coupeville, Seaplane Base, Lake Hancock, and the Boardman Target Range.*

Construction of NAS Whidbey Island's Ault Field started in March 1942, and the air station was commissioned in September of that year. The airfield was constructed as a result of a CNO directive to find a location for the rearming and refueling of Navy patrol planes operating in defense of Puget Sound. A year later, an area just southeast of Coupeville was approved as an auxiliary field to serve Naval Station (NS) Seattle. By September 1943, OLF Coupeville was operational.

Over the years, NAS Whidbey Island has evolved into the Navy's premier training center for electronic attack and patrol and reconnaissance squadrons. OLF Coupeville compliments training at Ault Field and is used for field carrier landing practice (FCLP) and other operations including helicopter and parachute operations.

[2] www.naswi.navy.mil.
[3] Acreages obtained from NAS Whidbey Island *State of the Station Brief,* 2001.
[4] Lake Hancock is a bombing/rocket practice site that is now a saltwater estuary with protected birds and animal species.



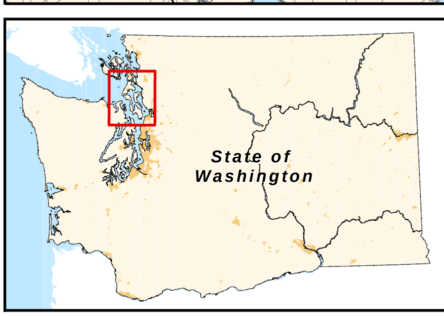


# Figure 2-1
## Regional Location Map

Sources:
WA Dept. of Ecology, 1994
WA Dept. of Transportation, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004

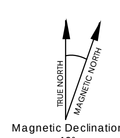
TRUE NORTH
MAGNETIC NORTH
Magnetic Declination
19°

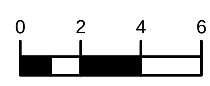
0 5 10 15
Miles


# Figure 2-2
## Vicinity Map

Sources:
WA Dept. of Ecology, 1994
WA Dept. of Transportation, 2004
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004



### 2.3.1 Ault Field

The following section details airfield facilities and provides additional information related to airfield operations at Ault Field as found in *NAS Whidbey Island Instruction (NASWHIDBEYINST) 3710.7S*, August 14, 2002. Many of the details are illustrated in Figure 2-3, the Airfield Diagram for Ault Field.

**Airfield Overview and Features**

Location. The specific geographical location for Ault Field is latitude 48° 21’N and longitude 122° 39’W. The airfield is approximately 3 nautical miles (NM) northwest of the City of Oak Harbor, Washington.

*An Aviation Machinist's Mate removes the propeller control of a P-3C Orion for routine maintenance. NAS Whidbey Island’s Ault Field has an Aircraft Intermediate Maintenance Detachment (AIMD) and several maintenance and hangar facilities.*

Hours of Operation. The airfield is in operation 24 hours per day. Airfield operations may be suspended or curtailed temporarily by the Commanding Officer or designated representatives based on the following factors:

- Condition of landing area/airfield repairs
- Availability of crash and rescue equipment
- Weather conditions hazardous to flight
- Status of navigational aid

Navigational Aids. A Class H Tactical Air Navigation (TACAN), NUW Channel 85, is located on the airfield. The paired frequency for VOR (Very High Frequency [VHF] Omni-directional Range) equipped aircraft is 113.8 megahertz (MHz) (distance measuring equipment [DME] only).

Airfield Elevation. Field elevation is 47 feet mean sea level (MSL) measured at the approach end of Runway 31.

Runways. The landing area consists of two runways.

- Runway 07/25 Length: 8,000 feet
  Width: 200 feet
  Magnetic headings: 67°/247° (07/25)
  Overruns: 1,000/700 feet (07/25)
- Runway 13/31 Length: 8,000 feet
  Width: 200 feet
  Magnetic headings: 134.5°/314.5° (13/31)
  Overruns: 1,000/1,000 feet (13/31)

Helicopter Takeoff/Landing Areas. Any runway or taxiway surface may be used for helicopter takeoffs/landings. Additionally, several helicopter pads are marked on the taxiways. The compass rose may be used when traffic condition warrants, daylight only (unlighted).

Taxiways. Taxiways Alpha through Lima and an angle and high-speed taxiway are available for aircraft or ground vehicles, depending on their condition/surface deterioration.

Runway/Taxiway Marking. Runways and taxiways are marked following standard criteria. A lighted simulated carrier deck 800 feet in length is located approximately 800 feet from the approach end of each runway, port side.

Arresting Gear. E-28 bi-directional and E-5 unidirectional chain overrun arresting gears are installed on each runway.

**Airfield Lighting System**

Runway Lighting. Variable high-intensity runway lights (HIRLs) are available for approach on all runways except Runway 07. The lights are operated by the control tower, simultaneously with the threshold, circle guidance, runway distance marker, and windsock lights.

- Runway 25: "U.S. Standard (A-1)" type approach lighting system with sequenced flashing lights and single roll guidance bar
- Runway 13: "U.S. Standard (A-1)" type approach lighting system with sequenced flashing lights, roll guidance bars, touchdown zone lights (TDZLs), and centerline lights
- Runway 31: "U.S. Standard (A-1)" type approach lighting system with sequenced flashing lights, roll guidance bars, and centerline lights
- Runway 07: No approach lighting system

Carrier Deck Lighting. Simulated carrier decks are lighted by a four-step lighting system operated by the control tower.

Frensel Lens Optical Landing System (FLOLS) and Improved Fresnel Lens Optical Landing System (IFLOLS):[5]

- MK-8/MOD 1 FLOLS are installed on the port side of Runways 07, 31, and 25, approximately 1,000 feet from the threshold. Lens angle and light intensity are controlled at the site by the Fire Department/Landing Signal Officer (LSO).
- MK-14/MOD 0 IFOLS is installed on the port side of Runway 13, approximately 1,000 feet from the threshold. Lens angle and intensity are controlled at the site by the Fire Department/LSO. Activation of the IFLOLS wave-off lights is controlled by the LSO.

Arresting Gear Lighting. E-28 arresting gear locations are identified by internally lighted arresting gear markers.

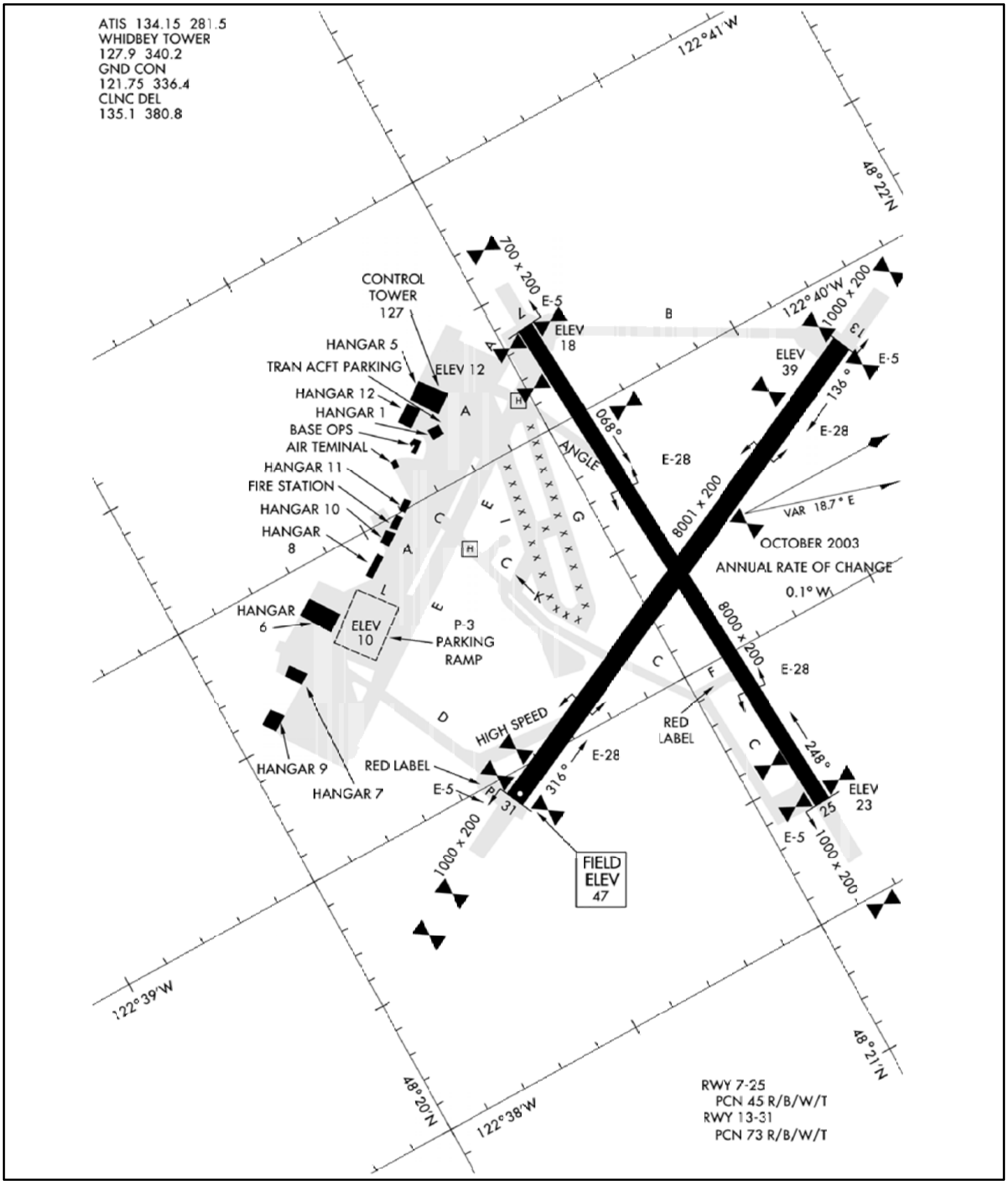
Wave-off Lighting. Runway wave-off cluster lights are located on both sides of each runway, 900, 1,700, and 2,500 feet from the approach end. They are tested daily and activated from the control tower.

Taxiway Lighting. Standard variable-intensity blue taxiway lights are used. Variable-intensity green bi-directional centerline lights are located on Taxiway Alpha, Runway 13 High-Speed Taxiway, and Runway 25 Angle Taxiway.

Rotating Beacon. A standard dual-peaked white and green rotating beacon is located atop the control tower. When the airfield is open, the beacon is operated continuously from sunset to sunrise, and during day light hours when the airfield in under Instrument Flight Rules (IFR).

Obstruction Lighting. Obstructions in the vicinity of the airfield are marked with standard red lights.

[5] Currently there is only one IFLOLS at NAS Whidbey Island. Until additional IFLOLS are installed, the primary location is Runway 13. In preparation for additional IFLOLS, all runway lens locations have been certified for its use. When necessary, the IFLOLS is moved to the runway that will best accommodate training requirements.




## Figure 2-3
### Airfield Diagram for Ault Field

Source:
Federal Aviation Administration
Airport Diagrams, 2002

**Service Facilities and Capabilities**

Maintenance Facilities. NAS Whidbey Island's Aircraft Intermediate Maintenance Detachment (AIMD) is capable of performing intermediate-level maintenance functions for tenant and transient units. Functions provided include emergency calibrations support, ground support equipment, tire/wheel build-up, and precision measuring equipment. AIMD is located in Building 2547 and performs over 100,000 maintenance actions each year.

Organizational Maintenance. A transient line crew is available to assist in parking and routine servicing of transient aircraft.

Hangars. Eight hangars are used by NAS Whidbey Island and its squadrons for aircraft storage and squadron level maintenance.

Maintenance Run-up Areas. The primary high-power run-up areas are located off Taxiway Charlie and at the ends of Runways 07 and 31. Lower power run-ups take place in several locations along the flight line. Run-ups also occur at two engine test cell sites. Maintenance run-ups are further discussed in Section 3.0, and their locations are depicted in Figure 3-12.

Magnetic Compass Swing Sites. The primary magnetic compass swing site is located on the VAQ-129 line.

Tacan Checkpoints. Four checkpoints are available at the approach end of each runway.

Windsocks. Lighted windsocks are located at the approach end of all runways. Additional windsocks are located atop Hangar 1 and the Flying Club.

Fuel, Oil, and Oxygen. Refueling and oxygen servicing facilities are available for most military aircraft. Hot pit refueling is also available in two areas—in front of the Control Tower and adjacent to Taxiway Echo.

Aircraft Wash Rack Area. A taxi-through wash rack is located south of Taxiway Delta, between Taxiways Alpha and Echo.

## 2.3.2 OLF Coupeville

The following section provides details about airfield facilities and provides additional information related to airfield operations at OLF Coupeville as found in *NASWHIDBEYINST 3710.7S*, August 14, 2002. See Figure 2-4 for airfield diagram.


*OLF Coupeville is used primarily for FCLP operations. While Ault Field remains operational around the clock, OLF Coupeville is operational from 0800 to 2400.*

**Airfield Overview and Features**

Location. The specific geographical location of the airfield is latitude 48° 11’N and longitude 122° 38’W. The airfield is approximately 10 NM south-southeast of Ault Field.

Hours of Operation. The airfield is available Monday through Friday from 0800 to 2400. OLF Coupeville is manned during FCLP periods or by prior arrangement. Seasonal adjustments of hours may occur.

Navigational Aids. An AN/URN-25 TACAN (Channel 62X) is located 1,500 feet north of the approach end of Runway 14. Azimuth and DME is provided for reference.

Airfield Elevation. Field elevation is 199 feet MSL.

Runways. Runway 14/32 is 5,400 feet by 200 feet. Magnetic headings are 137°/317° (14/32).

Runway/Taxiway Marking. The runway is marked following standard criteria. A standard carrier deck “box” is painted on the approach end of each runway with deck lighting incorporated.

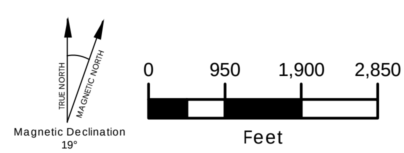
Arresting Gear. E-5 unidirectional chain overrun arresting gear is located at midfield.

Runway Lighting. In addition to the carrier deck lighting, HIRL, Fresnel lens, and Manually Operated Visual Landing Aid System (MOVLAS) lighting is available. Two permanent LSO shacks located abeam each carrier deck contain controls for all field lighting and the Fresnel lens.

Obstruction Lighting. Obstructions in the vicinity of the airfield are marked with standard red lights.


**Figure 2-4**
**Airfield Diagram for OLF Coupeville**

Sources:
NAS Whidbey Island GIS, 2004
Island County GIS, 2004



## 2.4 Economic Impact

According to the Washington State Office of Financial Management, 88 percent of all economic activity in Island County is directly or indirectly linked to the Navy's presence[6]. The 2003 on-base employment of over 10,000 persons constitutes 68 percent of total employment in Island County.

*NAS Whidbey Island is important to Island County. Above is a recently developed shopping complex in the City of Oak Harbor. According to Washington State statistics, NAS Whidbey Island contributes nearly $500 million directly to the Island County economy.*

### 2.4.1 Direct Impacts

The direct impacts of the base include employment, payrolls, retiree pension, payments to private health care providers, and purchases of goods and services from local vendors. These impacts for 2003 are shown in Table 2-1.

**Table 2-1 Direct Impacts of NAS Whidbey Island in Island County, 2003**

| Impact | Totals |
|---|---|
| Employment (Military and Civilian) | 10,066 Persons |
| Payroll | $399.1 Million |
| Military Retiree Pensions | $91.1 Million |
| TriCare Payment to Private Providers | $14.1 Million |
| Contracts for Goods and Services | $12.2 Million |
| On-base Retail Spending | $22.0 Million |
| **Net Direct Impact*** | **$494.5 Million** |

**Note:**
*Reduced by on-base retail spending.

**Source:**
Washington State Office of Financial Management, *Economic Impacts of the Military Bases in Washington*, July 2004.

The annual payroll earned by these civilian and military workers is $399.1 million, 52 percent of countywide labor earnings. The Navy operates a hospital in Oak Harbor. However, the services area is supplemented with $14.1 million of health services purchased from private providers. Military retiree pensions are administered through the bases, and many retirees live in the county near the base administering their pension so that they can take advantage of on-base services such as overseas travel or access to commissaries. Pensions administered at NAS Whidbey total $91.1 million annually. Contracts administered by the base for a variety of goods, services, and on-base construction total $12.2 million, a number that varies highly from year to year depending on the number of military construction (MILCON) projects taking place. Active duty personnel, military retirees, and their spouses and dependents are eligible to use the on-base retail facilities provided by the commissaries and base exchanges. Spending at these facilities does not impact the state economy in any way unless the goods are provided by in-state vendors (captured in the contract data). Therefore, the payroll and pension amounts are reduced by the $22 million spent at the commissaries and base exchanges in Island County to calculate net direct impact as shown in Table 2-1. This net direct impact totals $494.5 million.

In addition, the federal government compensates school districts for schooling the dependents of federal employees, including service personnel. School districts Island County receive $4.5 million annually in impact aid for schooling the dependents of military personnel.

[6] This entire section is taken from Washington State Office of Financial Management, *Economic Impacts of the Military Bases in Washington*, July 2004.

### 2.4.2 Multiplier Impacts

When military-related payrolls are spent within the county or state, and when the base administers contracts to businesses in the county or state, these expenditures have multiplier or indirect impacts that generate additional economic activity. By applying formulas, total impact estimates can be derived for 2003, as listed in Table 2-2. NAS Whidbey Island directly and indirectly accounts for nearly 17,500 jobs in Island County and over 20,100 statewide. The total impacts in terms of labor earnings sum to $674 million within Island County (approximately 88 percent of wage disbursements in the county) and nearly $775 million statewide.

**Table 2-2 Total Impacts of NAS Whidbey Island in Island County, 2003**

| Impact | Totals |
|---|---|
| Employment in Island County | 17,494 Persons |
| Statewide Employment | 20,141 Persons |
| Labor Earning for Island County | $674 Million |
| Statewide Labor Earnings | $775 Million |

**Source:**
Washington State Office of Financial Management, *Economic Impacts of the Military Bases in Washington,* July 2004.

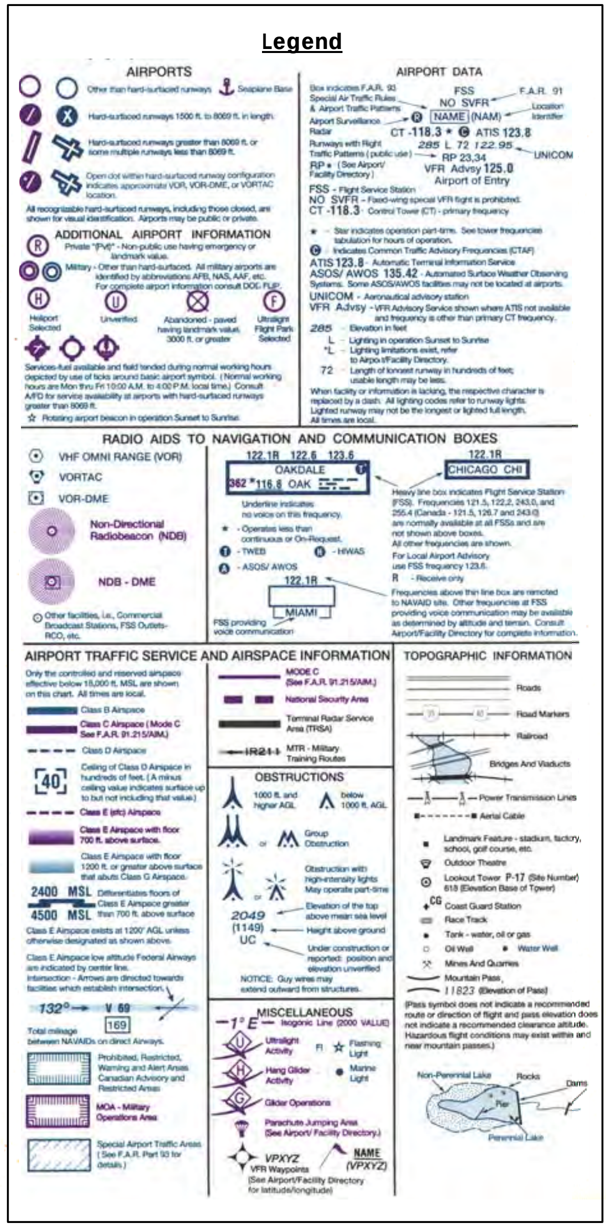
## 2.5 Airspace

NAS Whidbey Island's Ault Field is surrounded by Class C airspace, as illustrated in Figure 2-5. Most pattern operations at Ault Field take place in this airspace, which is continuously available. On the figure, horizontal Class C limits are shown by solid magenta circles. Vertical limits are separated by two layers—an upper layer with a 10 NM radius over a bottom layer with a 5 NM radius. The floor of the upper layer is 1,200 feet above ground level (AGL) with a ceiling of 4,000 feet AGL. The bottom layer extends from the surface to 1,200 feet AGL.

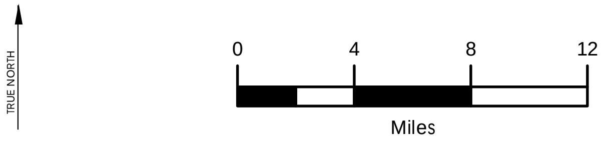
OLF Coupeville is surrounded by A-680, as illustrated in Figure 2-5. The alert airspace extends from the surface to 5,000 feet MSL and encompasses OLF Coupeville pattern operations.

When not deployed, NAS Whidbey Island pilots conduct numerous flight operations around the airfields and in the region. These include pattern operations and other operations generally in defense-related special use airspace (SUA) that is located over open ocean adjacent to the west coast of Washington, or over land in both Oregon and Washington. Full-sized FAA sectional aeronautical charts can be referenced for the location of the airspaces not shown in Figure 2-5.

## Figure 2-5
### Airspace Diagram


Source:
Federal Aviation Administration
Sectional Aeronautical Chart, Seattle, 2004



## 3.0 Aircraft Operations

The main sources of sound at Navy air installations are aircraft operations, including flight operations and engine maintenance operations, or run-ups. The level of sound exposure is related to a number of variables; however, the types of aircraft, number of aircraft operations, and flight tracks are the most significant factors. This section details aircraft stationed at NAS Whidbey Island, the type and number of operations conducted by these aircraft, and the runways and flight tracks used to conduct the operations. Detailed operational data is presented for the CY03 existing condition and for the CY13 projected condition.

## 3.1 Aircraft Types

### 3.1.1 Past, Present, and Future Aircraft Types

Since the 1940s, a wide variety of aircraft have been stationed at NAS Whidbey Island. The earliest squadrons of aircraft were F4F Wildcats, which came aboard in 1942, followed by F6F Hellcats. Later that same year, PV-1 Venturas arrived for training. By 1944, SBD Dauntless dive-bombers became the predominant aircraft at Ault Field, while several PBM seaplanes and PBY patrol bombers were located at the Seaplane Base.

*A PBY patrol bomber sits on the Seaplane Base ramp in 1944. Photo courtesy of the National Archives.*

Following World War II and through the Korean War, P-2V Neptune and PB4Y2 Privateer patrol bombers were stationed at Ault Field. P5M-2 Marlin patrol boat squadrons occupied the Seaplane Base. By 1956, the first A-3D Skywarrior jet aircraft were delivered to NAS Whidbey Island.

In the late 1960s, the evolution of aircraft types at NAS Whidbey Island began to reach a point that is reflective of today's aircraft mix, with the first A-6 Intruders and P-3 Orions coming on board. These aircraft soon became the predominant attack and patrol aircraft, and aircraft such as A-3s and P-2s were phased out.

By the time of the 1986 AICUZ Update, NAS Whidbey Island fixed-wing and rotary-wing aircraft inventory included the A-6E, EA-6B, P-3C, C-12F, TC-4, and H-3s. Today, upgraded EA-6B and P-3 platforms (P-3C and EP-3E) are the predominant aircraft at NAS Whidbey Island. Additionally, C-9B and UH-3H aircraft are in the air station's current inventory.

In the future, the EA-18G will replace EA-6B electronic warfare aircraft. The EA-6B will begin retirement in 2010, after a career that exceeded 40 years of deployments in support of Navy, Marine Corps, and Air Force strike forces.

### 3.1.2 Aircraft Details

This section provides details on the EA-6B, P-3C, EP-3E, C-9B, UH-3H, and the EA-18G.

**EA-6B Prowler**

Role: Suppression of enemy air defenses in support of strike aircraft and ground troops by interrupting enemy electronic activity and obtaining tactical electronic intelligence within the combat area.

- Manufacturer: Grumman Aircraft Corporation
- Engines: Two Pratt & Whitney J52-P408 turbofan engines
- Thrust: 11,200 pounds per engine
- Length, Height, and Wing Space: 59 feet, 15 feet, and 53 feet
- Speed: Maximum .99 mach; cruise .72 mach
- Armament: ALQ-99 Tactical Jamming System (TJS); High-Speed Anti-Radiation Missile (HARM)
- Sensors: ALQ-99 On-board System (OBS)
- Upgrades: Improved Capability (ICAP III) and the Multifunctional Information Distribution System (MIDS)

*At NAS Whidbey Island, EA-6Bs are currently the dominant aircraft in terms of number of aircraft and number of operations. All of the air station's EA-6B aircraft will eventually be replaced with the EA-18G.*

**P-3C Orion and EP-3E Aries II**

Roles: The P-3C Orion is a land-based, long-range anti-submarine warfare (ASW) patrol aircraft. The P-3C also provides effective anti-surface warfare (ASUW) and Command, Control, Communications, Computers, and Intelligence, Surveillance, and Reconnaissance (C4ISR) capabilities to naval and joint commanders.

The EP-3E ARIES (Airborne Reconnaissance Integrated Electronics System) aircraft provides the capability to detect and exploit tactically significant electronic signals and communication. The P-3 platform can also be equipped with meteorological sensors to measure temperature, humidity, pressure, winds, and fluxes.

- Manufacturer: Lockheed Martin Aeronautical Systems Company
- Engines: Four Allison T-56-A-14 turboprop engines
- Power: 4,900 shaft horsepower per engine
- Length, Height, and Wingspan: 117 feet, 33 feet, and 100 feet
- Cruise Speed: 328 knots
- Armament (P-3C): Up to around 20,000 pounds (9 metric tons) internal and external loads

*A P-3C Orion flies with bomb-bay doors open. The EP-3E ARIES uses the same P-3 platform, but is easily distinguishable from the P-3C Orion by features such as a dome under the front fuselage and additional "canoe" fairings that cover antennas.*

### C-9B Sky Train

Role: The C-9B Sky Train provides cargo and passenger transportation as well as forward deployment logistics support.

- Manufacturer: McDonnell Douglas Corporation
- Engines: Two Pratt & Whitney JT8D-9A turbofan engines
- Thrust: 14,500 pounds per engine
- Length, Height, and Wingspan: 119 feet, 27 feet, and 93 feet
- Speed: 500 to 565 mph

*NAS Whidbey Island's Fleet Logistic Support Squadron flies the C-9 Sky Train aircraft.*

### UH-3H Sea King

Role: The UH-3H Sea King is primarily used for Search and Rescue (SAR). The helicopter can also be used for Medical Evacuation (MEDVAC) and Very Important Person (VIP) missions.

- Manufacturer: Sikorsky Aircraft, Division of United Technologies
- Engines: Two General Electric T-58-GE-402 turboshaft engines
- Power: 1,500 shaft horsepower per engine
- Speed: Up to 120 knots
- Endurance: Between 3.5 and 5.5 hours, depending on the mission
- Range: 500-plus miles
- Rescue Hoist Lifting Capacity: 600 pounds

*A UH-3H Sea King helicopter assigned to Fleet Logistics Search and Rescue Team at NAS Whidbey Island conducts hovering exercises during a training flight.*

### EA-18G

Role: The EA-18G will perform full-spectrum electronic surveillance and electronic attack of enemy threat radars and communications nets. The EA-18G leverages the U.S. Navy's investment in the FA-18E/F Super Hornet platform. A derivative of the two-seat FA-18F Super Hornet—a platform that is in production today—the EA-18G is a highly flexible design that enables the warfighter to perform a broad range of tactical missions, operating from either the deck of an aircraft carrier or land-based fields.

- Manufacturer: Boeing
- Engines: Two General Electric F404-GE-400 afterburning, low-bypass turbofans
- Thrust: 16,000 pounds per engine
- Length, Width, and Height: 56 feet, 16 feet, and 38 feet
- Maximum Speed, Intermediate Power: Mach 1 plus

*The EA-18G is designed to support strike aircraft and ground troops by suppressing enemy air defenses. The aircraft works to interrupt enemy electronic activity and to obtain tactical electronic intelligence within the combat area.*

## 3.2 Aircraft Flight Operations

Table 3-1 provides a historical perspective of aircraft flight operations at NAS Whidbey Island's Ault Field and OLF Coupeville from 1994 through 2002. Over this period, peak operations totaling 111,463 occurred in 1994. Much of the recent decline is attributable to increases in squadron deployments.

**Table 3-1 Historical Annual Operations for Ault Field and OLF Coupeville**

| Year | Ault Field | | | | | OLF Coupeville | |
|---|---|---|---|---|---|---|---|
| | Military | | Civilian | | Totals | Military | Totals |
| | Navy/Marine Corps | Other | Air Carrier | General Aviation | | Navy/ Marine Corps | |
| 1994 | 102,304 | 1,548 | 116 | 7,495 | 111,463 | 21,628 | 21,628 |
| 1995 | 96,391 | 1,206 | 158 | 7,665 | 105,420 | 19,954 | 19,954 |
| 1996 | 78,553 | 1,028 | 109 | 7,205 | 86,895 | 13,066 | 13,066 |
| 1997 | 78,440 | 1,521 | 251 | 7,881 | 88,093 | 9,736 | 9,736 |
| 1998 | 68,503 | 1,450 | 333 | 7,147 | 77,433 | 6,808 | 6,808 |
| 1999 | 68,943 | 1,312 | 269 | 6,490 | 77,014 | 6,752 | 6,752 |
| 2000 | 74,277 | 1,577 | 259 | 8,311 | 84,424 | 6,378 | 6,378 |
| 2001 | 70,886 | 1,560 | 215 | 7,196 | 79,857 | 3,568 | 3,568 |
| 2002 | 68,525 | 956 | 370 | 7,610 | 77,461 | 4,100 | 4,100 |

**Source:**
NAS Whidbey Island, *Air Traffic Activity Reports,* 1994 through 2002.

A flight operation is any takeoff or landing at an airfield. The takeoff and landing may be part of a training maneuver (or pattern) associated with the airfield's runways or may simply be a departure or arrival of an aircraft. Several basic flight operations are listed below:

- Departure: An aircraft takeoff.
- Overhead Break Arrival: An expeditious arrival using visual flight rules. An aircraft approaches the runway 500 feet above the altitude of the landing pattern. Approximately halfway down the runway, the aircraft performs a 180-degree descending left turn to enter the landing pattern. Once established in the pattern, the aircraft lowers landing gear and flaps and performs a 180-degree descending left turn to land on the runway.
- Ground Controlled Approach (GCA) Box: An approach directed from the ground by Air Traffic Control (ATC) personnel. ATC personnel provide aviators with verbal course and glide slope information, allowing them to make an instrument approach during inclement weather.
- Touch and Go: An aircraft lands and takes off on a runway without coming to a full stop. After touching down, the pilot immediately goes to full power and takes off again. .
- Field Carrier Landing Practice (FCLP): A touch and go conducted to the carrier box outlined on a runway. FCLPs are required training for all pilots before landing on a carrier.

### 3.2.1 Detailed CY03 and CY13 Aircraft Flight Operations

Flight operations for the CY03 existing condition at Ault Field and OLF Coupeville are shown in Table 3-2[1]. Flight operations for the CY13 projected condition at both airfields are shown in Table 3-3. The tables detail operations by tenant name, aircraft type, and operation type.

For CY03, a total of 81,959 operations were conducted at Ault Field and 7,682 operations were conducted at OLF Coupeville. EA-6B aircraft were the dominant aircraft in terms of operations at both airfields. For the CY13 projected condition, the EA-18G will replace all EA-6B aircraft. The EA-18G is projected to account for 40,521 operations in CY13, an 11 percent decrease from the 46,294 operations the EA-6B totaled in CY03. Even with this decrease, the EA-18G will remain dominant in terms of operations. The C-12 is due for phase-out in CY05 and is not shown for CY13.

For both CY03 and CY13, approximately 90 percent of all flight operations at Ault Field are or are projected to be conducted during “acoustical” daytime hours (0700 to 2200), with the remaining 10 percent conducted during “acoustical” nighttime hours (2200 to 0700). At OLF Coupeville, 83 percent of operations occur or are projected to occur during “acoustical” daytime hours, with the remaining 17 percent occurring during “acoustical” nighttime hours.

[1] Whidbey Island personnel provided flight operation numbers for CY03 for the EA-6B, P-3, C-9, C-12, and transient aircraft (McCarter, 2004). A representative of the Commander Naval Air Forces, U.S. Pacific Fleet (COMNAVAIRPAC), later approved the operations data (Papapietro, 2004). For the EA-6B and P-3 aircraft, the Community Planning Liaison Officer (Melaas, 2004) provided operational percentages for departure, arrival, and pattern operations. Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington*, 2004.

## Table 3-2 Flight Operations for Ault Field and OLF Coupeville for CY03

| Tenant Name | Aircraft Type | Operation Type | Description | CY03 Operations | | |
|---|---|---|---|---|---|---|
| | | | | 0700-2200 | 2200-0700 | Total |
| **Ault Field** | | | | | | |
| CVWP | EA-6B | Departure | Departure | 3,935 | 241 | 4,176 |
| | | | Interfacility – Ault Field to OLF Coupeville | 531 | 109 | 640 |
| | | | **Total All Departures** | **4,466** | **350** | **4,816** |
| | | Arrival | Overhead-Break | 1,860 | 136 | 1,996 |
| | | | Interfacility – OLF Coupeville to Ault Field | 531 | 109 | 640 |
| | | | TACAN | 411 | 25 | 436 |
| | | | IFR Full-Stop | 1,643 | 101 | 1,744 |
| | | | **Total All Arrivals** | **4,445** | **371** | **4,816** |
| | | Closed Pattern | FCLP | 18,983 | 3,967 | 22,950 |
| | | | Touch and Go | 9,160 | 433 | 9,593 |
| | | | Depart and Re-enter | 238 | 17 | 255 |
| | | | GCA Box | 2,032 | 1,832 | 3,864 |
| | | | **Total All Closed Patterns** | **30,413** | **6,249** | **36,662** |
| | | | **Total** | **39,324** | **6,970** | **46,294** |
| CPRW | P-3 | Departure | Low-TACAN | 4,289 | 81 | 4,370 |
| | | | IFR | 3,668 | 145 | 3,813 |
| | | | **Total All Departures** | **7,957** | **226** | **8,183** |
| | | Arrival | VFR | 4,290 | 81 | 4,371 |
| | | | Low-TACAN | 1,834 | 72 | 1,906 |
| | | | IFR Full-Stop | 1,834 | 72 | 1,906 |
| | | | **Total All Arrivals** | **7,958** | **225** | **8,183** |
| | | Closed Pattern | Touch and Go | 12,867 | 244 | 13,111 |
| | | | GCA Box | 4,661 | 175 | 4,836 |
| | | | **Total All Closed Patterns** | **17,528** | **419** | **17,947** |
| | | | **Total** | **33,443** | **870** | **34,313** |
| VR-61 | C-9 [1] | Departure | Departure | 211 | 114 | 325 |
| | | Arrival | Straight-In Arrival | 211 | 114 | 325 |
| | | | **Total** | **422** | **227** | **649** |
| Station | C-12 [1] | Departure | Departure | 65 | 35 | 100 |
| | | Arrival | Straight-In Arrival | 65 | 35 | 100 |
| | | | **Total** | **129** | **70** | **199** |
| Transient | Transient [1, 2] | Departure | Departure | 164 | 88 | 252 |
| | | Arrival | Straight-In Arrival | 164 | 88 | 252 |
| | | | **Total** | **328** | **176** | **504** |
| **Total Number of Operations for CY03 (all aircraft)[1]** | | | | **73,646** | **8,313** | **81,959** |
| **OLF Coupeville** | | | | | | |
| CVWP | EA-6B | Closed Pattern | FCLP | 6,390 | 1,292 | 7,682 |
| | | | **Total All Closed Patterns** | **6,390** | **1,292** | **7,682** |
| **Total Number of Operations for CY03 (all aircraft)** | | | | **6,390** | **1,292** | **7,682** |
| **Ault Field and OLF Coupeville** | | | | | | |
| **Total Number of Operations for CY03 at Ault Field and OLF Coupeville (all aircraft) [1]** | | | | **80,036** | **9,605** | **89,641** |

**Source:**
Wyle Laboratories, *Wyle Report 94-13 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington*, 1994.

**Notes:**
1. These totals differ from those listed in the station's Air Activity Reports since this table does not include operations through the airspace that do not originate or terminate at NAS Whidbey Island.

2. All closed patterns in Table 3-2 are counted as two (2) operations in the table.

### Table 3-3 Flight Operations for Ault Field and OLF Coupeville for CY13

| Tenant Name | Aircraft Type | Operation Type | Description | CY13 Operations | | |
|---|---|---|---|---|---|---|
| | | | | 0700-2200 | 2200-0700 | Total |
| **Ault Field** | | | | | | |
| CVWP | EA-18G | Departure | Departure | 3,749 | 229 | 3,978 |
| | | | Interfacility – Ault Field to OLF Coupeville | 506 | 104 | 610 |
| | | | **Total All Departures** | **4,255** | **333** | **4,588** |
| | | Arrival | Overhead-Break | 1,772 | 129 | 1,901 |
| | | | Interfacility – OLF Coupeville to Ault Field | 506 | 104 | 610 |
| | | | TACAN | 391 | 24 | 415 |
| | | | IFR Full-Stop | 1,566 | 96 | 1,662 |
| | | | **Total All Arrivals** | **4,235** | **353** | **4,588** |
| | | Closed Pattern | FCLP | 15,122 | 3,160 | 18,282 |
| | | | Touch and Go | 8,727 | 412 | 9,139 |
| | | | Depart and Re-enter | 226 | 17 | 243 |
| | | | GCA Box | 1,936 | 1,745 | 3,681 |
| | | | **Total All Closed Patterns** | **26,011** | **5,334** | **31,345** |
| | | | **Grand Total** | **34,501** | **6,020** | **40,521** |
| CPRW | P-3 | Departure | Low-TACAN | 4,289 | 81 | 4,370 |
| | | | IFR | 3,668 | 145 | 3,813 |
| | | | **Total All Departures** | **7,957** | **226** | **8,183** |
| | | Arrival | VFR | 4,290 | 81 | 4,371 |
| | | | Low-TACAN | 1,834 | 72 | 1,906 |
| | | | IFR Full-Stop | 1,834 | 72 | 1,906 |
| | | | **Total All Arrivals** | **7,958** | **225** | **8,183** |
| | | Closed Pattern | Touch and Go | 12,867 | 244 | 13,111 |
| | | | GCA Box | 4,661 | 175 | 4,836 |
| | | | **Total All Closed Patterns** | **17,528** | **419** | **17,947** |
| | | | **Grand Total** | **33,443** | **870** | **34,313** |
| VR-61 | C-9 [1] | Departure | Departure | 211 | 114 | 325 |
| | | Arrival | Straight-In Arrival | 211 | 114 | 325 |
| | | | **Grand Total** | **422** | **227** | **649** |
| Transient | Transient [1, 2] | Departure | Departure | 164 | 88 | 252 |
| | | Arrival | Straight-In Arrival | 164 | 88 | 252 |
| | | | **Grand Total** | **328** | **176** | **504** |
| **Total Number of Operations for CY13 (all aircraft) [1]** | | | | **68,693** | **7,294** | **75,987** |
| **OLF Coupeville** | | | | | | |
| CVWP | EA-18G | Closed Pattern | FCLP | 5,091 | 1,029 | 6,120 |
| | | | **Total All Closed Patterns** | **5,091** | **1,029** | **6,120** |
| **Ault Field and OLF Coupeville** | | | | | | |
| **Total Number of Operations for CY13 at Ault Field and OLF Coupeville (all aircraft) ) [1]** | | | | **73,784** | **8,323** | **82,107** |

**Source:**
Wyle Laboratories, *Wyle Report 94-13 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville*, *Washington*, 1994.

**Notes:**
1. These totals differ from those listed in the station's Air Activity Reports since this table does not include operations through the airspace that do not originate or terminate at NAS Whidbey Island.

2. All closed patterns in Table 3-3 are counted as two (2) operations in the table.

### 3.2.2 Runway and Flight Track Utilization

At NAS Whibey Island's Ault Field, Runway 25 is the most active runway and is used 44 percent of the time. The second most active runway is Runway 13, which is used 36 percent of the time. Table 3-4 provides utilization percentages for the remaining runways and compares them with utilization percentages contained in the 1986 AICUZ.[2] Runway utilization for CY13 is projected to remain the same as for CY03.

**Table 3-4 Runway Utilization Past, Present, and Projected at Ault Field**

| Runway Number | 1986 Annual Utilization (1) | CY03 and CY13 Utilization (2) |
|---|---|---|
| 13 | 27% | 36% |
| 31 | 04% | 07% |
| 07 | 20% | 13% |
| 25 | 49% | 44% |
| **Total** | 100% | 100% |

**Sources:**
1. Reid, Middleton, and Associates, Inc., and Environmental Planning and Design, *NAS Whidbey Island AICUZ Update,* 1986.

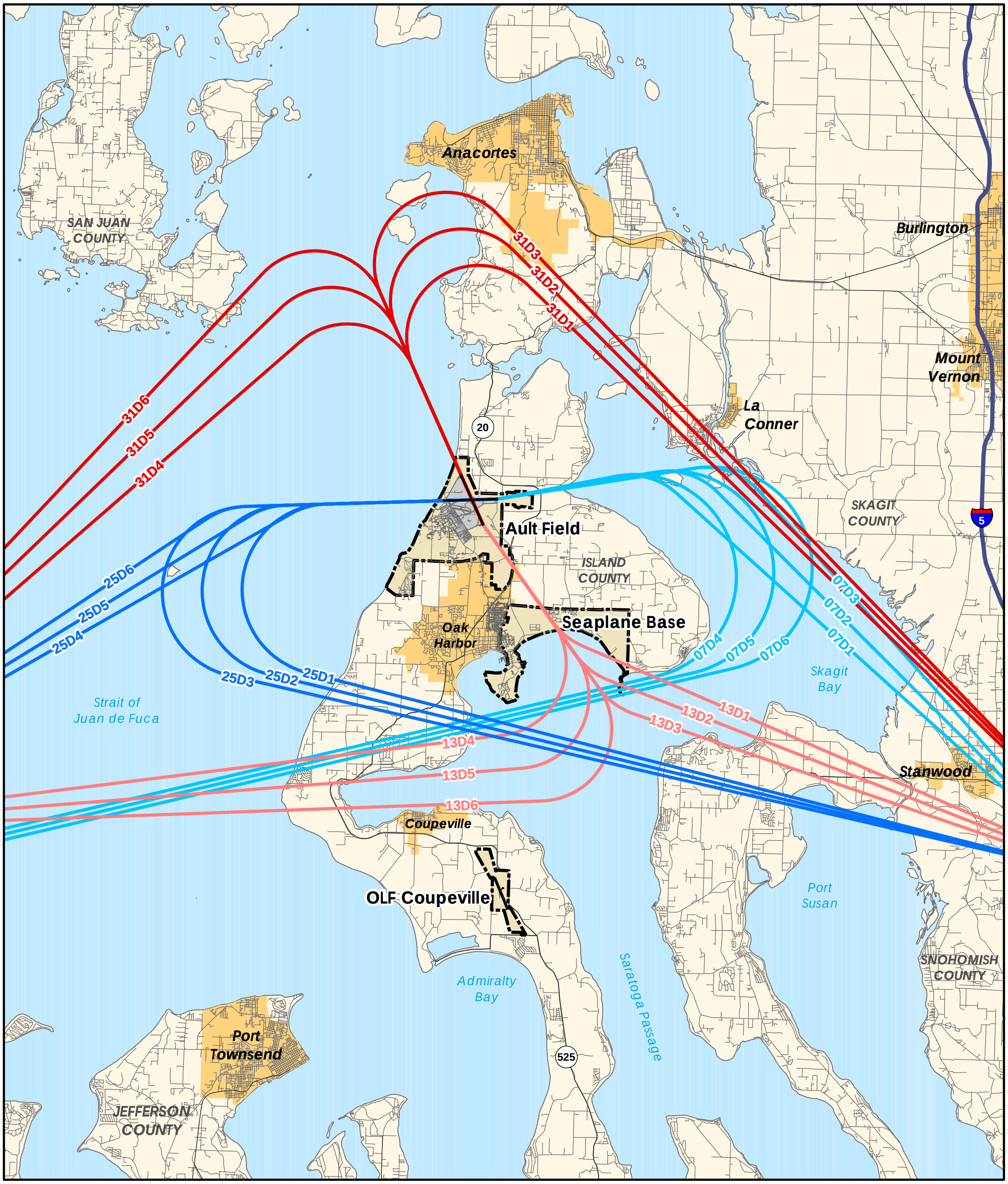
2. Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington*, 2004.

Appendix A presents modeled CY03 and CY13 Average Annual Day Aircraft Operations used to develop noise contours and APZs. The tables were derived by multiplying the annual operations by the runway and track utilization percentages and dividing the result by 365 days. This allows for the computation of the Average Annual Daytime and Nighttime events by flight track for each of the aircraft types, rounded to the nearest 0.01 event. NOISEMAP, the suite of programs used to generate noise contours, uses Average Annual Day events per flight track to compute the noise exposure around airfields. An event is defined as a takeoff operation, a landing operation, or a combination of both when the aircraft remains in the vicinity of the airfield. In order to input operations into NOISEMAP correctly, closed patterns (i.e., Touch and Go, FCLP, GCA Box) that were counted as two operations (a takeoff and a landing) were divided by two to represent an average number of daily events. Given an overall total of 89,641 CY03 operations at Ault Field and OLF Coupeville, a total of 246 Average Annual Day flight events were modeled for CY03 conditions. For CY13, 82,107 operations at Ault Field and OLF Coupeville were projected and a total of 225 Average Annual Day flight events were modeled.

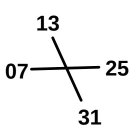
The flight tracks listed in the tables are depicted in Figures 3-1 through 3-11. These flight tracks represent "typical" operations[3]. There are 188 flight tracks depicted and used for noise modeling. The tracks consist of departures, straight-in arrivals, overhead-break arrivals, and closed patterns. The departures are divided into regular departures and Low-TACAN departures as shown in Figure 3-1 and 3-2. The arrivals are divided into Straight-In, High- and Low-TACAN, Overhead-Break, and Exclusive P-3 arrivals (See Figures 3-3 through 3-6). The closed-pattern flight tracks are divided into Depart and Re-enter, Touch and Go, FCLP, and GCA Box and are shown in Figures 3-7 through 3-10. Interfacility tracks between Ault Field and OLF Coupeville are shown in Figure 3-11.

[2] Reid, Middleton, and Associates, Inc., and Environmental Planning and Design, *NAS Whidbey Island AICUZ Update*, 1986.

[3] The flight tracks depicted represent predominant flight paths of aircraft. Noise modeling is based on the use of predominant flight paths because these paths dominate the noise environment around an airfield. Flight paths are represented as single lines on maps, but actual flight paths may vary because of aircraft performance, pilot technique, and weather conditions. Therefore, an actual flight path (track) is better thought of as a band rather than a single line.

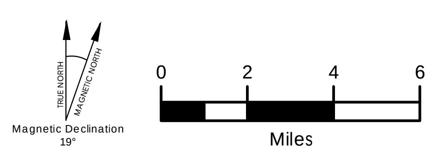


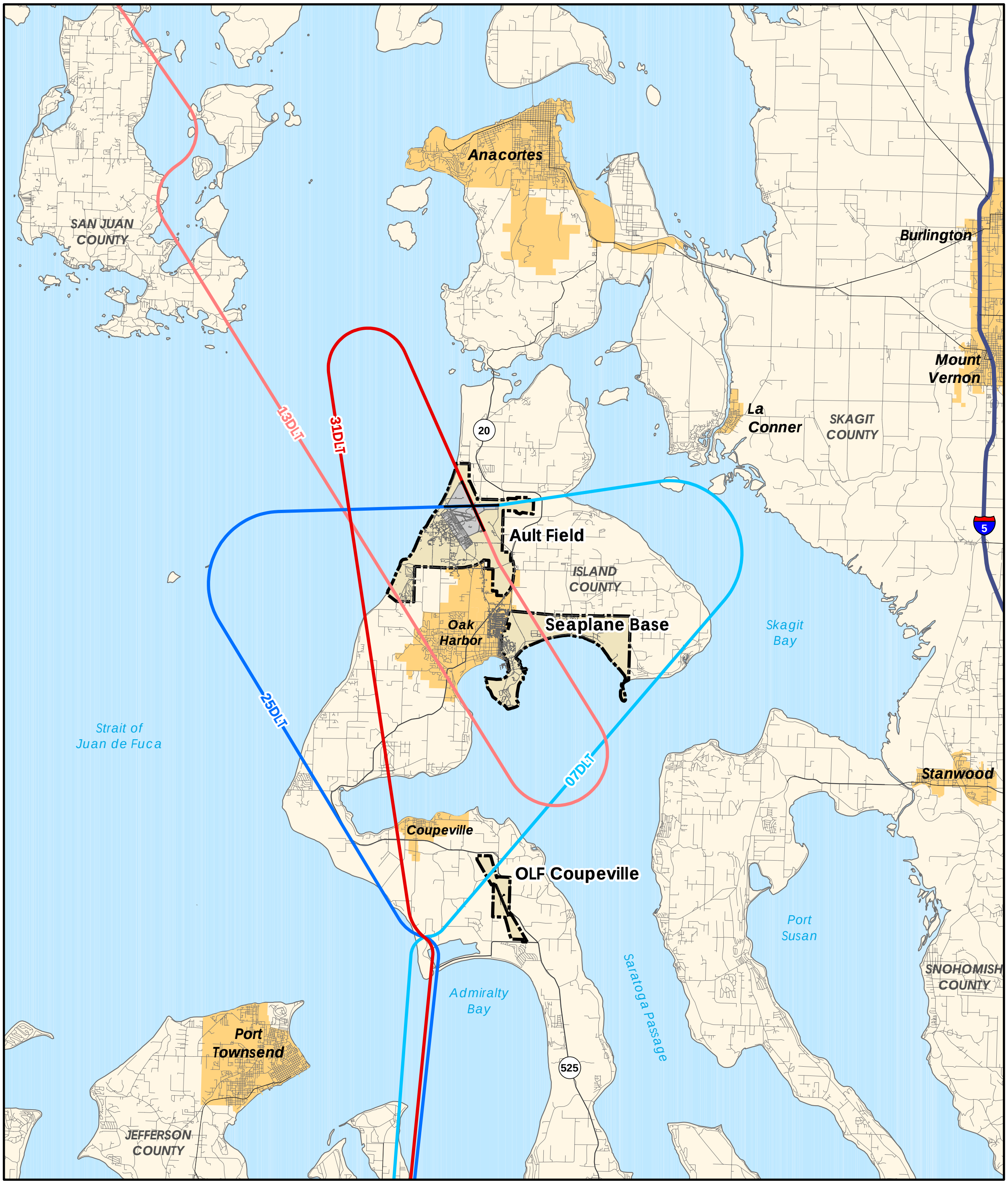

**Ault Field Runways**



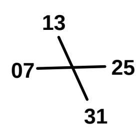

# Figure 3-1
## Departure Flight Tracks at Ault Field

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004



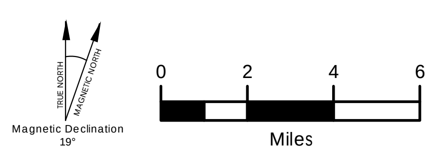


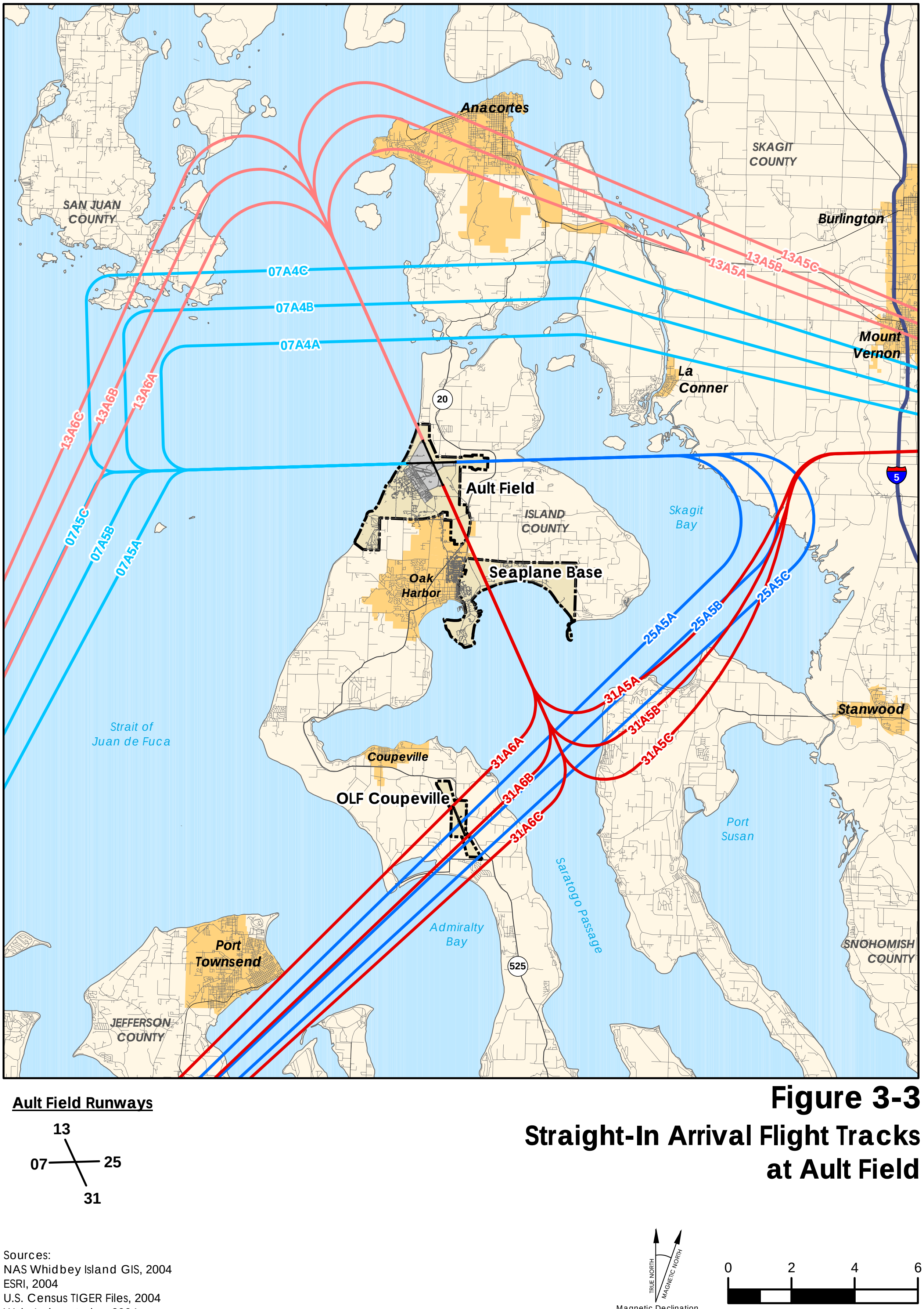

Ault Field Runways




# Figure 3-2
## Low-TACAN Departure Flight Tracks at Ault Field

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004

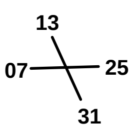





# Figure 3-3
## Straight-In Arrival Flight Tracks at Ault Field

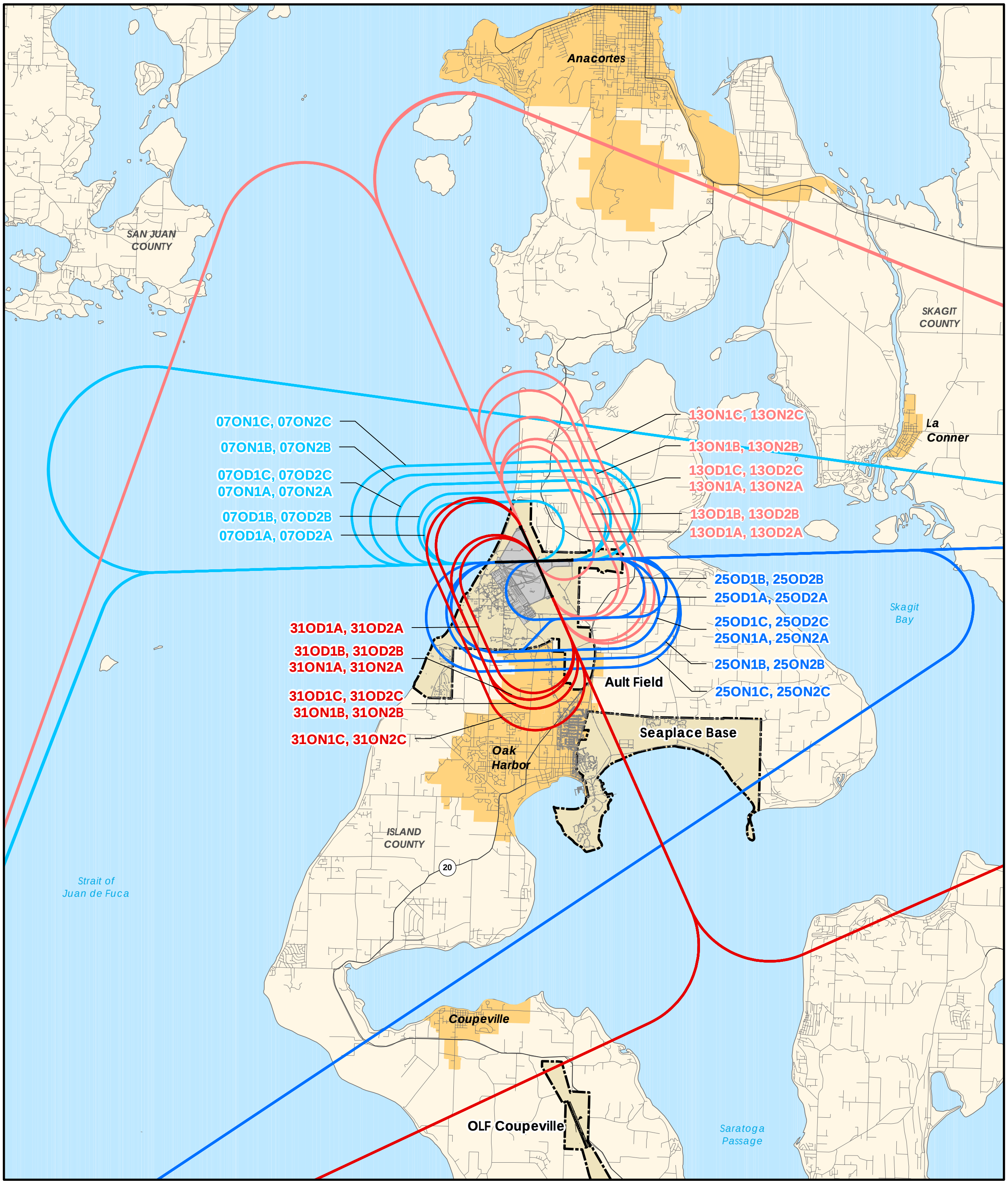
Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004


**Ault Field Runways**

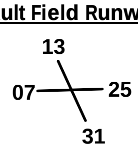



# Figure 3-4
## High- and Low-TACAN Arrival Flight Tracks at Ault Field

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004

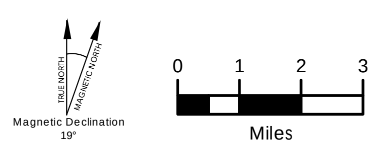


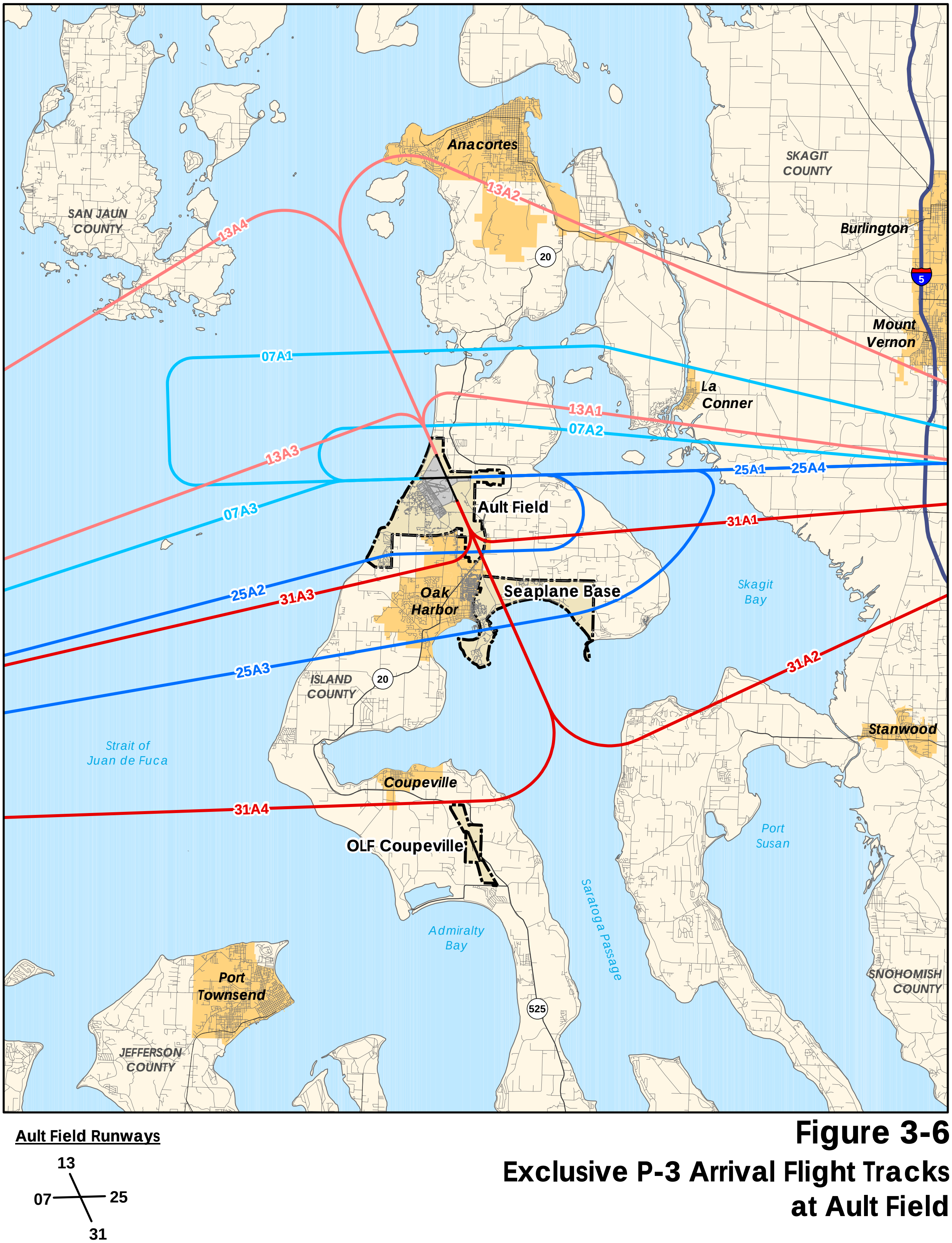

**Ault Field Runways**




# Figure 3-5
## Overhead-Break Arrival Flight Tracks at Ault Field

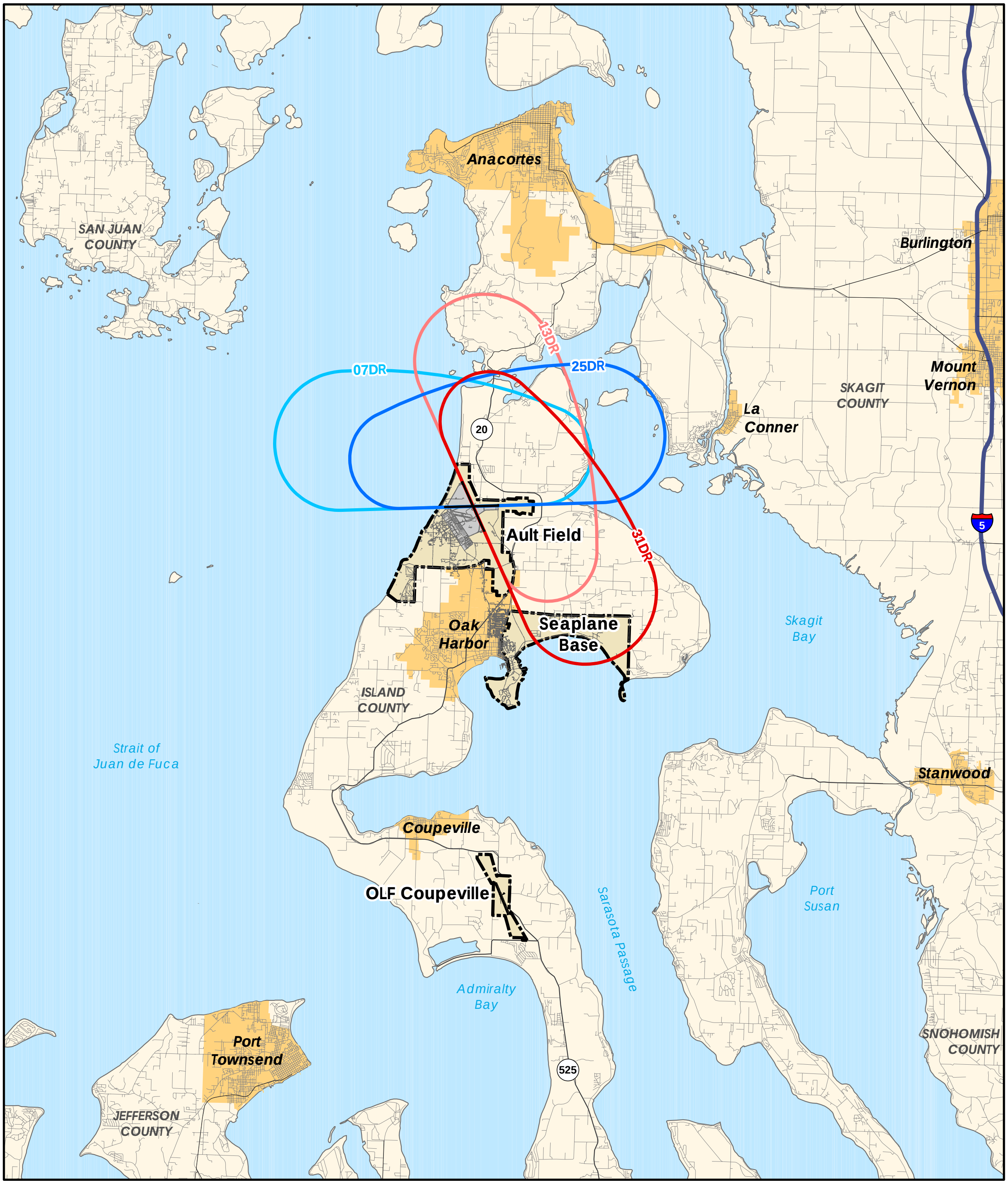
Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004



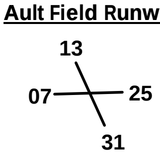



# Figure 3-6
## Exclusive P-3 Arrival Flight Tracks at Ault Field

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004

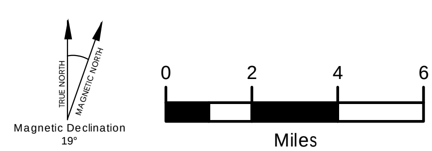


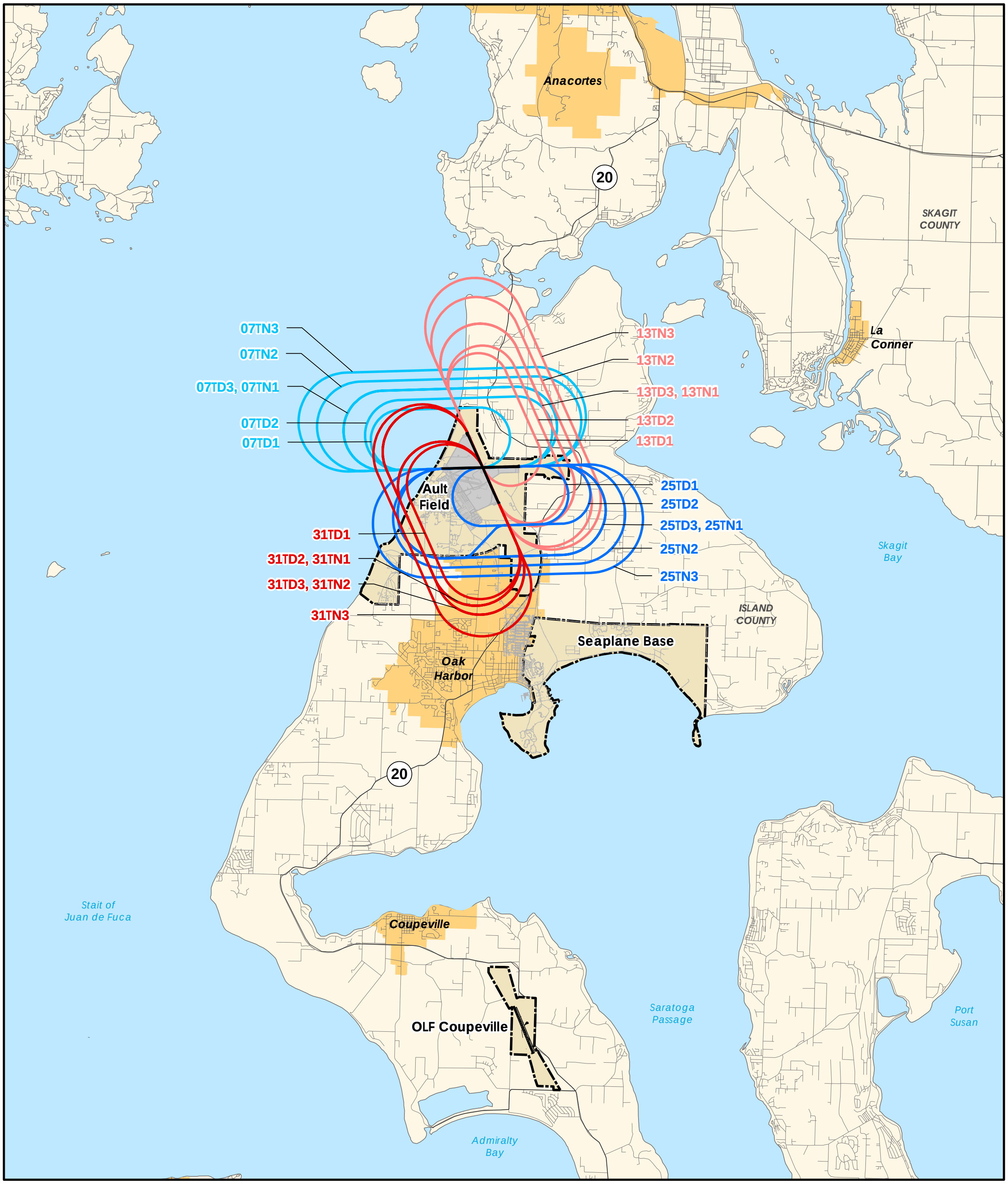

**Ault Field Runways**

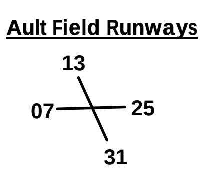



# Figure 3-7
## Depart and Re-enter Flight Tracks at Ault Field

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004



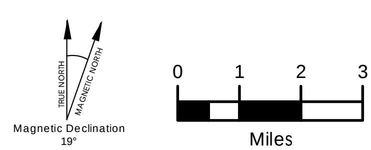


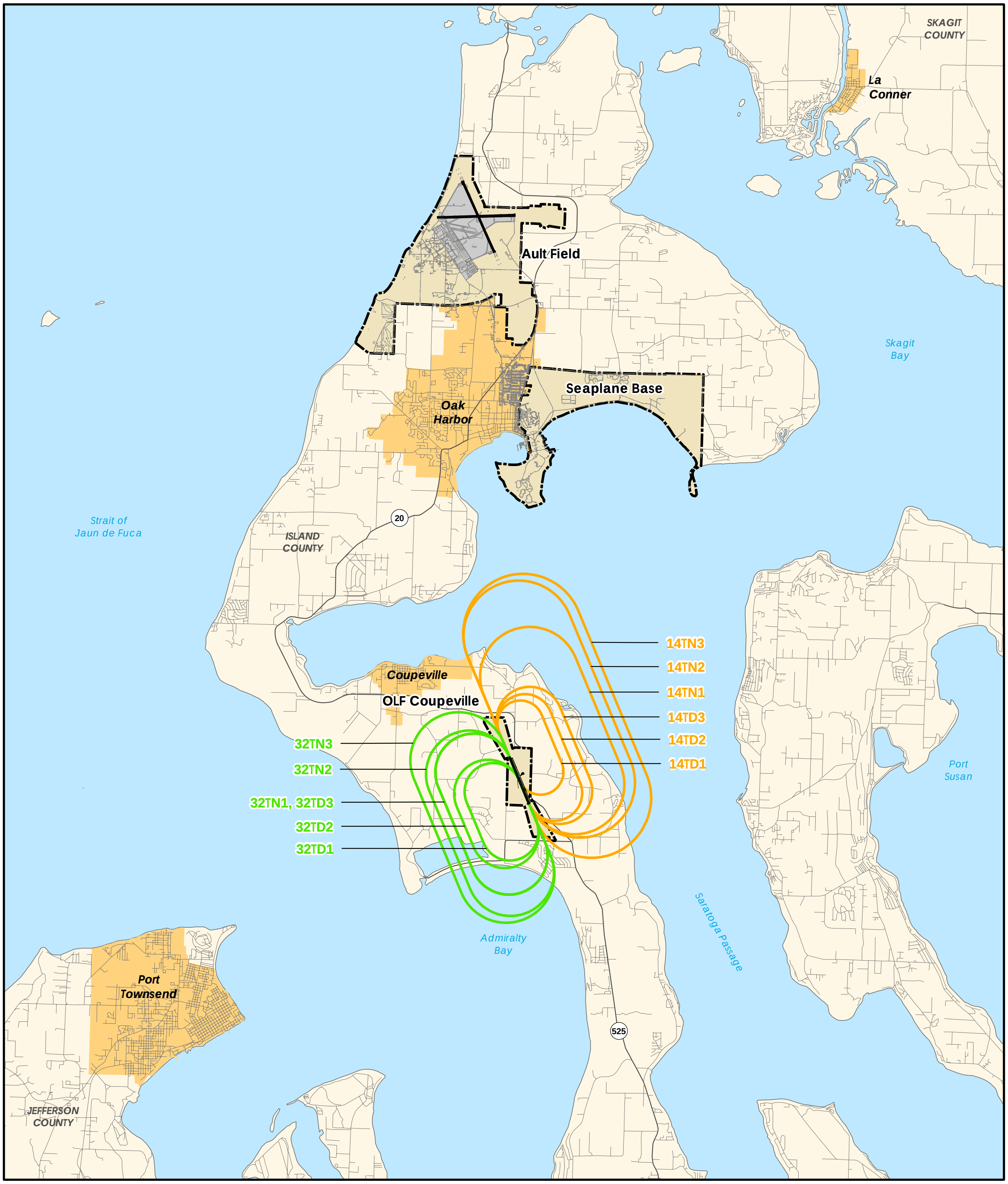




# Figure 3-8
## Tower Pattern* Flight Tracks at Ault Field

* (Touch and Go, and FCLP)

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004






# Figure 3-9
## FCLP Flight Tracks at OLF Coupeville

**OLF Coupeville Runway**

14

32

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004

TRUE NORTH
MAGNETIC NORTH
Magnetic Declination
19°

0 1 2 3
Miles

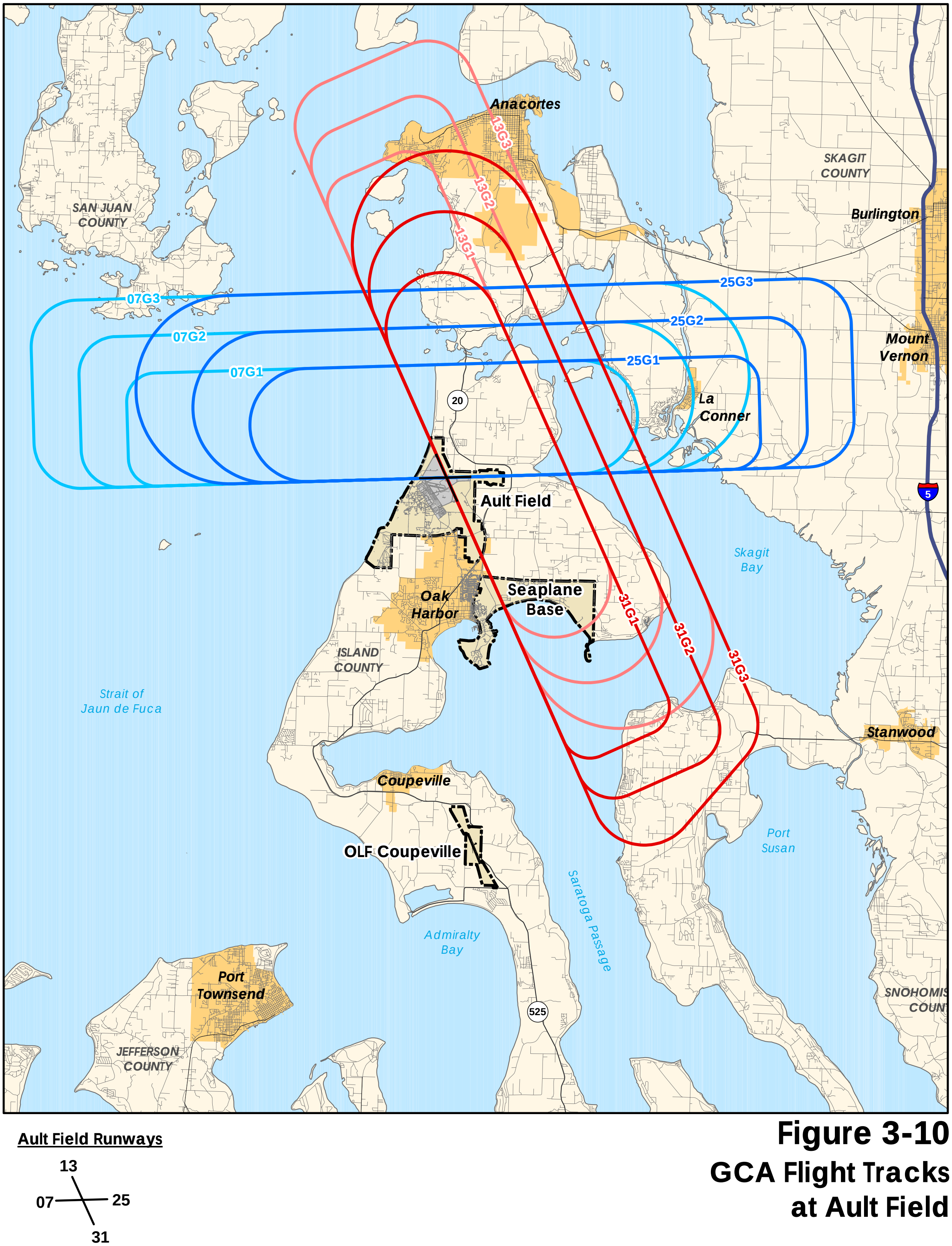
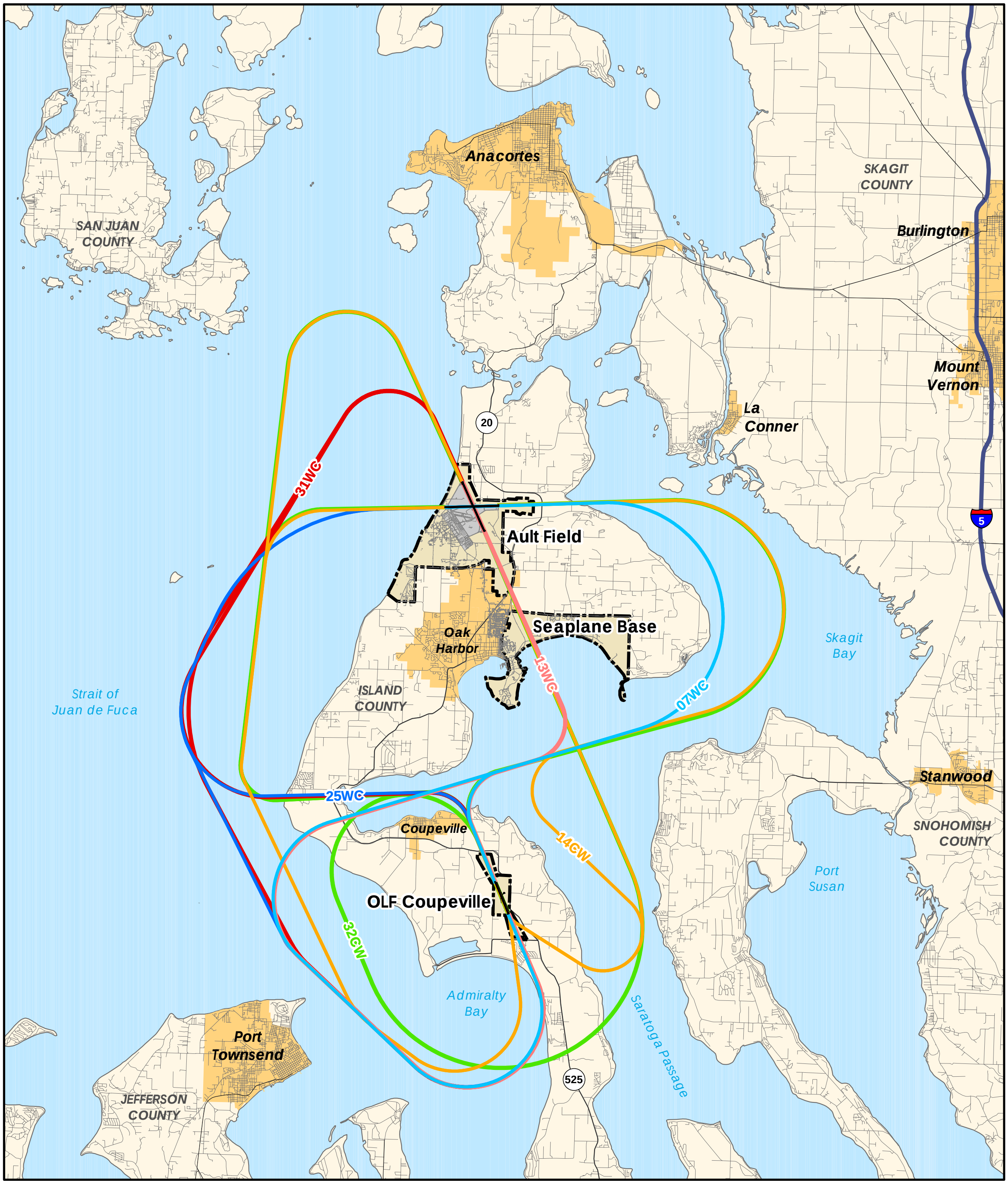


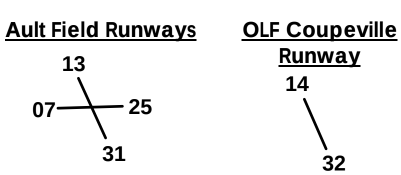

**Figure 3-10**
**GCA Flight Tracks at Ault Field**

Sources:
NAS Whidbey Island GIS, 2004
Island County GIS, 2004
Wyle Laboratories, 2004




# Figure 3-11

## Interfacility Flight Tracks between Ault Field and OLF Coupeville




Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census Tiger Files, 2004
Wyle Laboratories, 2004

## 3.3 Pre-flight and Maintenance Run-up Operations

Preflight run-up operations are generally not conducted by EA-18G or P-3 aircraft, so none were modeled at Ault Field. However, maintenance run-up operations frequently take place at several locations, as illustrated in Figure 3-12. Locations include low- and high-power run-up areas and two engine test cell areas.

Tables 3-5 and 3-6 present the maintenance run-up operations for CY03 and CY13 used for modeling noise. The tables detail the type of operation, power setting, frequency, and duration for several representative events by aircraft. Run-up specifics for the two engine test cell areas are also included.

### Table 3-5 Modeled Maintenance Run-up Operations at Ault Field for CY03

| Aircraft Type | Maintenance Operation | Engine Mode | Engine Power Setting (N2) | No. of Engines in Use | Operations Per year | Time-In-Mode per Engine (Min.) |
|---|---|---|---|---|---|---|
| EA-6B | Low Power | Main Engine Run | Idle (60%) | 1 | 2592 | 15 |
| | | | 75% | 1 | 2592 | 5 |
| | Low Power/ Water Wash | Main Engine Run | Idle (60%) | 2 | 1080 | 25 |
| | | | 75% | 2 | 1080 | 8 |
| | High Power | Engine Start/Taxi | Idle (60%) | 2 | 360 | 16 |
| | | Intermediate Power | 70% | 2 | 360 | 15 |
| | | High Power | 98% | 2 | 360 | 10 |

| Aircraft Type | Maintenance Operation | Location | Engine Power Setting (ESHP) | No. of Engines in Use | Operations Per year | Time per Operation Type (Min.) |
|---|---|---|---|---|---|---|
| P-3 | Low Power | Flight Line | 1,000 | 1 | 520 | 15 |
| | Propeller Dynamic Balancing | Flight Line (50%) | 1,500 | 1 | 40 | 15 |
| | | High-Power Area (50%) | 1,500 | 1 | 40 | 15 |
| | Out-of-phase Turn | Flight Line | 250 (Low Idle) | 4 | 42 | 30 |
| | | | 450 (Normal Idle) | 4 | 42 | 10 |
| | | | 1,000 | 4 | 42 | 10 |
| | High Power | Red Label Delta | 1,500 | 2 (2 idling) | 50 | 15 |
| | | | 2,750 | 2 (2 idling) | 50 | 15 |
| | | | 4,300 | 2 (2 idling) | 50 | 10 |
| | High Power | Red Label Delta | 1,500 | 2 (2 idling) | 50 | 15 |
| | | | 2,750 | 2 (2 idling) | 50 | 15 |
| | | | 4,300 | 2 (2 idling) | 50 | 10 |

| Test Cell | Maintenance Operation | Location | Engine Power Setting | No. of Engines in Use | Operations Per year | Time-In-Mode per Engine (Min.) |
|---|---|---|---|---|---|---|
| J52-P-408A (EA-6B) | Engine Test Cell | In Building 2525 and adjacent to Building 2765 | Ground Idle (56% N2) | 1 | 174 | 25 |
| | | | 76% N2 | 1 | 174 | 10 |
| | | | 90% N2 | 1 | 174 | 10 |
| | | | 97% N2 | 1 | 174 | 10 |
| | | | 100% N2 | 1 | 174 | 5 |

**Source:**
Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington,* 2004.

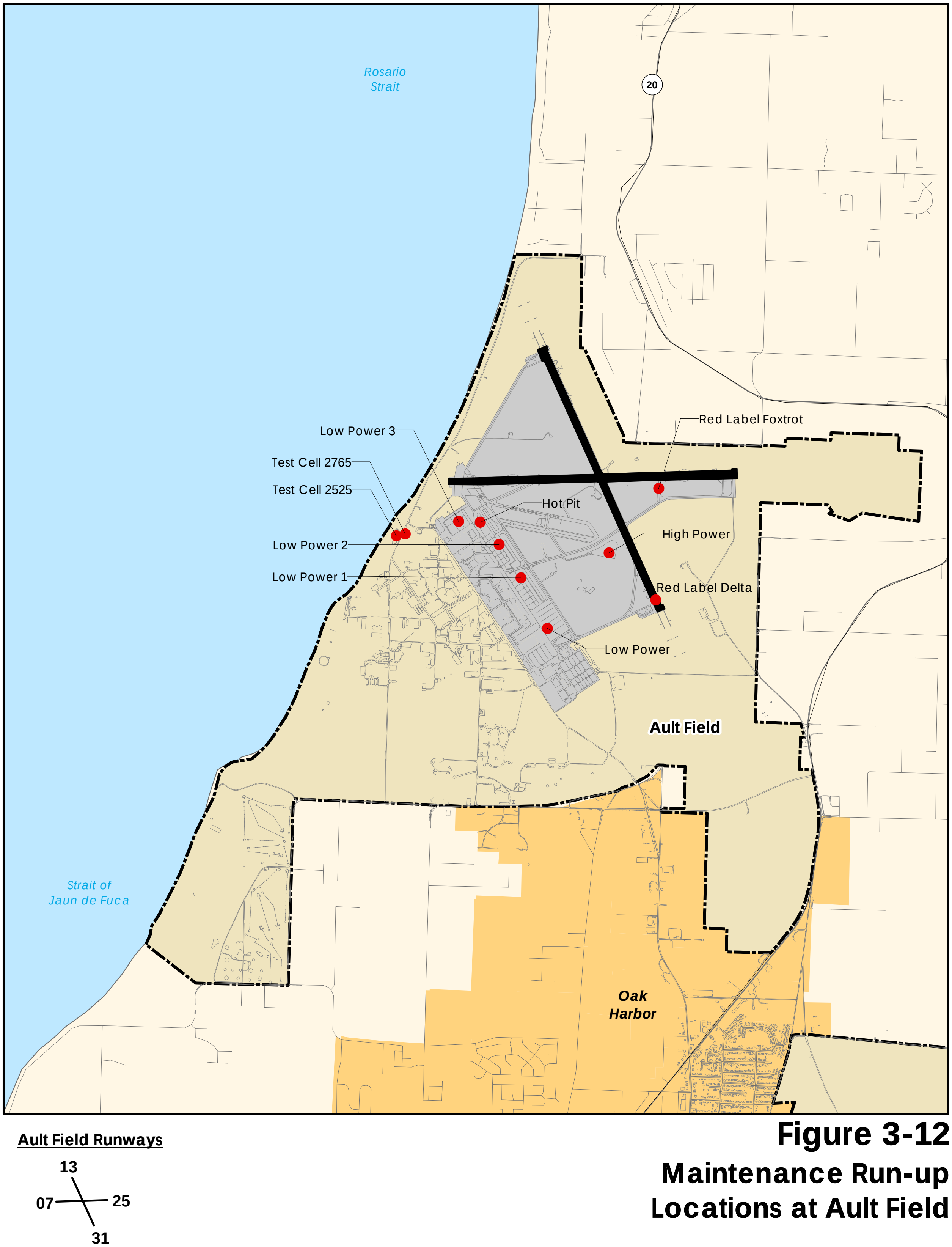
### Table 3-6 Modeled Maintenance Run-up Operations at Ault Field for CY13

| Aircraft Type | Maintenance Operation | Engine Mode | Engine Power Setting (N1) | No. of Engines in Use | Operations Per year | Time-In-Mode per Engine (Min.) |
|---|---|---|---|---|---|---|
| EA-18G | Water Wash | Main Engine Run | Ground Idle | 1 | 57 | 10 |
| | Low Power - 2 Engines | Main Engine Run | Ground Idle | 2 | 701 | 15 |
| | | | 80% | 2 | 701 | 15 |
| | High Power | Main Engine Run | Ground Idle | 2 | 34 | 10 |
| | | | 80% | 2 | 34 | 10 |
| | | | 90% | 2 | 34 | 10 |
| | | | MIL 96% | 2 | 34 | 10 |
| | | | AB 97% | 2 | 34 | 3 |

| Aircraft Type | Maintenance Operation | Location | Engine Power Setting (ESHP) | No. of Engines in Use | Operations Per year | Time per Operation Type (Min.) |
|---|---|---|---|---|---|---|
| P-3 | Low Power | Flight Line | 1,000 | 1 | 520 | 15 |
| | Propeller Dynamic Balancing | Flight Line (50%) | 1,500 | 1 | 40 | 15 |
| | | High-Power Area (50%) | 1,500 | 1 | 40 | 15 |
| | Out-of-phase Turn | Flight Line | 250 (Low Idle) | 4 | 42 | 30 |
| | | | 450 (Normal Idle) | 4 | 42 | 10 |
| | | | 1,000 | 4 | 42 | 10 |
| | High Power | Red Label Delta | 1,500 | 2 (2 idling) | 50 | 15 |
| | | | 2,750 | 2 (2 idling) | 50 | 15 |
| | | | 4,300 | 2 (2 idling) | 50 | 10 |
| | High Power | Red Label Delta | 1,500 | 2 (2 idling) | 50 | 15 |
| | | | 2,750 | 2 (2 idling) | 50 | 15 |
| | | | 4,300 | 2 (2 idling) | 50 | 10 |

| Test Cell | Maintenance Operation | Location | Engine Power Setting | No. of Engines in Use | Operations Per year | Time-In-Mode per Engine (Min.) |
|---|---|---|---|---|---|---|
| F414-GE-400 (EA-18G) | Engine Test Cell | In Building 2525 and adjacent to Building 2765 | Ground Idle (56% N2) | 1 | 71 | 9 |
| | | | 80% N2 | 1 | 71 | 51 |
| | | | 97% N2 (A/B) | 1 | 71 | 3 |

**Source:**
Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington,* 2004.




# Figure 3-12
## Maintenance Run-up Locations at Ault Field

Sources:
NAS Whidbey Island GIS, 2004
Island County GIS, 2004
Wyle Laboratories, 2004

## 4.0 Noise

This section provides background discussion on sound; noise environmental sound descriptors; noise metrics; noise analysis; and the noise associated with aircraft operations, including that generated by in-flight operations and maintenance run-up operations at Ault Field and flight operations at OLF Coupeville.

## 4.1 Aircraft Sound Sources

The main sources of sound at air installations are generally related to in-flight operations, pre-flight and maintenance run-up operations. Computer models are used to develop noise contours for land use planning purposes based on information about these operations, based upon the following factors:

- Type of operation (e.g. arrival, departure, pattern)
- Number of operations per day
- Time of operation
- Flight track
- Aircraft power settings, speeds, and altitudes
- Number and duration of maintenance run-ups
- Environmental data (temperature and humidity)
- Topographical features of the area

## 4.2 What Is Noise?

Noise is unwanted sound. Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the ear. Whether that sound is interpreted as pleasant (e.g., music) or unpleasant (e.g., jackhammers) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound.

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

Aircraft noise is of concern to many in communities surrounding airports. The impact of aircraft noise is also a factor in the planning of future land use near air facilities. Because the noise from these operations impacts surrounding land use, the Navy has defined certain noise zones and provided associated recommendations regarding compatible land use in the AICUZ Program.

## 4.3 Characteristics of Sound

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 vibrations and is expressed in terms of sound pressure. The higher the sound pressure, the more energy carried by the sound and the louder the perception of that sound. Frequency is the number of times per second the air vibrates or oscillates. Low-frequency sounds are characterized as rumbles or roars, while sirens or screeches typify high-frequency sounds. Duration is the length of time the sound can be detected.

A logarithmic unit known as decibel (dB) is used to represent the intensity of sound. Such a representation is called a sound level. A sound level of 10 dB is approximately the threshold of human hearing and is barely audible under extremely quiet conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort and above 140 dB as pain. See Figure 4-1.

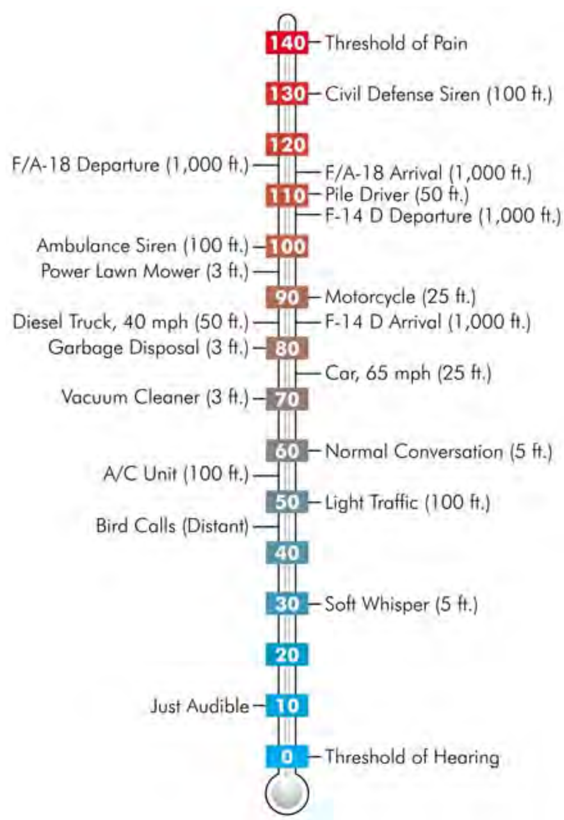
Because of the logarithmic nature of the decibel unit, sound levels cannot be arithmetically added or subtracted. Therefore, the total sound level produced by two sounds of different levels is usually slightly higher than the higher of the two. If two sounds of equal intensity are added, the sound level increases by 3 dB. For example

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

$$60 \text{ dB} + 60 \text{ dB} = 63 \text{ dB}.$$

A change of 3 dB is the smallest change detected by the average human ear. An increase of about 10 dB is usually perceived as a doubling of loudness. This applies to sounds of all volumes. Figure 4-1 provides some examples of sound levels of typical noise sources and noise environments.

**Figure 4-1 Sound Levels of Typical Sources and Environments**




A small change in dB will not generally be noticeable. As the change in dB increases, the individual perception is greater, as shown in Table 4-1.

**Table 4-1 Subjective Responses to Changes in A-weighted Decibels (dBA)**

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

**Source:**
Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington*, 2004.

### 4.3.1 Environmental Sound Descriptor

The sound environment around an air installation is typically described using a measure of cumulative exposure that results from all aircraft operations. The DOD-specified metric used to account for this is DNL. A more detailed description of DNL follows:

- In general, DNL can be thought of as an accumulation of all of the sound produced by individual events that occur throughout a 24-hour period. The sound of each event is accounted for by an integration of the changing sound level over time. These integrated sound levels for individual events are called SELs. The logarithmic accumulation of the SELs from all operations during a 24-hour period determines the DNL for the day at that location.
- DNL also takes into account the time of day the events occur. The measure recognizes that events during the nighttime hours may be more intrusive, and therefore more annoying, than the same events during daytime hours, when background sound levels are higher. To account for this additional annoyance, a penalty of 10 dB is added to each event that takes place during "acoustic" nighttime hours, defined as 2200 to 0700 the next day.
- DNL values around an air installation are presented not just for a single specific 24-hour period, but rather for an annual average day.[1]

DNL averaging is done to obtain a stable representation of the noise environment free of variations in day-to-day operations or between weekdays and weekends as well as from fluctuations in wind directions, runway use, temperature, aircraft performance, and total airfield operations (any one of which can significantly influence noise exposure levels from one day to the next).

### 4.3.2 Individual Response to Sound Levels

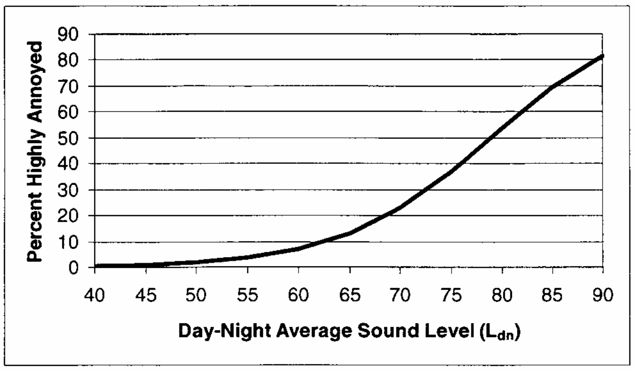
Individual response to sound levels is influenced by many factors, including the following:

- Activity the individual is engaged in at the time of the event
- General sensitivity to sound
- Time of day
- Length of time an individual is exposed to a sound
- Predictability of sound
- Average temperature/Inversions/Other weather phenomena

[1] The average annual day takes the total number of operations per year and divides it by 365.

Various scientific studies and social surveys have found a high correlation between the percentages of groups of people in communities highly annoyed and the level of average sound exposure measured in DNL. This correlation is depicted using a curve shown in Figure 4-2. Originally developed in the 1970s, the curve has been updated over the past 10 years; it remains the best available method to estimate community response to aircraft sound levels.

**Figure 4-2 Influences of Sound Levels on Annoyance**




**Source:**
Shultz 1978 as taken from Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington,* 2004.

For more information on sound and noise, see Appendix B.

## 4.4 Noise Complaints and Noise Abatement Procedures

### 4.4.1 Noise Complaints at NAS Whidbey Island

NAS Whidbey Island has implemented a policy for handling noise complaints and other flight-related disturbances at Ault Field and OLF Coupeville, as well as for those that may occur at the numerous ranges and airspace used for training[2]. The policy is designed to enable air station personnel to log noise complaints, analyze complaint locations and times, and identify the flights/operations that generated the complaints.

Persons with noise complaints or who experience other flight-related disturbances call a complaint hotline at (360) 257-2681. Once a call is received, it is taken by the Operations Duty Officer (ODO) gathers information from the caller as outlined in a telephone complaint form. The ODO records pertinent information such as the location, time, and description of the noise-generating event, as well as the address and contact information for the caller.

After speaking with the caller, the ODO may follow up by contacting ATC, OLF Coupeville, Range Scheduling, AIMD, or other activities/tenants as appropriate to compile information as to what may have generated the noise complaint.

[2] NAS Whidbey Island, *NAS Whidbey Instruction (NASWHIDBEYINST) 3710.10A Handling of Noise Complaints and Other Flight-related Disturbances*, February 23, 2000.

The ODO provides copies of any previous day's complaints to several persons, including the Commanding Officer, Executive Officer, Operations Officer, and Community Plans and Liaison Officer (CP&LO) the following day. These persons may, when necessary, initiate an informal inquiry into the allegations of any complainant to determine the validity of those allegations. This inquiry may involve a follow-up call to the complainant. The CP&LO maintains a file of noise complaints. Table 4-2 lists the number of complaints on record from 1999 through 2003 at NAS Whidbey Island. See Figure 4-3 for a representation of the location of recent noise complaints.

**Table 4-2 Noise Complaints for NAS Whidbey Island**

| Year | Number of Complaints per Year |
|---|---|
| **1999** | 302 |
| **2000** | 244 |
| **2001** | 108 |
| **2002** | 85 |
| **2003** | 126 |

**Source**
NAS Whidbey Island, *Noise Complaints Log*, 2000-2004.

### 4.4.2 Noise Abatement at NAS Whidbey Island

Numerous noise abatement procedures are contained in the current air operations manual (*NASWHIDBEYINST 3710.7S*, August 14, 2002 et seq.).

> "It is Commanding Officer, NAS Whidbey Island policy to conduct required training and operational flights with a minimum impact on surrounding communities. All aircrew using Ault Field, OLF Coupeville, Admiralty Bay Mining Range, Boardman Target and the myriad of northwest instrument and visual military training routes (IR/VR), are responsible for the safe conduct of their mission while complying with published course rules, noise abatement procedures, and good common sense. Each aircrew must be familiar with the noise profiles of their aircraft and must be committed to minimizing noise impacts without compromising operational and safety requirements."

See *NASWHIDBEYINST 3710.7S* for noise abatements procedures.

## 4.5 Noise Metrics

As used in environmental noise analyses, a metric refers to the unit or quantity that measures the effect of noise on the environment. The metric for the noise environment on and in the vicinity of airbases is normally described in terms of the time-average sound level generated by the aircraft operating at the facility. The federal noise metric used for this purpose is the Day-Night Average Sound Level (DNL), which is defined in units of dB. DNL has been determined to be a reliable measure of community sensitivity to noise and has become the standard metric used in the United States to quantify noise in aircraft noise studies and associated compatible land use and zoning analysis.

The average of sound over a 24-hour period does not ignore the louder single events. When sound levels of two or more sources are added, the source with the lower sound level is dominated by the source with the higher sound level. The combined sound level is usually only slightly higher than the sound level produced by the louder source.

Aircraft noise is expressed in terms of A-weighted sound levels. A-weighting is a method of adjusting the frequency content of a sound event to closely resemble the way the average human ear responds to aircraft sound. The A-weighting scale is therefore considered to provide a good indication of the impact of noise produced by aircraft operations.

Noise exposure is measured using the DNL. The symbol Ldn is generally used as the descriptor for day-night average sound level in mathematical equations, although the descriptors Ldn and DNL are often used interchangeably. DNL is used throughout this report.

Noise levels of the loudest aircraft operations significantly influence the 24-hour average. For example, if one daytime aircraft overflight measuring 100 dBA for 30 seconds occurs within a 24-hour period in a 50-dBA noise environment, the DNL will be 65.5. If ten such 30-second aircraft overflights occur in daytime hours in the 24-hour period, the DNL will be 75.4. Therefore, a few maximum sound events occurring during a 24-hour period will have a strong influence on the 24-hour DNL even though lower sound levels from other aircraft between these flights could account for the majority of the flight activity.

The accumulation of noise computed in this manner provides a quantitative tool for comparing overall noise environments and use in developing compatible land use plans and zoning regulations in the airfields' environs. The DNLs are represented as contours connecting points of equal value, usually in 5-dB increments from 60 or 65 dB up to 75 or 80 dB on the contour values.

However, individuals do not "hear" DNL. The DNL contours are intended for land use planning, not to describe what someone hears when a single event occurs.

Individual or single noise events are described in terms of the Sound Exposure Level (SEL) in units of dB. SEL takes into account the amplitude of a sound and the length of time during which each noise event occurs. It thus provides a direct comparison of the relative intrusiveness among single noise events of different intensities and durations of aircraft overflights.

Table 4-3 lists SEL values that indicate what a person on the ground would hear when an aircraft is flying overhead at representative distances from an aircraft.

### Table 4-3 Representative SEL Values for Aircraft

| Comparison of Representative SEL Values for Downwind Leg Segment of FCLP Pattern | | |
|---|---|---|
| **Aircraft** | **Altitude (feet AGL)** | **SEL (dBA)** |
| F/A-18 C/D | 600 | 111 |
| | 800 | 109 |
| | 1,000 | 108 |
| EA-18G | 600 | 117 |
| | 800 | 115 |
| | 1,000 | 113 |
| EA-6B | 600 | 121 |
| | 800 | 119 |
| | 1,000 | 117 |

| Comparison of Representative SEL Values for Take-off and Approach Referenced to 1,000 FT | | |
|---|---|---|
| **Aircraft** | **Operation Type** | **SEL (dBA)** |
| F/A-18 C/D | Departure | 117 |
| | Approach | 109 |
| EA-18G | Departure | 117 |
| | Approach | 114 |
| EA-6 B | Departure | 114 |
| | Approach | 107 |

**Source:**
Wyle Laboratories personal communication to the Onyx Group, January 2004.

**Notes:**
SEL generated for representative airspeed and power settings. Sound Exposure Level (SEL), above ground level (AGL), compressor speed (NC), revolutions per minute (RPM)

## 4.6 Noise Contours at Ault Field and OLF Coupeville

At a minimum, DOD requires that contours be plotted for DNL values of 65, 70, 75, and 80 in AICUZ studies. Recently, contours of 60 DNL are also depicted to account for potential noise impacts in areas of low ambient noise levels. Three general noise exposure zones are defined in the AICUZ program: areas with a DNL of less than 65; areas with a DNL between 65 and 75; and areas with a DNL of 75 or greater. These three areas are defined as Noise Zones 1, 2, and 3, respectively.

### 4.6.1 Methodology

The Navy periodically conducts noise studies to assess the noise impacts of aircraft operations. As with updates to AICUZ studies, the need to conduct a noise study is generally prompted by a change in aircraft operations—either by the number of operations conducted at the airfield, the number and type of aircraft using the airfield, or the flight paths used for airfield departure/arrival changes. A noise study is also normally conducted as a part of an update of an AICUZ study.

The transition from the EA-6B to the EA-18G was the driver behind the latest noise study, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington,* 2004. The noise contour data presented for CY03 and CY13 comes from this noise study.

The Navy uses NOISEMAP (Version 7.2), a widely accepted computer model that projects noise impacts around military airfields, to generate noise contour data. NOISEMAP calculates DNL contours resulting from aircraft operations using such variables as power settings, aircraft model and type, maximum sound levels, and duration and flight profiles for a given airfield.

The flight tracks, as well as pre-flight and maintenance run-up operations, establish the shape of the noise contours. In general, approaches and departures cause the narrow tapering of portions of the contours aligned with the runways, while touch and go and FCLP operations determine the general contour size. Noise from pre-flight and maintenance run-up operation locations, if not overshadowed by flight operations, causes generally circular arcs.

### 4.6.2 CY03 Noise Contours

The noise contours associated with CY03 operations are shown in Figure 4-3. Table 4-4 shows the population numbers, housing units, and area in acres within the 60 to 85+ dB DNL contours at 5 dB increments[3]. Ault Field, OLF Coupeville, and the Seaplane Base installation properties and bodies of water are not included in the acreage, population and housing impact calculations.

**Table 4-4 CY03 Noise Exposure at Ault Field and OLF Coupeville**

| DNL (dB) | Population | Housing Units | Area (Acres) |
|---|---|---|---|
| **Ault Field** | | | |
| 60 dB to less than 65 dB | 15,720 | 7,320 | 31,228 |
| 65 dB to less than 70 dB | 5,715 | 2,560 | 6,085 |
| 70 dB to less than 75 dB | 3,612 | 1,477 | 3,992 |
| 75 dB to less than 80 dB | 2,674 | 1,120 | 5,354 |
| 80 dB to less than 85 dB | 289 | 145 | 926 |
| 85 dB + | 52 | 21 | 157 |
| **Totals** | **28,062** | **12,643** | **47,742** |
| **OLF Coupeville** | | | |
| 60 dB to less than 65 dB | 1,372 | 686 | 2,441 |
| 65 dB to less than 70 dB | 1,211 | 626 | 4,731 |
| 70 dB to less than 75 dB | 772 | 385 | 2,695 |
| 75 dB to less than 80 dB | 385 | 185 | 1,091 |
| 80 dB to less than 85 dB | 19 | 9 | 181 |
| 85 dB + | 3 | 1 | 25 |
| **Totals** | **3,762** | **1,892** | **11,164** |

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**Source:**
Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington,* 2004.

**Notes:**
The acreage calculations included in the table exclude NAS Whidbey Island, OLF Coupeville and bodies of water.

[3] The population data used for all tables in this section were obtained from the U.S. Census Bureau 2000 Census. Census block groups surrounding Ault Field and OLF Coupeville were extracted from the most recent Topographically Integrated Geographic Encoding and Referencing (TIGER) files, while demographic data were extracted from the Summary Tape File 1A (STF1A). The total area outside the boundaries of Ault Field, OLF Coupeville, and the Seaplane Base and the number of residents and houses within each contour band were then calculated for comparison purposes. Populations calculated with U.S. Census data are estimates and are most useful in determining relative change in population impact between different noise contours. .

### 4.6.3 CY13 Noise Contours

The noise contours associated with projected CY13 operations are shown in Figure 4-4. Table 4-5 shows the population numbers, housing units, and area in acres within the 60 to 85+ dB DNL contours at 5 dB increments for Ault Field and OLF Coupeville.[4]

The decrease in CY13 DNL contours versus those of CY03 is primarily attributed to the better performance of the EA-18G compared to the EA-6B. For example, the E/A-18G climb-out rate is much faster that that of the EA-6B. A better climb rate generally results in an aircraft spending less time at lower altitudes and a lower resulting noise exposure as the aircraft's elevation rises farther away from the airfield.

**Table 4-5 CY13 Noise Exposure at Ault Field and OLF Coupeville**

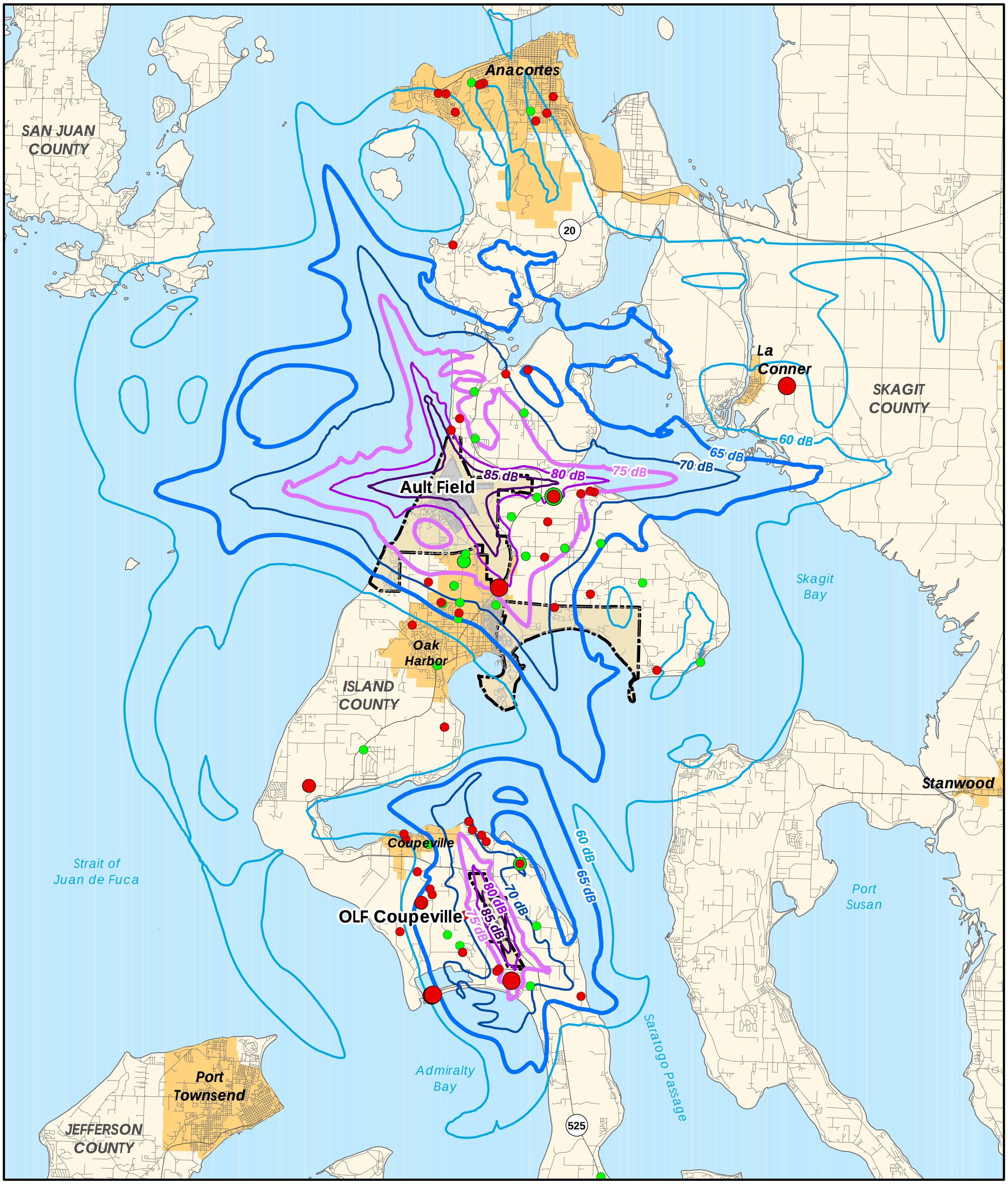
| DNL (dB) | Population | Housing Units | Area (Acres) |
|---|---|---|---|
| **Ault Field** | | | |
| 60 dB to less than 65 dB | 3,965 | 1,659 | 4,441 |
| 65 dB to less than 70 dB | 2,982 | 1,271 | 2,723 |
| 70 dB to less than 75 dB | 2,654 | 1,098 | 4,084 |
| 75 dB to less than 80 dB | 2,080 | 894 | 4,505 |
| 80 dB to less than 85 dB | 141 | 64 | 539 |
| 85 dB + | 27 | 11 | 120 |
| **Totals** | **11,849** | **4,997** | **16,412** |
| **OLF Coupeville** | | | |
| 60 dB to less than 65 dB | 480 | 273 | 1,545 |
| 65 dB to less than 70 dB | 1,196 | 609 | 4,742 |
| 70 dB to less than 75 dB | 589 | 291 | 2,690 |
| 75 dB to less than 80 dB | 224 | 106 | 497 |
| 80 dB to less than 85 dB | 4 | 2 | 38 |
| 85 dB + | 0 | 0 | 1 |
| **Totals** | **2,493** | **1,281** | **9,513** |

**Source:**
Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington,* 2004.
**Notes:**
The acreage calculations included in the table exclude NAS Whidbey Island, OLF Coupeville and bodies of water.

### 4.6.4 1986 AICUZ Noise Contours

The noise contours used in the *1986 AICUZ Study Update for NAS Whidbey Island's Ault Field and OLF Coupeville* are shown in Figure 4-5.

[4] The population data used for all tables in this section were obtained from the U.S. Census Bureau 2000 Census. Census block groups surrounding Ault Field and OLF Coupeville were extracted from the most recent Topographically Integrated Geographic Encoding and Referencing (TIGER) files, while demographic data were extracted from the Summary Tape File 1A (STF1A). The total area outside the boundaries of Ault Field, OLF Coupeville, and the Seaplane Base and the number of residents and houses within each contour band were then calculated for comparison purposes. Populations calculated with U.S. Census data are estimates and are most useful in determining relative change in population impact between different noise contours.




**DNL Noise Contours**

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

**Noise Complaints**

| 2003 | 2002 |
| --- | --- |
| 1 - 2 | 1 - 2 |
| 3 - 4 | 3 - 4 |
| 5 - 10 | 5 - 10 |

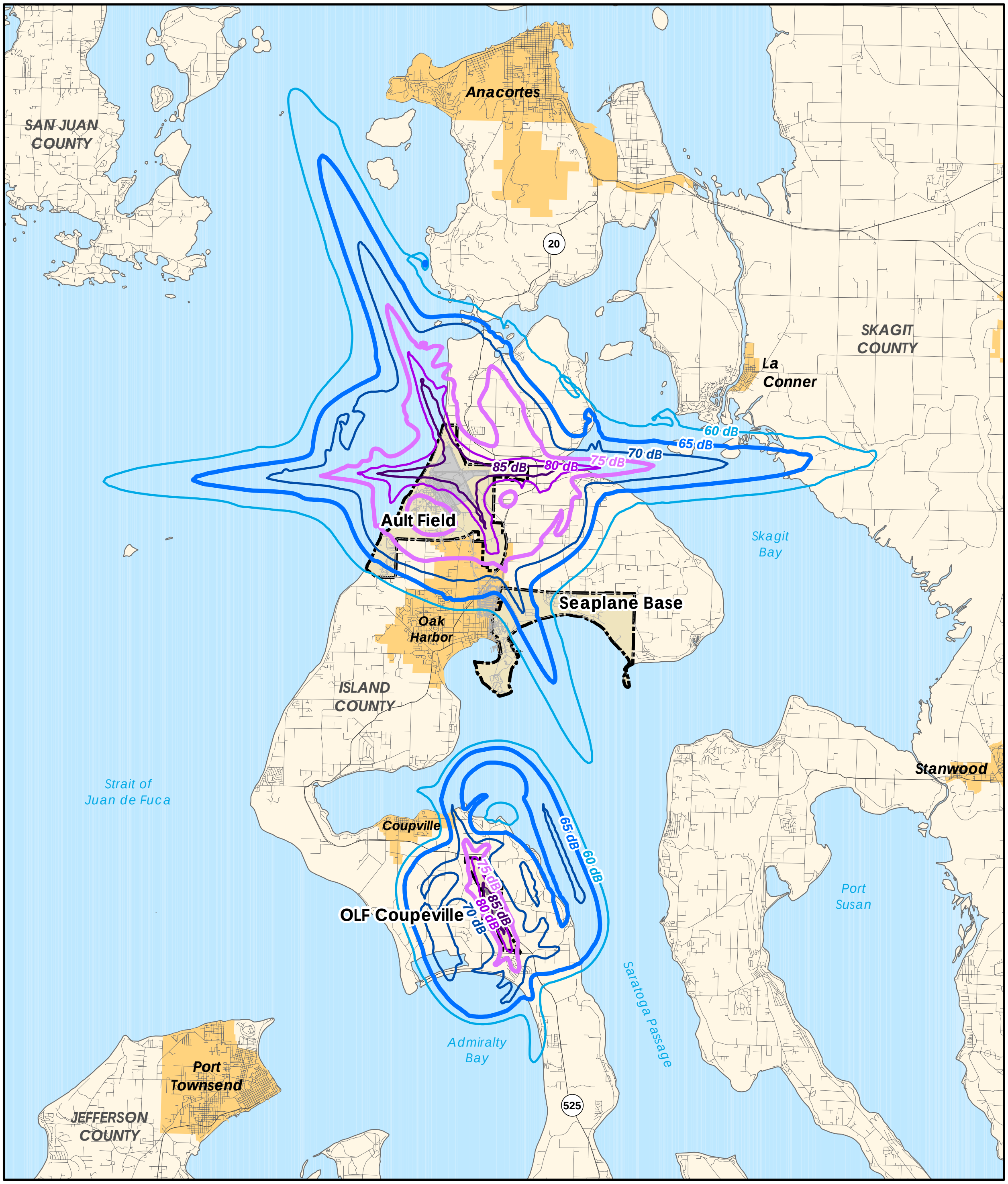
(Calls Per Address)

## Figure 4-3
## CY03 Noise Contours

TRUE NORTH
MAGNETIC NORTH
Magnetic Declination
19°

0 1 2 3
Miles

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
The Onyx Group, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004

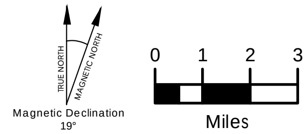


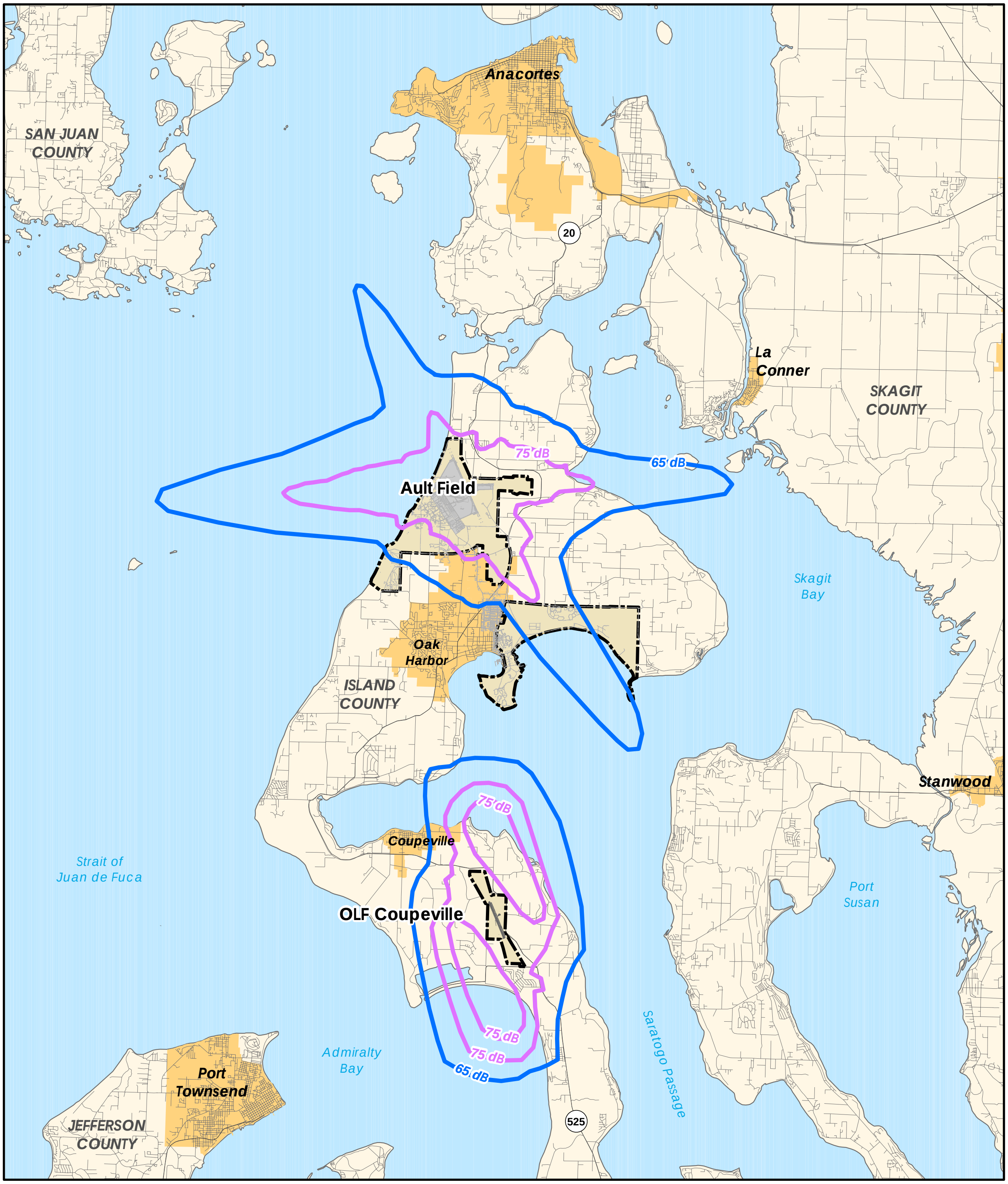

# Figure 4-4
## CY13 Noise Contours

**DNL Noise Contours**

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

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004






**DNL Noise Contours**

65 dB

75 dB

# Figure 4-5
## 1986 AICUZ Noise Contours

TRUE NORTH
MAGNETIC NORTH
Magnetic Declination
19°

0 0.9 1.8 2.7
Miles

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
The Onyx Group, 2004
U.S. Census TIGER Files, 2004
Wyle Laboratories, 2004
AICUZ for NAS Whidbey Island, 1986

# 5.0 Safety

The Navy has created airfield planning tools to assist its facility planners and the local community in creating a safe environment on and around Naval air installations. These tools include imaginary surfaces and accident potential zones (APZs). The tools help identify and aid in the elimination of objects that potentially obstruct or interfere with aircraft arrivals, departure, and flight patterns. The tools also help identify incompatible land uses and promote compatible land uses surrounding air installations.

*Aviation boatswain's mates practice extinguishing a fire on the Mobile Aircraft Firefighter Training Device (MAFTD) at NAS Whidbey Island. Though aircraft mishaps are rare, this section details airfield planning tools that the Navy and community can use to help create a safe environment on and around Ault Field and OLF Coupeville.*

This section details Ault Field and OLF Coupeville CY03 and CY13 APZs, as well as prevention of other obstructions that can cause aircraft mishaps or impact operations. For the safety of the aviators and to protect persons on the ground, the height of objects and vegetation should be restricted. Imaginary surfaces that extend off runways can help to identify areas where potential airspace obstructions could occur and help with their prevention before they occur.

APZs rely on the fact that aircraft mishaps are more likely to occur on or near the runways than other areas. The Navy has identified APZ criteria around its runways and under flight tracks based on historical data showing where mishaps have occurred. Although the likelihood of an accident is remote, the Navy recommends that certain land uses that concentrate large numbers of people, such as dense residential developments and schools be not located in the APZs.

Other hazards to flight safety that are not recommended in the vicinity of the airfield include the following:

- Uses that attract birds, especially waterfowl
- Lighting (direct or reflected) that impairs pilot vision
- Uses that would generate smoke, steam, or dust
- Uses that generate electromagnetic interference with aircraft communication, navigation, and electric systems

## 5.1 Objects Affecting Navigable Airspace

Aircraft operations can be constrained by the surrounding natural terrain and manmade features such as buildings, towers, poles, and other potential vertical obstructions to navigation. FAA, *CFR Title 14, Part 77, Objects Affecting Navigable Airspace* (PART 77) outlines a notification procedure for proposed construction or alteration of objects near airports that could affect navigable airspace. NAVFAC P-80.3 (as well as PART 77) also identify a complex series of imaginary surfaces or planes used for siting facilities on and near military airfields and determining obstructions or hazards to air navigation for these airfields.

The U.S. standard for Terminal Instrument Procedures (TERPS) for airports is a joint Army, Navy, Air Force, Coast Guard, and FAA publication (OPNAVINST 3722.16C) that provides procedures to be used in analyzing the potential impact a proposed construction or alteration project may have on TERPS for an airfield and if the proposal would create an obstruction to air navigation if constructed. The early analysis of construction or alteration proposals in areas identified near airfields could identify and help preclude an air navigation obstruction before it occurs.

Island County code and their comprehensive plan recognize PART 77 and TERPS:

Island County's Communication Tower Ordinance (Adopted 29 September 1998) states that "All Communication Towers shall comply with state and local mechanical, electrical and building codes, FCC requirements, FAA requirements (including *FAR Part 77, Objects Affecting Navigable Airspace*)."

In the Island County Comprehensive Plan (General Land Use Policies, Airport and Aviation Safety Overlay, Page 148 of 181 of Policy Plan/Land Use Element), "Land use proposals, structures, or objects that would interfere with the safe operation of aircraft will be examined for compatibility as defined in CFR Title 14, FAR Part 77 and FAA Terminal Instrument Procedures (TERPS) Chapter 12, and WA 31. The object is to permit land uses which allow safe aircraft operations as defined in the documents referenced above."

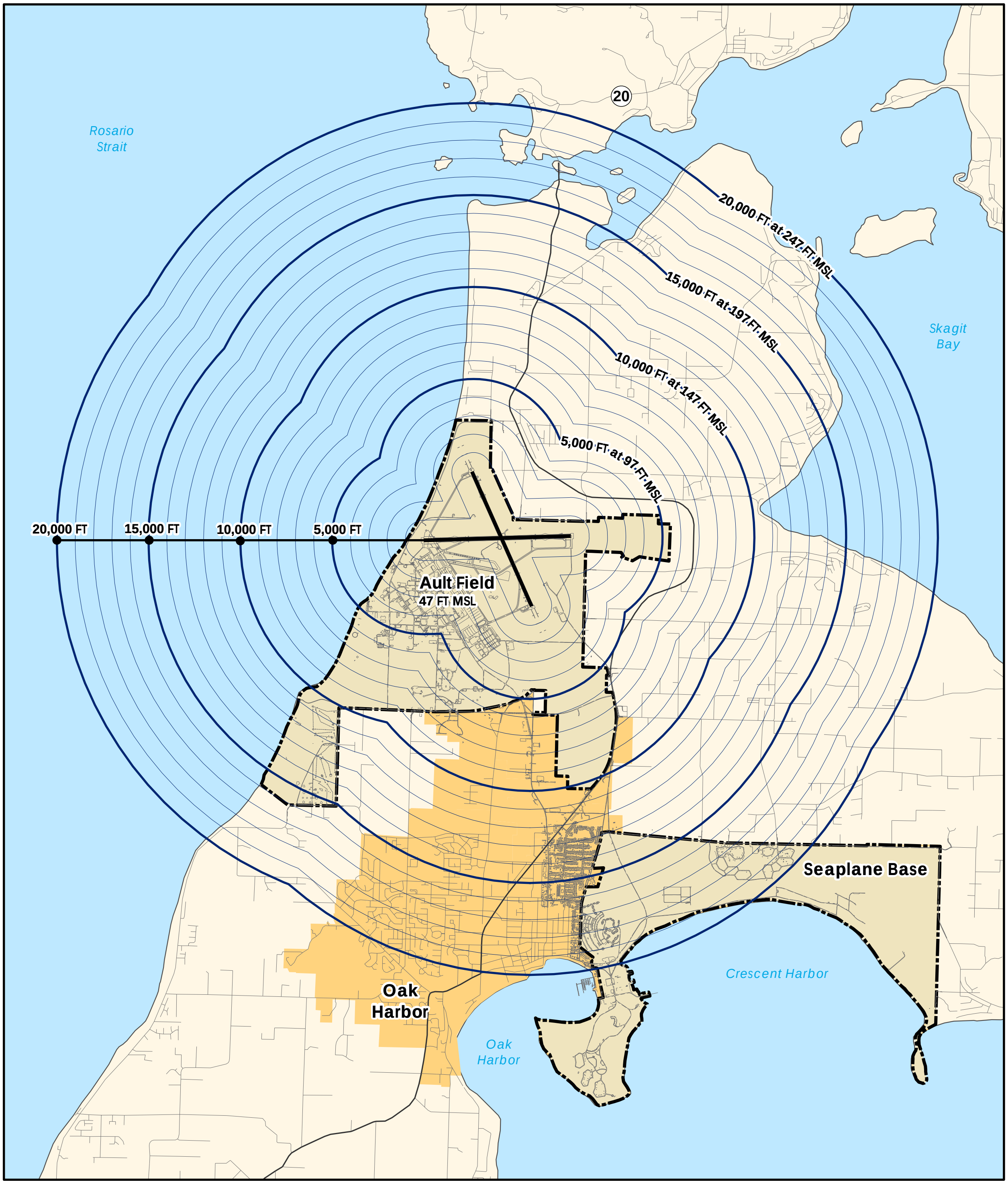
### 5.1.1 Notice of Construction or Alteration

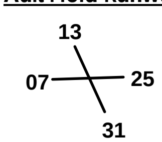
Under the provisions of PART 77, each sponsor[1] who proposes any of the following construction/alteration must notify the Administrator of the FAA prior to beginning so that its potential impact on airspace can be assessed. As part of this assessment, both obstruction standards and TERPS impacts are evaluated to determine if the project will result in an adverse impact on the airport flight procedures or create an obstruction or hazard to air navigation. Notification to FAA is required in the following areas:

1. Any construction or alteration of more than 200 feet in height above ground level (AGL) at its site.
2. Any construction or alteration of greater height than an imaginary surface extending outward and upward at a 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway.
3. Any highway, railroad, or other traverse way for mobile objects, of a height which, if adjusted upward (specific distances specified in the PART 77), and for a water way or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it, would exceed the heights outlined in subparagraphs 1 and 2 above.
4. Any construction or alteration that would be in an instrument approach area (defined in FAA standards) and available information indicates it might exceed a (imaginary surface) standard for obstructions. Paragraph 5.1.2 below outlines these standards for Ault Field and OLF Coupeville.
5. Any construction or alterations on an airport.

PART 77 also outlines formats and timing of notification. Figures 5-1 and 5-2 outline the areas involved in notification under subparagraph 2 above.

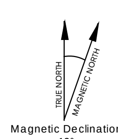
[1] PART 77 provides for certain specific exceptions to the notification generally encompassing those situations where a proposed project would be lower than a similar adjacent object (see PART 77 for specific details).



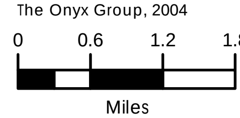




# Figure 5-1
## Areas Requiring FAA Notification of Proposed Construction or Alterations near Ault Field

Note: Above illustrates contours extending outward and upward at rate of 100 feet horizontal to 1 foot vertical for a horizontal distance of 20,000 feet from the nearest point of the runways. The contour interval shown reflects 10 feet in vertical rise for every 1,000 feet in horizontal distance away from the runways. Vertical distance ranges 200 feet from the airfield surface elevation of 47 feet MSL to 247 feet MSL. Based on FAA Part 77 guidance.




Sources:
NAS Whidbey Island GIS, 2004
Island County GIS, 2004
The Onyx Group, 2004




# Figure 5-2
## Areas Requiring FAA Notification of Proposed Construction or Alteration near OLF Coupeville

Note: Above illustrates contours extending outward and upward at rate of 100 feet horizontal to 1 foot vertical for a horizontal distance of 20,000 feet from the nearest point of the runways. The contour interval shown reflects 10 feet in vertical rise for every 1,000 feet in horizontal distance away from the runways. Vertical distance ranges 200 feet from the airfield surface elevation of 199 feet MSL to 399 feet MSL. Based on FAA Part 77 guidance.

Sources:
NAS Whidbey Island GIS, 2004
Island County GIS, 2004
The Onyx Group, 2004

### 5.1.2 Obstruction Standards

Subpart C of PART 77 and NAVFAC P-80.3 establish standards for determining obstructions to air navigation commonly referred to as imaginary surfaces. Before the imaginary surfaces can be determined, the classes of runways are determined. DOD fixed-wing runways are separated into two classes for the purpose of defining imaginary surfaces and APZs: Class A and Class B runways. Class A runways are used primarily by light aircraft and do not have the potential for intensive use by heavy or high-performance aircraft. Class B runways are used by all other fixed-wing aircraft. All runways at NAS Whidbey Island are Class B runways.

- Ault Field has two Class B runways: 07/25 and 13/31.
- OLF Coupeville has one Class B runway: 14/32.

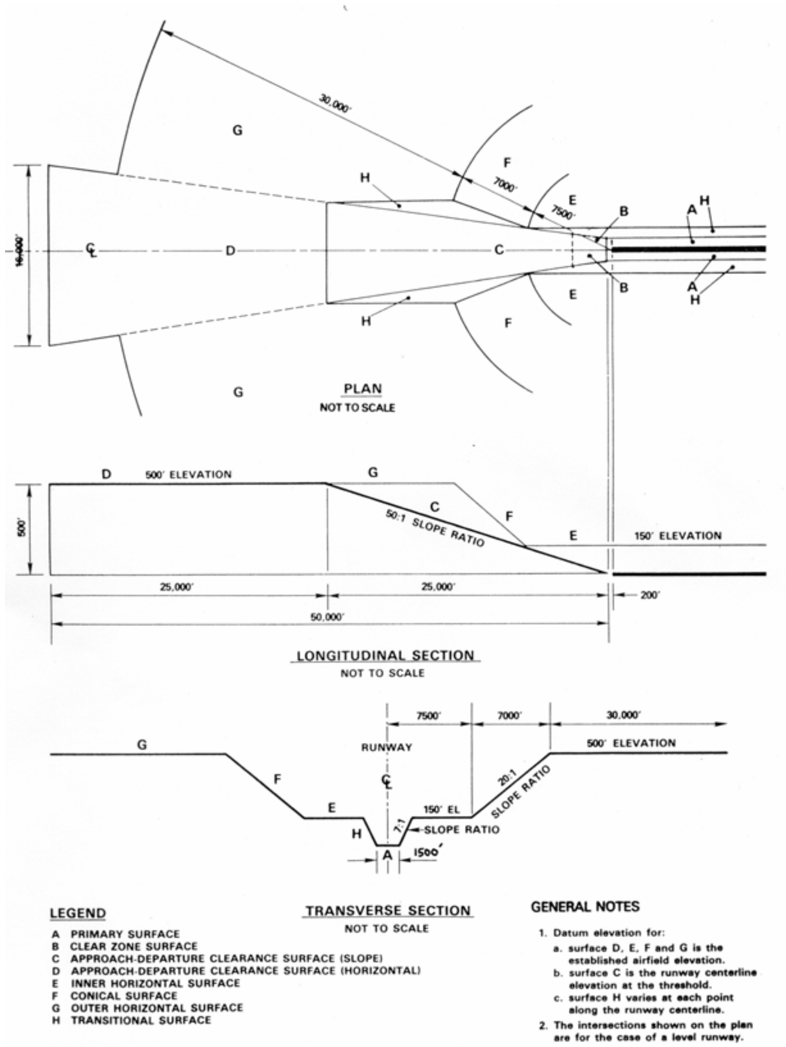
Per the P-80.3, for Class B runways, specific criteria are provided for the implementation of the following:

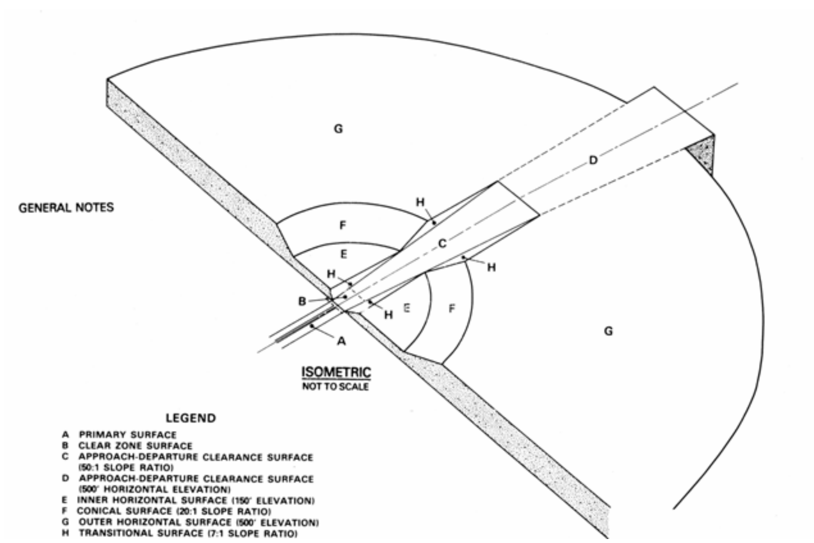
- The *Primary Surface* is a surface on the ground or water centered lengthwise on the runway and extending 200 feet beyond each end of the runway. The width is 1,500 feet per Class B runway. The Primary Surface is normally highly protected and free of all obstructions.
- The *Clear Zone* is immediately adjacent to the end of the runway and extends 3,000 feet outward along the runway centerline.
- *Approach/Departure Clearance Surfaces* extend from the primary surfaces at a 50:1 inclined plane for a Class B runway. When the surface reaches an elevation of 500 feet, the surface becomes a horizontal plane.
- *Horizontal Clearance Surfaces* include one at 150 feet above airfield elevation extending to 7,500 feet from the runway, and another at 500 feet above airfield elevation extending from 14,500 feet to 44,500 feet from the runway end.
- *Conical and other Transitional Surfaces* connect the Horizontal Clearance Surfaces to the Approach/Departure Clearance Surfaces and the Primary Surfaces.

Figure 5-3 details the geometry used to create the imaginary surfaces for Class B runways.

In general, no aboveground structures are permitted in the Primary Surface and Clear Zone areas. The height of structures should be controlled to prevent penetration of the transitional surfaces and approach departure surfaces. These restrictions limit the height of structures as the distance from the runway surface decreases. Approaching the runway surface and its corresponding flight path, more stringent height limitations are imposed. In addition, TERPS considerations and coordination as noted above also provide more stringent limitations in the areas outlined in Figures 5-1 and 5-2.

## Figure 5-3 Imaginary Surfaces for Class B Runways




**Source:**
NAVFAC P-80.3, 05 January 1982.

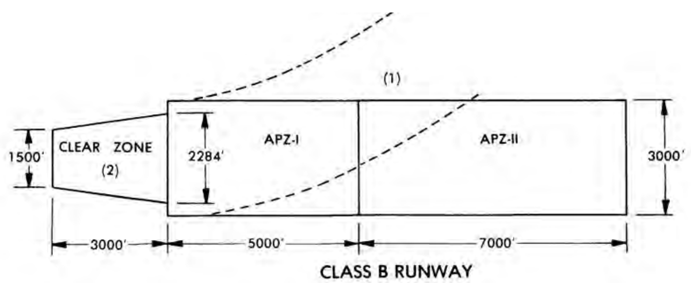
## 5.2 Accident Potential Zones

APZs are based on historical accident and operations data throughout the military and the application of margins of safety within those areas (which have been determined to be potential impact areas) if an accident were to occur. Criteria on APZs are found in OPNAVINST 11010.36B. Figure 5-4 details the geometry that is used to create APZs for the Class B runways.

The U.S. Navy recognizes three types of APZs for Class B runways: the Clear Zone, APZ I, and APZ II, defined as follows:

- *Clear Zone*—The trapezoidal area lying immediately beyond the end of the runway and outward along the extended runway centerline for a distance of 3,000 feet. For U.S. Navy and Marine Corps installations, the dimensions are 1,500 feet wide at the runway threshold and 2,284 feet wide at the outer edge. The Clear Zone is required for all active runway ends.
- *APZ I*—The rectangular area beyond the Clear Zone, which has a measurable potential for aircraft accidents relative to the Clear Zone. APZ I is provided under flight tracks that experience 5,000 or more annual operations (departures or approaches). APZ I is typically 3,000 feet wide by 5,000 feet long and may be rectangular or curved to conform to the shape of the predominant flight track.
- *APZ II*—The rectangular area beyond APZ I (or the Clear Zone if APZ I is not used), which has a measurable potential for aircraft accidents relative to APZ I or the Clear Zone. APZ II is always provided where APZ I is required. The dimensions of APZ II are typically 3,000 feet wide by 7,000 feet long, and like APZ I, may be curved to correspond with the predominant flight track.

**Figure 5-4 Fixed-Wing APZs for Class B Runways**




**Notes:**

(1) APZ I and II may be altered to conform to flight shadow.

(2) The 2284' dimension is based on criteria of using a 7°-58'-11" flare angle for the approach departure surface where the outer width of that surface was established at 15,500'. This dimension would be 2,312' where the outer width of the surface was established at 16,000'. Flare starts at 200' from end of runways and 3,000' Clear Zone length starts at runway end. See NAVFAC P-80.3 for more details.

**Source:**
OPNAVINST 11010.36B, 2002.

### 5.2.1 Fixed-Wing Runway APZs at Ault Field and OLF Coupeville for CY03 and CY13

Figures 5-5 and 5-6 depict the fixed-wing APZs for Ault Field and OLF Coupeville as generated by CY03 and CY13 operational levels. As the figures show, all runways have Clear Zones. At Ault Field, APZs I and II are also shown. At OLF Coupeville, APZs I and II are not generated by CY03 or CY13 operational levels. It is noted that small areas of the Clear Zones at OLF Coupeville extend outside Navy owned property. The land use in these areas is compatible (undeveloped), and there appears to be a low likelihood of incompatible development occurring in these areas in the future. Table 5-1 summarizes the APZs for both airfields.

### Table 5-1 Fixed-Wing Runway APZs at Ault Field and OLF Coupeville for CY03 and CY13

| APZ | Runway(s) |
|---|---|
| **Ault Field** | |
| Clear Zones | Runways 07, 13, 25, and 31 |
| Arrival APZs I and IIs | Runways 13 and 25 |
| Departure APZs I and IIs | Runways 13 and 25 |
| Pattern APZs I and IIs | Runway 13 centered on pattern 13TN2<br>Runway 25 centered on pattern 25TN2 |
| **OLF Coupeville** | |
| Clear Zones | Runways 14 and 32 |

**Note:**
Accident Potential Zone (APZ).

**Source:**
The Onyx Group, 2004.

## 5.2.2 Helicopter APZs

Helicopter APZs at Ault Field are minimal in size and are encompassed by fixed-wing APZs on the runways, they are not illustrated in Figure 5-5. However, facility planners should consider them when siting any facilities near the airfield's many landing pads. APZ guidelines for helicopters are much smaller than those for fixed-wing aircraft and are outlined in OPNAVINST 11010.36B:

## 5.2.3 Accident History

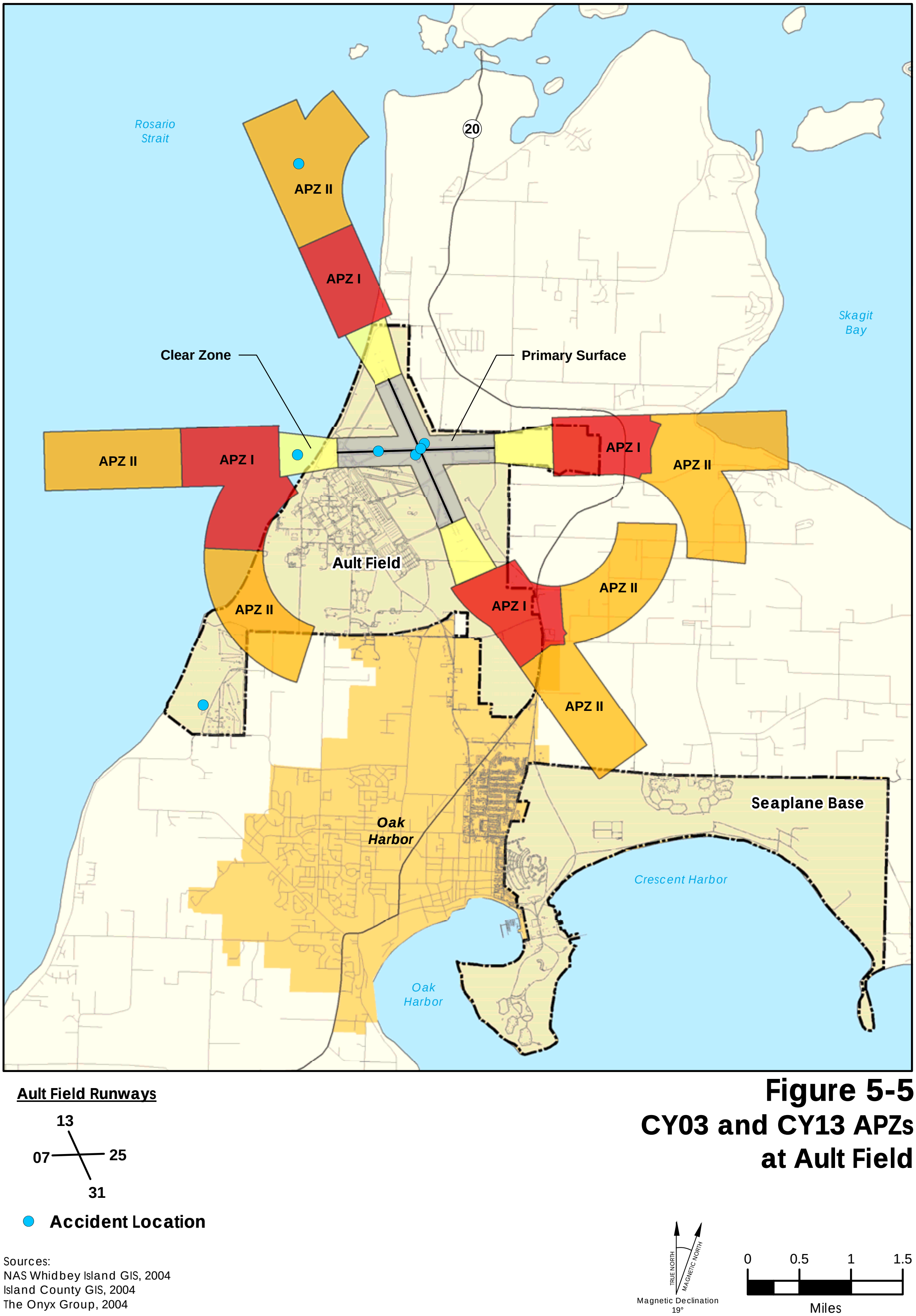
A summary of NAS Whidbey Island aircraft accidents that occurred near the airfields during flight operations is presented in Table 5-2. These accidents are also highlighted on the APZ figures. The point of impact for each of the accidents was either NAS Whidbey Island property or the waters near Ault Field, with the exception of one accident that occurred on non-Navy property just west of OLF Coupeville. None of these accidents caused any injury to civilians.

### Table 5-2 Accident History Summary, 1975-Present

| Aircraft Type | Date | Accident General Location | Type of Flight Operation |
|---|---|---|---|
| EA-6 | August 1976 | NAS Whidbey Island Golf Course | IFR departure |
| A-6 | September 1976 | Water west of Ault Field Runway 07 | Instrument operation |
| EA-6B | February 1980 | Water northwest of Ault Field Runway 13 | FCLP (approach) |
| P-3A | January 1981 | Hard landing on Ault Field runway | Landing (touchdown) |
| EA-6B | December 1982 | OLF Coupeville off government property | FCLP (break maneuver) |
| EA-6B | October 1985 | Landing on Ault Field runway | Landing (rollout) |
| A-6 | August 1989 | Ault Field runway | Practice air show flight demonstration |
| A-6 | November 1989 | Water northwest of Ault Field | Approach |
| A-6 | January 1990 | Ault Field Clear Zone | Post-maintenance flight |

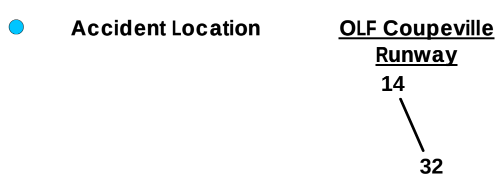
**Notes:**
Instrument Flight Rules (IFR), field carrier landing practice (FCLP)

**Source:**
*Draft Environmental Impact Statement (DEIS) for proposed air operations associated with increased training activity at Ault Field and OLF Coupeville*, August 2003.

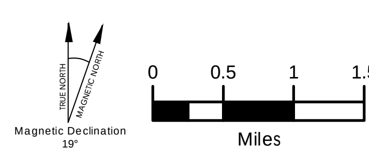



Sources:
NAS Whidbey Island GIS, 2004
Island County GIS, 2004
The Onyx Group, 2004

**Figure 5-5**
**CY03 and CY13 APZs at Ault Field**


# Figure 5-6
## CY03 and CY13 APZs at OLF Coupeville




Sources:
NAS Whidbey Island GIS, 2004
Island County GIS, 2004
The Onyx Group, 2004

### 5.2.4 CY03/CY13 and 1986 AICUZ APZ Comparison

Figure 5-7 compares the CY03 and CY13 APZs at both airfields with those from the last approved AICUZ document dated 1986[2]. As illustrated in Figure 5-7, all runways in CY03/CY13 and 1986 have both Clear Zones and Primary Surfaces. At Ault Field, differences include the inclusion of APZ I and II on the approach end to Runway 31 and APZ IIs that follow right or left turning patterns for CY13.

Clear Zones are always generated at the ends of active runways at military airfields. At OLF Coupeville, the 1986 AICUZ document also showed APZ IIs that reflected the FCLP patterns of the time. While FCLP patters will continue to exist at OLF Coupeville, numbers of operations are currently projected to fall below the current level for establishment of APZ I or II at this location and therefore are not depicted.

## 5.3 Airfield Safety Violations/Waivers

Airfield safety violations, in the form of flight obstructions, occur when any object (natural, manmade, stationary, or mobile) penetrates the imaginary surfaces, as outlined in NAVFAC P-80.3. These airfield safety violations require waivers, which are agreements that certain airfield safety violations will not be enforced due to the overriding operational needs of the station. According to NAS Whidbey Island ATC and Public Works personnel, there are no existing airfield safety violations and waivers on record at NAS Whidbey Island. To prevent any airfield safety violations and waivers in the future, all new construction must follow the established criteria in NAVFAC P-80.3.

[2] Reid, Middleton, and Associates, Inc., and Environmental Planning and Design, *NAS Whidbey Island AICUZ Update*, 1986.

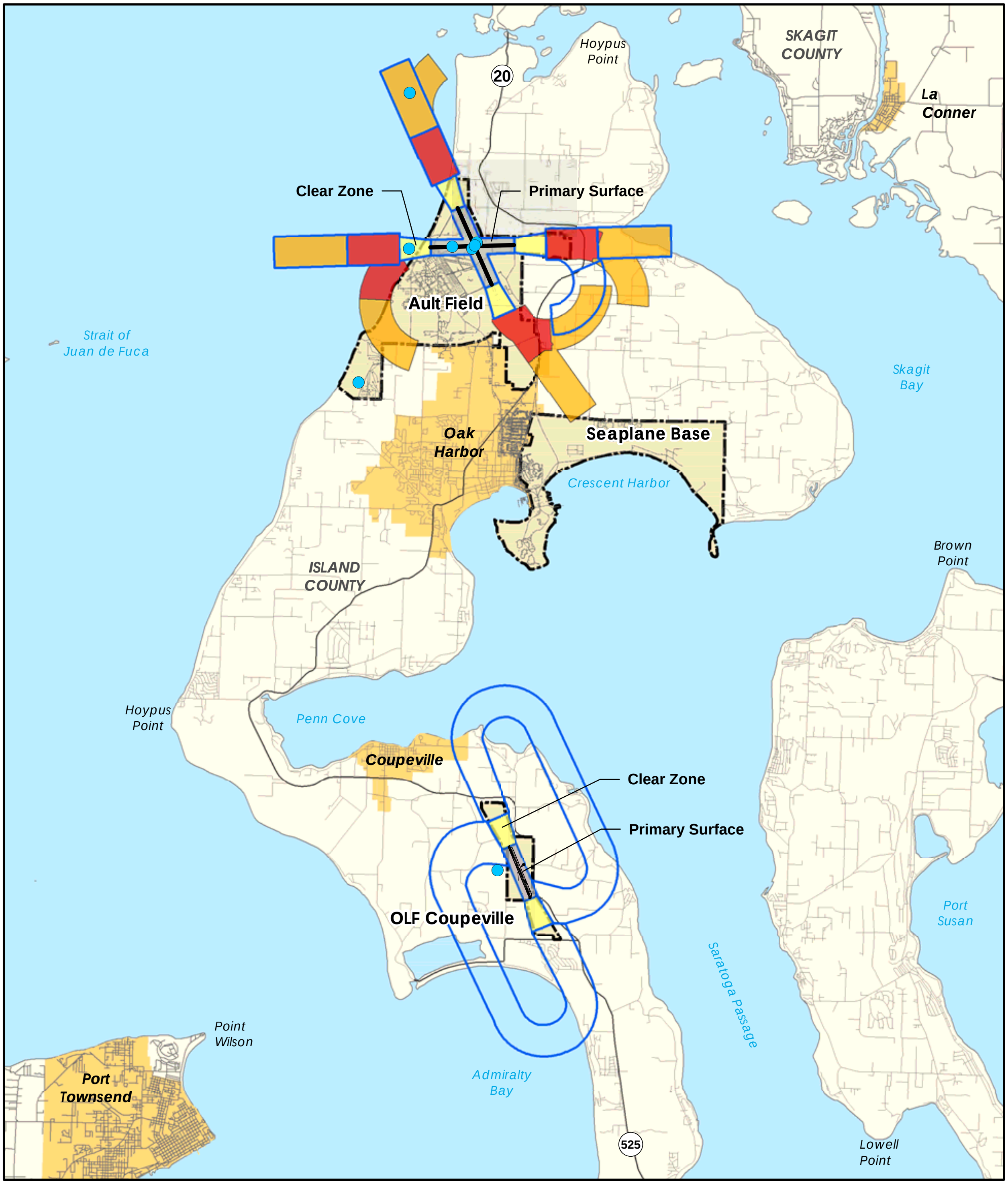
## 5.4 Electromagnetic Interference and Radiation

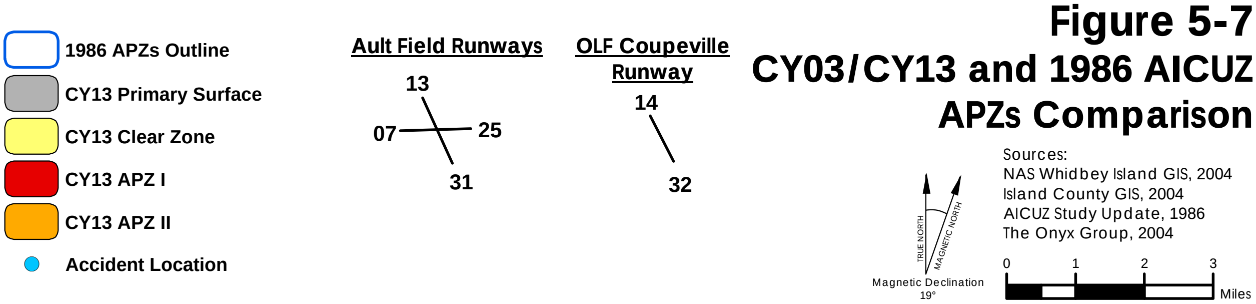
New generations of military aircraft are highly dependent on complex electronic systems to perform critical flight and mission-related functions. This dependence on digital electronics, combined with higher clock rates, power-conserving signal levels, increased use of composite materials, onboard radar, communications transmitters, and lasers, increases the susceptibility of aircraft communication, navigation, and other electrical systems to electromagnetic interference (EMI). EMI is defined by the American National Standards Institute (ANSI) as any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, such as high-tension line leakage. EMI may also be caused by atmospheric phenomena, such as lighting and precipitation static, and non-telecommunications equipment, such as vehicles and industrial machinery.

EMI may also affect aircraft weapons systems, which often include a myriad of digital electronics. Hazards of electromagnetic radiation to ordnance (HERO) are also of concern. *NASWHIDBEYINST 3710.7S*, August 14, 2002, provides guidelines related to HERO during aircraft weapons loading and unloading. Bombs, missiles, Advanced Undersea Weapons (AUWs), and aircraft service mines up to a maximum of 30,000 lbs net explosive weight may be loaded and unloaded only at the hazardous cargo/combat aircraft loading areas.

No on- or off-installation land uses create EMI/HERO for flight operations, communications among aviators and ground control personnel, or weapons loading and unloading.

Currently, two EMI issues are being investigated: occasional interference with the airfield lighting controls by an FM radio station in Canada, and an as yet unidentified source that interferes with one of the western approach frequencies between 1900 and 2200 on weekdays.




# Figure 5-7
## CY03/CY13 and 1986 AICUZ APZs Comparison

Sources:
NAS Whidbey Island GIS, 2004
Island County GIS, 2004
AICUZ Study Update, 1986
The Onyx Group, 2004

## 5.5 Lighting

Bright lights, either directed or reflected, in the vicinity of an airfield 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 to all other visual input. This is particularly dangerous at night when the flash can destroy the eye's adaptation to darkness, typically requiring 40 to 45 minutes for partial recovery. Several recent DOD pilot encounters with laser flashes from outdoor light at concerts, fairs, theme parks, and casinos have increased the awareness of this hazard. Spotlights and reflected light from glass-exterior buildings can also impair pilot vision. According to personnel at NAS Whidbey Island, there are no existing or expected major issues related to off-installation lighting in the vicinity of the airfields. This is due in part to the rural island environment and Island County sign and lighting code, which requires signs to be lit from above and any other lighting to be shielded so as not to produce glare up into the night sky.

*Bright lighting in the vicinity of airfield can impair a pilot's vision and impact the approaches to lit runways such as the one shown above. Island County and Oak Harbor code works to minimize such lighting by requiring that signs be lit from above, or be shielded so as not to produce glare.*

## 5.6 Smoke, Dust, and Steam

Unchecked land uses around airfields may emit smoke, fly ash, dust, steam, vapor, gases, or other forms of air emissions that can impair visibility in the vicinity of the airfield, interfere with the safe operation of aircraft, and endanger the landing, takeoff, or maneuvering of aircraft at the airfield. According to personnel at NAS Whidbey Island, there are also no major issues related to these types of air emissions at or in the vicinity of the airfields. Island County and Oak Harbor code requires entities that create fugitive dust (e.g., aggregate pits, farms, construction sites) to use best management practices to help control it. There is no heavy industry near the airfields. Significant amounts of smoke are sporadic and occur during brush pile burning on land being cleared, or at the NAS Whidbey Island Flight and Hangar Deck Fire Fighter School located at Ault Field.

## 5.7 Bird Aircraft Strike Hazards (BASH)

Wildlife represents a significant hazard to flight operations. Birds, in particular, are drawn to the open grassy areas and warm pavements of airfields. Although most bird and animal strikes do not result in crashes, they may involve extensive mechanical and structural damage to aircraft. Since 1980, Navy aviation-mishap reports show strike events have caused the death of two naval aviators, 14 crashed aircraft, 17 ejections, 36 injured aircrew, and 243 Class A, B, and C foreign object damaged (FODed) engines. These reports also indicate the top four wildlife species involved in mishap events are gulls, vultures, waterfowl, and deer. The cost to the Navy because of these mishaps is over $313 million.[3]

A seagull impacting an aircraft at 350 knots hits with a force of 32,000 foot-pounds. To help protect aviators and minimize potential damage to aircraft, NAS Whidbey Island implements bird aircraft strike hazard (BASH) guidelines for aviators. Above shows a traffic signal in NAS Whidbey Island Air Operations building used to denote different levels of hazard. The traffic signal was donated to the Navy from the City of Oak Harbor.

A large number of resident and migratory bird species can be found in the Island County area. The county lies within the Pacific Flyway, a major migratory path for birds flying north/south. As a result, NAS Whidbey Island maintains a BASH plan and has implemented BASH guidelines for aviators in *NASWHIDBEYINST 3710.1S*. NAS Whidbey Island is also home to the overall Navy and Marine Corps BASH program manager and the air station serves as the proving ground for many of the initiatives. One such example is the BIRDRAD (bird radar) program which will help document bird activity at airfields.

Table 5-3 lists the number of BASH incidents on record at NAVSAFCEN for NAS Whidbey Island from 2001 through 2004. Most incidents involve P-3 followed by EA-6 aircraft. P-3s at the air station are impacted most often, probably because of their larger size and wingspan. Most incidents occurred during the low phases of flight—takeoffs and landings. The records show that a wide variety of bird species were involved in the incidents, including owls, swallows, plovers, crows, and gulls, as well as bats.

**Table 5-3 NAS Whidbey Island BASH Incidents**

| Year | Incidents on Record |
|---|---|
| 2001 | 8 |
| 2002 | 27 |
| 2003 | 28 |
| 2004 | 23 |

**Source:**
Naval Safety Center at http://www.safetycenter.navy.mil/.

[3] Naval Safety Center BASH Article in Approach Magazine, April 2003.

# 6.0 AICUZ and Land Use Compatibility Guidelines

The AICUZ boundary is generally defined as the areas contained within the noise zones and APZs of an air installation. The AICUZ footprint is the minimum area where land use controls are recommended to protect the health, safety, and welfare of those living on or near a military airfield.

Although control over land use and development in the vicinity of military facilities is the responsibility of local governments, the Navy encourages localities to adopt programs, policies, and regulations that promote compatible development within the AICUZ footprint. This section presents the AICUZ footprint for NAS Whidbey Island's Ault Field and OLF Coupeville and the recommended land use compatibility guidelines that local planning and zoning officials can use in their review of land use control and zoning regulation updates.

## 6.1 AICUZ Footprints for Ault Field and OLF Coupeville

Figures 6-1 and 6-2 present the AICUZ footprints for Ault Field and OLF Coupeville based on CY13 operations.

The superimposed noise exposure levels and APZ boundaries conceptually create 12 potential subzones within an AICUZ footprint. As shown in Table 6-1, these subzones contain various combinations of noise and accident potential exposure. Note that the AICUZ footprints for Ault Field and OLF are not composed of all 12 subzones. For example, subzone I-2 (APZ I and Noise Zone 2) does not exist at Ault Field. Subzones that do not exist are indicated by N/A (not applicable) in the figure legends. The Noise Zone 2 area extending over the Seaplane Base area of NAS Whidbey Island results from the straight-in approach and GCA pattern for that runway, while the APZ in the same area results from the combined departures from Runway 13.

**Table 6-1 AICUZ Footprint Subzones**

| Accident Potential Zone | Noise Zones | | |
|---|---|---|---|
| | 1<br>Below 65 DNL (db) | 2<br>65-75 DNL (db) | 3<br>Above 75 DNL (db) |
| **Clear Zone** (including Primary Surface) | CZ | CZ | CZ |
| **APZ I** | I-1 | I-2 | I-3 |
| **APZ II** | II-1 | II-2 | II-3 |
| **Outside APZs** | 1 | 2 | 3 |

**Notes:**
Accident Potential Zone (APZ), Clear Zone (CZ), Day-Night Average Sound Level (DNL), decibels (dB).

**Source:**
*OPNAVINST 11010.36B*, 2002.

APZ I is beyond the Clear Zone and possesses a measurable potential for accidents relative to the Clear Zone. These areas can exist in conjunction with Noise Zones 1, 2, or 3. The combinations of noise and accident potential are shown as I-3 (APZ I-Noise Zone 3) for the highest combination of noise and accident potential, I-2 (APZ I-Noise Zone 2) for areas of moderate noise exposure and measurable accident potential, and I-1 (APZ I-Noise Zone 1) for areas of measurable accident potential and low noise exposure.

APZ II is an area beyond APZ I that has a measurable potential for aircraft accidents relative to APZ I or the Clear Zone. APZ II areas can exist in conjunction with Noise Zones 1, 2, or 3. These combinations of noise and accident potential are shown as II-3 (APZ II-Noise Zone 3) for the areas of highest noise exposure and measurable accident potential, II-2 (APZ II-Noise Zone 2) for areas of moderate noise exposure and measurable accident potential, and II-1 (APZ II-Noise Zone 1) for areas of low noise exposure and measurable accident potential. These areas have potential for accidents, and noise impacts and land use controls are recommended.

Noise zones are shown as 1, 2, and 3 in Table 6-1. Noise Zone 1 (less than 65 DNL) is an area of low or no impact (although some people in these areas may be annoyed by aircraft overflights), Noise Zone 2 (DNL 65-75) is an area of moderate impact where some land use controls are needed, and Noise Zone 3 (DNL 75 and above) is the most severely impacted area and requires the greatest degree of land use controls for noise exposure.

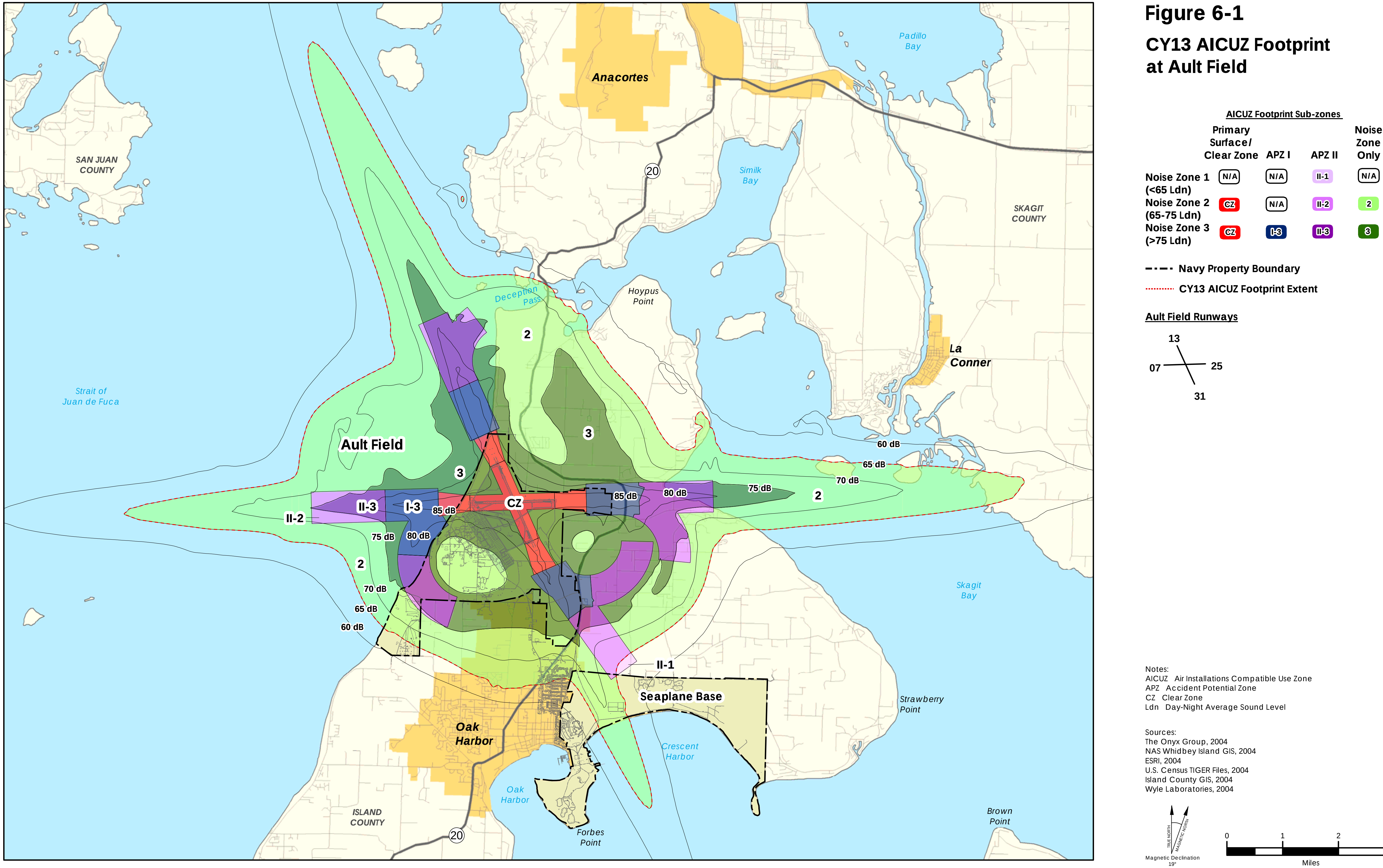
## 6.2 Suggested Land Use Compatibility within AICUZ Footprint

Land use compatibility recommendations for noise and APZs zones, as shown in Tables 6-2 and 6-3. Noise-sensitive uses including, but not limited to, housing, schools, hospitals, and churches are recommended to be placed outside of high-noise areas. People-intensive uses including, but not limited to, shopping malls, theaters, and activities that would draw concentrations of people to an area should be placed outside APZs.

Certain land uses are considered incompatible in high noise zones and APZs. Other land uses are considered compatible under certain conditions. For example, recreational uses, such as parks, are considered compatible under APZ I, provided that the recreational use does not include a high density of people (e.g., spectator sports). Agricultural uses are compatible above 75 DNL, but residential buildings are not considered compatible. Compatibility is a relative term and should be considered along with specific local land use development criteria by local governments in their decision making processes.

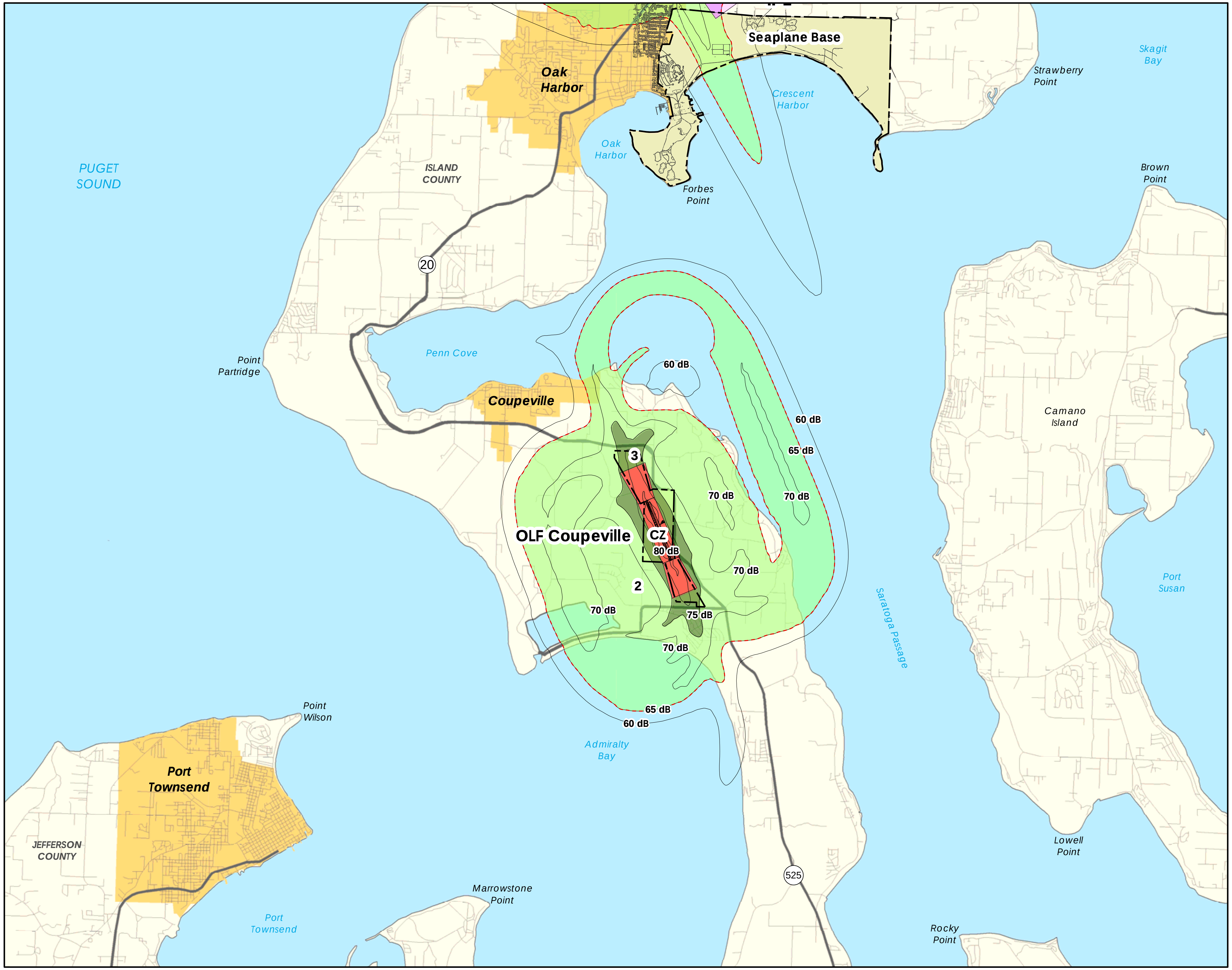
The guidelines for suggested land use listed in Tables 6-2 and 6-3 are also nationwide in scope. Since many air installations are in urban areas, these guidelines assume an urban environment with higher levels of ambient “background” noise than might exist in rural and suburban areas. These compatibility guidelines are, therefore, sometimes modified at the local government level to address a specific local noise environment.

# Figure 6-1
## CY13 AICUZ Footprint at Ault Field




Notes:
AICUZ Air Installations Compatible Use Zone
APZ Accident Potential Zone
CZ Clear Zone
Ldn Day-Night Average Sound Level

Sources:
The Onyx Group, 2004
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Island County GIS, 2004
Wyle Laboratories, 2004




# Figure 6-2

## CY13 AICUZ Footprint at OLF Coupeville

**AICUZ Footprint Sub-zones**

| | Primary Surface/ Clear Zone | APZ I | APZ II | Noise Zone Only |
|---|---|---|---|---|
| Noise Zone 1 (<65 Ldn) | N/A | N/A | N/A | N/A |
| Noise Zone 2 (65-75 Ldn) | CZ | N/A | N/A | 2 |
| Noise Zone 3 (>75 Ldn) | CZ | N/A | N/A | 3 |

Navy Property Boundary

CY13 AICUZ Footprint Extent

**OLF Coupeville Runway**

14

32

Notes:
AICUZ Air Installations Compatible Use Zone
APZ Accident Potential Zone
CZ Clear Zone
Ldn Day-Night Average Sound Level

Sources:
The Onyx Group, 2004
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Island County GIS, 2004
Wyle Laboratories, 2004

TRUE NORTH
MAGNETIC NORTH
Magnetic Declination 19°

0 1 2 3
Miles

## Table 6-2 Suggested Land Use Compatibility in Noise Zones

| Land Use | | Suggested Land Use Compatibility | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Noise Zone 1 (DNL or CNEL) | | Noise Zone 2 (DNL or CNEL) | | Noise Zone 3 (DNL or CNEL) | | |
| SLUCM NO | LAND USE NAME | < 55 | 55–64 | 65–69 | 70–74 | 75–79 | 80–84 | 85+ |
| | ***Residential*** | | | | | | | |
| 11 | Household units | Y | Y [1] | N [1] | N [1] | N | N | N |
| 11.11 | Single units: detached | Y | Y [1] | N [1] | N [1] | N | N | N |
| 11.12 | Single units: semidetached | Y | Y [1] | N [1] | N [1] | N | N | N |
| 11.13 | Single units: attached row | Y | Y [1] | N [1] | N [1] | N | N | N |
| 11.21 | Two units: side-by-side | Y | Y [1] | N [1] | N [1] | N | N | N |
| 11.22 | Two units: one above the other | Y | Y [1] | N [1] | N [1] | N | N | N |
| 11.31 | Apartments: walk-up | Y | Y [1] | N [1] | N [1] | N | N | N |
| 11.32 | Apartments: elevator | Y | Y [1] | N [1] | N [1] | N | N | N |
| 12 | Group quarters | Y | Y [1] | N [1] | N [1] | N | N | N |
| 13 | Residential hotels | Y | Y [1] | N [1] | N [1] | N | N | N |
| 14 | Mobile home parks or courts | Y | Y [1] | N | N | N | N | N |
| 15 | Transient lodgings | Y | Y [1] | N [1] | N [1] | N [1] | N | N |
| 16 | Other residential | Y | Y [1] | N [1] | N [1] | N | N | N |
| | | | | | | | | |
| ***20*** | ***Manufacturing*** | | | | | | | |
| 21 | Food and kindred products; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 22 | Textile mill products; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 23 | Apparel and other finished products; products made from fabrics, leather, and similar materials; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 24 | Lumber and wood products (except furniture); manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 25 | Furniture and fixtures; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 26 | Paper and allied products; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 27 | Printing, publishing, and allied industries | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 28 | Chemicals and allied products; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 29 | Petroleum refining and related industries | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |

(Continued on next page)

## Table 6-2 Suggested Land Use Compatibility in Noise Zones (Continued)

| Land Use | | Suggested Land Use Compatibility | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Noise Zone 1 *(DNL or CNEL)* | | Noise Zone 2 *(DNL or CNEL)* | | Noise Zone 3 *(DNL or CNEL)* | | |
| SLUCM NO | LAND USE NAME | < 55 | 55–64 | 65–69 | 70–74 | 75–79 | 80–84 | 85+ |
| ***30*** | ***Manufacturing (continued)*** | | | | | | | |
| 31 | Rubber and misc. plastic products; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 32 | Stone, clay, and glass products; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 33 | Primary metal products; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 34 | Fabricated metal products; manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 35 | Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks | Y | Y | Y | 25 | 30 | N | N |
| 39 | Miscellaneous manufacturing | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| | | | | | | | | |
| ***40*** | ***Transportation, communication, and utilities*** | | | | | | | |
| 41 | Railroad, rapid rail transit, and street railway transportation | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 42 | Motor vehicle transportation | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 43 | Aircraft transportation | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 44 | Marine craft transportation | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 45 | Highway and street right-of-way | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 46 | Automobile parking | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 47 | Communication | Y | Y | Y | 25 [5] | 30 [5] | N | N |
| 48 | Utilities | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 49 | Other transportation, communication, and utilities | Y | Y | Y | 25 [5] | 30 [5] | N | N |
| | | | | | | | | |
| ***50*** | ***Trade*** | | | | | | | |
| 51 | Wholesale trade | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 52 | Retail trade—building materials, hardware and farm equipment | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 53 | Retail trade—shopping centers | Y | Y | Y | 25 | 30 | N | N |
| 54 | Retail trade—food | Y | Y | Y | 25 | 30 | N | N |

(Continued on next page)

## Table 6-2 Suggested Land Use Compatibility in Noise Zones (Continued)

| Land Use | | Suggested Land Use Compatibility | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Noise Zone 1 (DNL or CNEL) | | Noise Zone 2 (DNL or CNEL) | | Noise Zone 3 (DNL or CNEL) | | |
| SLUCM NO | LAND USE NAME | < 55 | 55–64 | 65–69 | 70–74 | 75–79 | 80–84 | 85+ |
| ***50*** | ***Trade (Continued)*** | | | | | | | |
| 55 | Retail trade—automotive, marine craft, aircraft and accessories | Y | Y | Y | 25 | 30 | N | N |
| 56 | Retail trade—apparel and accessories | Y | Y | Y | 25 | 30 | N | N |
| 57 | Retail trade—furniture, home furnishings and equipment | Y | Y | Y | 25 | 30 | N | N |
| 58 | Retail trade—eating and drinking establishments | Y | Y | Y | 25 | 30 | N | N |
| 59 | Other retail trade | Y | Y | Y | 25 | 30 | N | N |
| | | | | | | | | |
| ***60*** | ***Services*** | | | | | | | |
| 61 | Finance, insurance, and real estate services | Y | Y | Y | 25 | 30 | N | N |
| 62 | Personal services | Y | Y | Y | 25 | 30 | N | N |
| 62.4 | Cemeteries | Y | Y | Y | Y [2] | Y [3] | Y [4,11] | Y [6,11] |
| 63 | Business services | Y | Y | Y | 25 | 30 | N | N |
| 63.7 | Warehousing and storage | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 64 | Repair services | Y | Y | Y | Y [2] | Y [3] | Y [4] | N |
| 65 | Professional services | Y | Y | Y | 25 | 30 | N | N |
| 65.1 | Hospitals, other medical facilities | Y | Y [1] | 25 | 30 | N | N | N |
| 65.16 | Nursing homes | Y | Y | N [1] | N [1] | N | N | N |
| 66 | Contract construction services | Y | Y | Y | 25 | 30 | N | N |
| 67 | Government services | Y | Y [1] | Y [1] | 25 | 30 | N | N |
| 68 | Educational services | Y | Y [1] | 25 | 30 | N | N | N |
| 69 | Miscellaneous | Y | Y | Y | 25 | 30 | N | N |
| | | | | | | | | |
| ***70*** | ***Cultural, entertainment, and recreational*** | | | | | | | |
| 71 | Cultural activities (churches) | Y | Y[1] | 25 | 30 | N | N | N |
| 71.2 | Nature exhibits | Y | Y[1] | Y[1] | N | N | N | N |
| 72 | Public assembly | Y | Y[1] | Y | N | N | N | N |
| 72.1 | Auditoriums, concert halls | Y | Y | 25 | 30 | N | N | N |
| 72.11 | Outdoor music shells, amphitheaters | Y | Y [1] | N | N | N | N | N |
| 72.2 | Outdoor sports arenas, spectator sports | Y | Y | Y [7] | Y [7] | N | N | N |
| 73 | Amusements | Y | Y | Y | Y | N | N | N |
| 74 | Recreational activities (golf courses, riding stables, water recreation) | Y | Y[1] | Y[1] | 25 | 30 | N | N |
| 75 | Resorts and group camps | Y | Y [1] | Y [1] | Y [1] | N | N | N |
| 76 | Parks | Y | Y [1] | Y [1] | Y [1] | N | N | N |
| 79 | Other cultural, entertainment, and recreation facilities | Y | Y [1] | Y [1] | Y [1] | N | N | N |

(Continued on next page)

## Table 6-2 Suggested Land Use Compatibility in Noise Zones (Concluded)

| Land Use | | Suggested Land Use Compatibility | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Noise Zone 1 (DNL or CNEL) | | Noise Zone 2 (DNL or CNEL) | | Noise Zone 3 (DNL or CNEL) | | |
| SLUCM NO | LAND USE NAME | < 55 | 55–64 | 65–69 | 70–74 | 75–79 | 80–84 | 85+ |
| ***80*** | ***Resource production and extraction*** | | | | | | | |
| 81 | Agriculture (except livestock) | Y | Y | Y [8] | Y [9] | Y [10] | Y [10,11] | Y [10,11] |
| 81.5 | Livestock farming | Y | Y | Y [8] | Y [9] | N | N | N |
| 81.7 | Animal breeding | Y | Y | Y [8] | Y [9] | N | N | N |
| 82 | Agriculture-related activities | Y | Y | Y [8] | Y [9] | Y [10] | Y [10,11] | Y [10,11] |
| 83 | Forestry activities | Y | Y | Y [8] | Y [9] | Y [10] | Y [10,11] | Y [10,11] |
| 84 | Fishing activities | Y | Y | Y | Y | Y | Y | Y |
| 85 | Mining activities | Y | Y | Y | Y | Y | Y | Y |
| 89 | Other resource production or extraction | Y | Y | Y | Y | Y | Y | Y |
| | | | | | | | | |

**Key:**

SLUCM Standard Land Use Coding Manual, U.S. Department of Transportation.

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* (Yes with Restrictions) Land use and related structures are generally compatible. However, see note(s) indicated by the superscript.

N* (No with Exceptions) Land use and related structures are generally incompatible. However, see notes indicated by the superscript.

NLR Noise Level Reduction (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 are compatible; however, measures to achieve NLR of 25, 30, or 35 must be incorporated into design and construction of structures. 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.

DNL Day Night Average Sound Level.

CNEL Community Noise Equivalent Level (Normally within a very small decibel difference of DNL).

Ldn Mathematical symbol for DNL.

**Notes:**

1.

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 local 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 these uses must be allowed, measures to achieve and outdoor to indoor NLR of at least 25 dB in DNL 65–69 and NLR of 30 dB in DNL 70–74 should be incorporated into building codes and be in individual approvals; for transient housing, an NLR of at least 35 dB should be incorporated in DNL 75–79.

c) Normal permanent construction can be expected to provide an NLR of 20 dB; thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation, upgraded Sound Transmission Class (STC) ratings in windows and doors and closed windows year-round. Additional consideration should be given to modifying NLR levels based on peak noise levels or vibrations.

d) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design, and use of berms and barriers can help mitigate outdoor noise exposure, particularly from ground-level sources. Measures that reduce noise at a site should be used wherever practical in preference to measures that protect only interior spaces.

**Notes (Continued):**

2. Measures to achieve 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.

3. Measures to achieve 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.

4. Measures to achieve 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.

5. If project or proposed development is noise sensitive, use indicated NLR; if not, land use is compatible without NLR.

6. No buildings.

7. Land use compatible provided special sound reinforcement systems are installed.

8. Residential buildings require NLR of 25.

9. Residential buildings require NLR of 30.

10. Residential buildings not permitted.

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

**Source:**
*OPNAVINST 11010.36B*, 2002.

### Table 6-3 Suggested Land Use Compatibility in Accident Potential Zones

| SLUCM NO. | LAND USE NAME | CLEAR ZONE Recommendation | APZ-I Recommendation | APZ-II Recommendation | Density Recommendation |
|---|---|---|---|---|---|
| ***10*** | ***Residential*** | | | | |
| 11 | Household units | | | | |
| 11.11 | Single units: detached | N | N | Y[2] | Maximum density of 1-2 Du/Ac |
| 11.12 | Single units: semidetached | N | N | N | |
| 11.13 | Single units: attached row | N | N | N | |
| 11.21 | Two units: side-by-side | N | N | N | |
| 11.22 | Two units: one above the other | N | N | N | |
| 11.31 | Apartments: walk-up | N | N | N | |
| 11.32 | Apartments: elevator | N | N | N | |
| 12 | Group quarters | N | N | N | |
| 13 | Residential hotels | N | N | N | |
| 14 | Mobile home parks or courts | N | N | N | |
| 15 | Transient lodgings | N | N | N | |
| 16 | Other residential | N | N | N | |
| | | | | | |
| ***20*** | ***Manufacturing*** [3] | | | | |
| 21 | Food and kindred products; manufacturing | N | N | Y | Maximum FAR 0.56 |
| 22 | Textile mill products; manufacturing | N | N | Y | Same as above |
| 23 | Apparel and other finished products; products made from fabrics, leather, and similar materials; manufacturing | N | N | N | |
| 24 | Lumber and wood products (except furniture); manufacturing | N | Y | Y | Maximum FAR of 0.28 in APZ I & 0.56 in APZ II |
| 25 | Furniture and fixtures; manufacturing | N | Y | Y | Same as above |
| 26 | Paper and allied products; manufacturing | N | Y | Y | Same as above |
| 27 | Printing, publishing, and allied industries | N | Y | Y | Same as above |
| 28 | Chemicals and allied products; manufacturing | N | N | N | |
| 29 | Petroleum refining and related industries | N | N | N | |

(Continued on next page)

**Table 6-3 Suggested Land Use Compatibility in Accident Potential Zones (Continued)**

| SLUCM NO. | LAND USE NAME | CLEAR ZONE Recommendation | APZ-I Recommendation | APZ-II Recommendation | Density Recommendation |
|---|---|---|---|---|---|
| | | | | | |
| ***30*** | ***Manufacturing [3] (continued)*** | | | | |
| 31 | Rubber and misc. plastic products; manufacturing | N | N | N | |
| 32 | Stone, clay, and glass products; manufacturing | N | N | Y | Maximum FAR 0.56 |
| 33 | Primary metal products; manufacturing | N | N | Y | Same as above |
| 34 | Fabricated metal products; manufacturing | N | N | Y | Same as above |
| 35 | Professional scientific, and controlling instruments; photographic and optical goods; watches and clocks | N | N | N | |
| 39 | Miscellaneous manufacturing | N | Y | Y | Maximum FAR of 0.28 in APZ I & 0.56 in APZ II |
| | | | | | |
| ***40*** | ***Transportation, communication, and utilities [4].*** | | | | See Note 3 below. |
| 41 | Railroad, rapid rail transit, and street railway transportation | N | Y[5] | Y | Same as above. |
| 42 | Motor vehicle transportation | N | Y[5] | Y | Same as above |
| 43 | Aircraft transportation | N | Y[5] | Y | Same as above |
| 44 | Marine craft transportation | N | Y[5] | Y | Same as above |
| 45 | Highway and street right-of-way | N | Y[5] | Y | Same as above |
| 46 | Auto parking | N | Y[5] | Y | Same as above |
| 47 | Communication | N | Y[5] | Y | Same as above |
| 48 | Utilities | N | Y[5] | Y | Same as above |
| 485 | Solid waste disposal (landfills, incineration, etc.) | N | N | N | |
| 49 | Other transport, communication, and utilities | N | Y[5] | Y | See Note 3 below |
| | | | | | |
| 50 | ***Trade*** | | | | |
| 51 | Wholesale trade | N | Y | Y | Maximum FAR of 0.28 in APZ I. & .56 in APZ II. |
| 52 | Retail trade—building materials, hardware and farm equipment | N | Y | Y | Maximum FAR of 0.14 in APZ I & 0.28 in APZ II |
| 53 | Retail trade—shopping centers | N | N | Y | Maximum FAR of 0.22. |
| 54 | Retail trade—food | N | N | Y | Maximum FAR of 0.24 |
| 55 | Retail trade—automotive, marine craft, aircraft and accessories | N | Y | Y | Maximum FAR of 0.14 in APZ I & 0.28 in APZ II |
| 56 | Retail trade—apparel and accessories | N | N | Y | Maximum FAR 0.28 |
| 57 | Retail trade—furniture, home furnishings and equipment | N | N | Y | Same as above |
| 58 | Retail trade—eating and drinking establishments | N | N | N | |
| 59 | Other retail trade | N | N | Y | Maximum FAR of 0.22 |

(Continued on next page)

## Table 6-3 Suggested Land Use Compatibility in Accident Potential Zones (Continued)

| SLUCM NO. | LAND USE NAME | CLEAR ZONE Recommendation | APZ-I Recommendation | APZ-II Recommendation | Density Recommendation |
|---|---|---|---|---|---|
| ***60*** | ***Services*** [6] | | | | |
| 61 | Finance, insurance, and real estate services | N | N | Y | Maximum FAR of 0.22 for "General Office/Office park" |
| 62 | Personal services | N | N | Y | Office uses only. Maximum FAR of 0.22. |
| 62.4 | Cemeteries | N | Y[7] | Y[7] | |
| 63 | Business services (credit reporting; mail, stenographic, reproduction; advertising) | N | N | Y | Max. FAR of 0.22 in APZ II |
| 63.7 | Warehousing and storage services | N | Y | Y | Max. FAR 1.0 APZ I; 2.0 in APZ II |
| 64 | Repair services | N | Y | Y | Max. FAR of 0.11 APZ I; 0.22 in APZ II |
| 65 | Professional services | N | N | Y | Max. FAR of 0.22 |
| 65.1 | Hospitals, nursing homes | N | N | N | |
| 65.1 | Other medical facilities | N | N | N | |
| 66 | Contract construction services | N | Y | Y | Max. FAR of 0.11 APZ I; 0.22 in APZ II |
| 67 | Government services | N | N | Y | Max FAR of 0.24 |
| 68 | Educational services | N | N | N | |
| 69 | Miscellaneous | N | N | Y | Max. FAR of 0.22 |
| | | | | | |
| ***70*** | ***Cultural, entertainment, and recreational*** | | | | |
| 71 | Cultural activities | N | N | N | |
| 71.2 | Nature exhibits | N | Y[8] | Y[8] | |
| 72 | Public assembly | N | N | N | |
| 72.1 | Auditoriums, concert halls | N | N | N | |
| 72.11 | Outdoor music shells, amphitheaters | N | N | N | |
| 72.2 | Outdoor sports arenas, spectator sports | N | N | N | |
| 73 | Amusements—fairgrounds, mini-golf, driving ranges; amusement parks | N | N | Y | |
| 74 | Recreational activities (including golf courses, riding stables, water recreation) | N | Y[8] | Y[8] | Max. FAR of 0.11 APZ I; 0.22 in APZ II |
| 75 | Resorts and group camps | N | N | N | |
| 76 | Parks | N | Y[8] | Y[8] | Same as 74 |
| 79 | Other cultural, entertainment, and recreation facilities | N | Y[8] | Y[8] | Same as 74 |
| | | | | | |
| *80* | ***Resource production and extraction*** | | | | |
| 81 | Agriculture (except livestock) | Y[4] | Y[9] | Y[9] | |
| 81.5, 81.7 | Livestock farming and breeding | N | Y[9,10] | Y[9,10] | |
| 82 | Agriculture-related activities | N | Y[9] | Y[9] | Max FAR of 0.28 APZ I; 0.56 APZ II no activity which produces smoke, glare, or involves explosives |
| 83 | Forestry activities [11] | N | Y | Y | Same as Above |
| 84 | Fishing activities [12] | N[12] | Y | Y | Same as Above |

(Continued on next page)

## Table 6-3 Suggested Land Use Compatibility in Accident Potential Zones (Concluded)

| SLUCM NO. | LAND USE NAME | CLEAR ZONE Recommendation | APZ-I Recommendation | APZ-II Recommendation | Density Recommendation |
|---|---|---|---|---|---|
| | | | | | |
| 85 | Mining activities | N | Y | Y | Same as Above |
| 89 | Other resource production or extraction | N | Y | Y | Same as Above |
| | | | | | |
| ***90*** | ***Other*** | | | | |
| 91 | Undeveloped land | Y | Y | Y | |
| 93 | Water areas | $N^{13}$ | $N^{13}$ | $N^{13}$ | |
| | | | | | |

**Key:**
SLUCM Standard Land Use Coding Manual, U.S. Department of Transportation
Y (Yes) Land use and related structures are normally compatible without restriction.
N (No) Land use and related structures are not normally compatible and should be prohibited.
$Y^x$ (Yes with restrictions) Land use and related structures are generally compatible. However, see notes indicated by the superscript.
$N^x$ (No with exceptions) Land use and related structures are generally incompatible. However, see notes indicated by the superscript.
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 nonresidential intensities.
Du/Ac Dwelling units per acre. This metric is customarily used to measure residential densities.

**Notes:**
1. A "Yes" or a "No" designation for compatible land use is to be used only for general comparison. Within each, uses exist where further evaluation may be needed in each category as to whether it is clearly compatible, normally compatible, or not compatible due to the variation of densities of people and structures. In order to assist installations and local governments, general suggestions as to floor/area ratios are provided as a guide to density in some categories. In general, land use restrictions that limit commercial, services, or industrial buildings or structure occupants to 25 per acre in APZ I and 50 per acre in APZ II are the range of occupancy levels considered to be low density. Outside events should normally be limited to assemblies of not more that 25 people per acre in APZ I and not more than 50 people per acre in APZ II.

2. The suggested maximum density for detached single-family housing is one to two 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 percent 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. No structures (except airfield lighting), buildings, or aboveground utility/ communications lines should normally be located in Clear Zone areas on or off the installation. The Clear Zone is subject to severe restrictions. See NAVFAC P-80.3 or Tri-Service Manual AFM 32-1123(I); TM 5-803-7, NAVFAC P-971, *Airfield and Heliport Planning & Design,* May 1, 1999, for specific design details.

5. No passenger terminals and no major aboveground transmission lines in APZ I.

6. Low-intensity office uses only. Accessory uses such as meeting places and auditoriums are not recommended.

7. No chapels are allowed within APZ I or APZ II.

8. Facilities must be low intensity, and provide no tot lots, etc. Facilities such as clubhouses, meeting places, auditoriums, and large classrooms are not recommended.

9. 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.

10. Includes feedlots and intensive animal husbandry.

11. 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.

12. Controlled hunting and fishing may be permitted for the purpose of wildlife management.

13. Naturally occurring water features (e.g., rivers, lakes, streams, wetlands) are compatible.

**Source:**
*OPNAVINST 11010.36B*, 2002.

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# 7.0 Land Use Compatibility Analysis

This section presents information pertaining to Island County history; socioeconomics; land use planning authorities, existing land use, zoning, and future land use.

In addition, this section examines the AICUZ recommendations as they apply to current and future land use in the areas surrounding the airfields. Land use compatibility decisions are made by local government authorities responsible for land use planning and zoning. Island County and the City of Oak Harbor have taken positive steps to help in ensuring compatible future development by recognizing airfield noise contours in local land use planning, zoning, and building code provisions. Further progress can be made by also considering compatible land use provisions related to APZs in future updates. A comparison of the noise contours contained in the current zoning regulations and those outlined in this AICUZ analysis is provided in this section for ease of reference.

# 7.1 Island County

"Rural character is one of Island County's most valued assets, providing the quality of life desired by most island residents" according to the *Island County Comprehensive Plan*, 1998.

Nestled in the Puget Sound basin between the Cascade Mountains to the east and the Olympic Mountains to the west, Island County's name reflects the fact that it consists of just two islands—Whidbey and Camano. The county covers a land area of 208 square miles, or 133,120 acres. Included are the county's three municipalities of Oak Harbor, Langley, and Coupeville, which total 3,173 acres. The Town of Coupeville serves as the county seat.

*Above shows the Town of Coupeville's scenic waterfront. The Town of Coupeville serves as the Island County seat.*

## 7.1.1 Island County History

Before the advent of white exploration and settlement, Native Americans moved throughout what is now Island County. The principal tribes were the Snohomish, Skagit, and Kikialos. The mainstay of local tribal economies was fishing[1].

In 1792, an expeditionary party led by Captain George Vancouver of the British Navy discovered Puget Sound, signaling the advent of white exploration in the region. In June of that year, Ship's Master Joseph Whidbey of the HMS *Discovery* charted a recently discovered island, which Captain Vancouver later named "Whidbey" in his honor. Through the early 1800s, other explorers, scouts, and trappers visited the island.

American settlement of Island County began around 1850, primarily around the Oak Harbor and Penn's Cove areas. Soon after, Island County was created out of Thurston County on January 6, 1853, by the legislature of the Oregon Territory. Agriculture and logging/timbering began to flourish. By the turn of the century, other businesses followed, and Oak Harbor and Coupeville became small centers for banking, shipping, industry, and trading within the county.

[1] Information in this section was obtained from the *American Local History Network for Island County, Washington* at www.usgennet.org/usa/wa/county/island, 2004.

By 1910, the county's population was 4,704. Farm families and town entrepreneurs continued to settle into defined communities throughout the following decades. Construction of the Deception Pass Bridge in 1935 provided a highway link to the mainland and fostered more economic development within the county.

*After years of trying to raise funds for a bridge to connect Whidbey Island to the mainland, the Deception Pass Bridge was finally constructed in 1935.*

The military played a vital role in Island County's economy long before plans for NAS Whidbey Island were established in 1942. In 1896, Congress appropriated funds for the construction of a triangular system of fortresses to defend Admiralty Inlet, the entrance to Puget Sound. One position, Fort Casey, was sited at Admiralty Head on Whidbey Island.

Fort Casey was heavily fortified and manned during the First and Second World Wars and the Korean Conflict. It was also used to a limited extent for troop induction and training. Personnel stationed there contributed tremendously to the local economy, particularly in Coupeville and Keystone. Another defense post, Fort Ebey, was established near Oak Harbor during World War II as an artillery bunker. Both were deactivated and are now state parks/recreation areas.

NAS Whidbey Island was established in late 1942 at the height of World War II. It was the site of seaplane patrol operations, rocket firing training, torpedo overhaul, and recruit and officer training. In late 1949, work began to upgrade it to an all-weather airfield. The conversion was accompanied by more personnel. As a result, Island County's population soared from 6,098 in 1940 to 11,079 by 1950—an 82 percent increase. The tremendous influx of military personnel also boosted local commerce.

### 7.1.2 Island County Socioeconomics

Today, Island County's economy remains focused on government jobs—principally those at NAS Whidbey Island. However, a large retail sector, a fast-growing services sector, and tourism are helping form a broader economic base. The county is focused on a future economic development strategy that encourages appropriate economic development, consistent with the county's rural character and protective of its environment.

*With an increasing population and economic base, there is a high demand for new housing in Island County. The sign above is an advertisement for new single-family homes near Oak Harbor.*

The population of Island County has grown from 1,870 persons in 1900 to 71,558 persons in 2000, according to the U.S. Census Bureau. Table 7-1 shows Island County population and percentage change by decade from 1900 through 2020. Immigration, a high birth rate among existing residents, and the influx of retirees are all factors leading projected increases.

Building permit data for Island County are shown in Table 7-2. Since 1999, total building permits issued per year have remained relatively constant, ranging from the mid- to high 500s per year. In the future, the number of building permits issues is projected to remain similar.

### Table 7-1 Island County Population and Percentage Change by Decade

| Year | Population | Percentage Change from Previous Decade |
|---|---|---|
| 1900 | 1,870 | N/A |
| 1910 | 4,704 | 152% |
| 1920 | 5,489 | 17% |
| 1930 | 5,369 | -2% |
| 1940 | 6,098 | 14% |
| 1950 | 11,079 | 82% |
| 1960 | 19,638 | 77% |
| 1970 | 27,011 | 38% |
| 1980 | 44,048 | 63% |
| 1990 | 60,195 | 37% |
| 2000 | 71,558 | 19% |
| 2010* | 88,312 | 23% |
| 2020* | 108,520 | 23% |

**Note:**
Not applicable (N/A).

**Sources:**
U.S. Census Bureau, *Population of Counties by Decennial Census: 1900 to 2000*.

* Washington State Office of Financial Management, *Projections of the Total Resident Population for the Growth Management Act,* 2002.

### Table 7-2 Island County Building Permit Data

| Year | Permit Issued for all of Island County | Permits Issued for Whidbey Island | Permits Issued for Camano Island |
|---|---|---|---|
| 1999 | 570 | 353 | 217 |
| 2000 | 576 | 346 | 230 |
| 2001 | 552 | 352 | 200 |
| 2002 | 543 | 333 | 210 |
| 2003 | 592 | 343 | 249 |
| 2004* | 660 | 339 | 321 |
| 2005* | 566 | 345 | 221 |
| 2006* | 560 | 338 | 221 |

**Note:**
* Projected.

**Source:**
Island County, Washington, *County Code and General Information*, 2004.

## 7.2 Existing Land Use in AICUZ Areas

The development pattern in Whidbey Island remains largely rural in character, with much of the area wooded or covered with small farms. The shoreline is often less than five miles away from any interior point, and the land close to Ault Field and OLF Coupeville offers vast areas of undeveloped landscape where distant mountains and water are often visible. The majority of development within the county occurs along shoreline areas or in the municipalities of Oak Harbor, Langley, and Coupeville. However, because of the natural attractiveness of the countryside, there is an interest for residential development in the rural areas outside of the municipalities. The result is that much of the island, including the areas around the airfields, is becoming developed with low-density residential and rural agricultural uses characterized by single-family homes located on large lots that are often cultivated.

*Whidbey Island has a distinct and picturesque rural character. This rural character, when coupled with the proximity to water, helps generate a continual demand for single family housing on the island. Many residents use their large lots for agricultural purposes.*

Land use surrounding the airfields is generally compatible with AICUZ recommendations. Limited existing incompatibilities are attributable to residential development scattered inside the 65 and 75 and above dB contours of the airfields that were constructed in the past, prior to current zoning revisions in 1994. The current local land use controls include requirements to incorporate noise level reduction materials and disclosure above 60 DNL. Existing residential development densities in these noise areas vary from one dwelling unit per 10 acres to dwelling units located on quarter-acre lots within previously platted developments. The *Island County Comprehensive Plan* provides that housing should not be constructed above 70 DNL.

Existing platted developments are in a general sense “grandfathered,” or somewhat exempt from some but not all current land use regulations enacted by the county and municipalities. For example all new construction within platted developments or on individual parcels, or major renovations to existing structures are required to meet a variety of regulations related to density, type, and construction practices. These regulations include noise level reduction for construction or major renovations occurring in higher noise areas a well as disclosure. The regulations that the local jurisdictions have enacted that specifically work toward land use compatibility in the Ault Field and OLF Coupeville noise and safety environs are supportive of compatible land use in the areas covered.

## 7.3 Zoning and Land Use Controls

The privately owned parcels near Ault Field and OLF Coupeville are subject to the policies and procedures of Island County, or the municipalities of the City of Oak Harbor and the Town of Coupeville. Table 7-3 provides a summary of existing zoning and land use controls around NAS Whidbey Island's Ault Field and OLF Coupeville by the county and local municipalities. Island County and the City of Oak Harbor have developed ordinances that require noise level reduction/sound attenuation in noise areas around the airfields. The county and local municipalities do not currently address accident potential/APZs in their ordinances.

### 7.3.1 Island County Zoning and Land Use Controls

Island County has adopted a Zoning Ordinance; an Airport and Aircraft Operations Noise Disclosure Ordinance for property sold, rented, or leased around Ault Field and OLF Coupeville; and a Noise Level Reduction Ordinance to specify minimum standards for building construction within the noise zones around Ault Field and OLF Coupeville. In addition, the county has adopted a Cell Tower Ordinance and a Signs and Lighting Ordinance. The latter is designed to help preserve the dark skies and rural character of the county. Together, these ordinances help to ensure the safety of aircraft operations and protect the health, safety, and welfare of citizens.


*Island County has implemented a number of regulations that promote compatibility between Ault Field and OLF Coupeville operations and surrounding development.*

As for zoning, Figures 7-1 and 7-2 show that the majority of parcels under county jurisdiction near the airfields are zoned Rural (R) Zone or Rural Agriculture (RA) Zone. The figures also show the 60dB and 70dB contours recognized in the current ordinances requiring noise level reduction. The CY13 AICUZ footprint (combination of CY13 noise contours and CY13 APZs) has been overlaid on the figures. As mentioned earlier, accident potential is not yet recognized in the local ordinances.

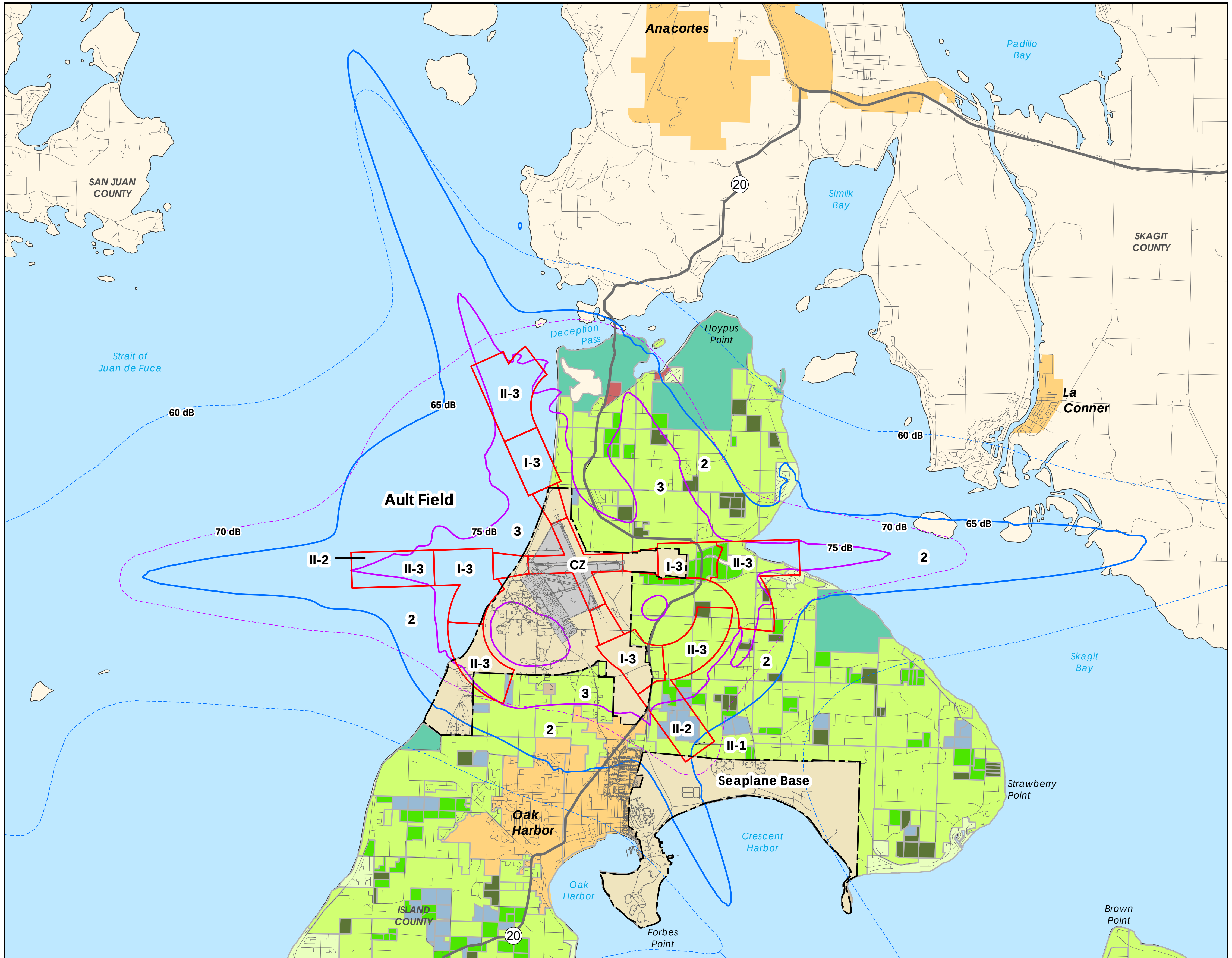
The Rural (R) Zone generally limits development density to one unit per 5 acres. The ordinance states that the "limitations on density and uses are designed to provide for a variety of rural lifestyles and to ensure compatible uses." Permitted uses include single-family residences, farms, and other types of structure where few people congregate. Conditional uses where a larger number of people may congregate include churches, schools, and inns. Approval for such conditional uses is often contingent on a community meeting which allows the Navy a public forum for discussion and opinion.

The Rural Agriculture (RA) Zone generally limits development density to one lot per 10 acres. The primary purpose of the Rural Agriculture (RA) zone is "to protect and encourage the long term productive use of Island County's agricultural land resources of local importance." Permitted uses include single-family residences, farms, and other types of structure where few people congregate. Conditional uses where a larger number of people may congregate include churches and inns.

The Navy recently purchased 18 avigation easements over 27 parcels scattered around OLF Coupeville. Easements grant the Navy the right of passage in and through the airspace at various altitudes, depending upon the location of the parcel(s). The easements also offer the Navy some flexibility, for they give the Navy the right to cause in and through the airspace such noise as has been inherent in the operation of A-3D, A-6E, EA-6B, or follow-on aircraft of lesser or comparable noise level; or no more than 10,000 flights through the individual parcel's airspace per calendar year, whichever is greater, caused by the utilization of OLF Coupeville.

### Table 7-3 Zoning and Land Use Controls in Impacted Areas

| Zoning and Land Use Control | Island County | City of Oak Harbor | Town of Coupeville |
|---|---|---|---|
| **Adopted Zoning Ordinance** | Majority of parcels near airfields zoned for low-density development—5- and 10-acre minimum lot sizes. | Ordinance contains provisions for Aviation Environs Overlay Zone that requires development in any area of above the 60dB DNL contour to sound attenuate. A stated goal/policy objective within the city's 2003 Comprehensive Plan is to prohibit residential development in any area above the 70dB DNL contour. | Yes |
| **Noise Disclosure Ordinance** | Gives notice to prospective buyers, renters, or lessees that the property of interest is subject to aircraft noise for the northern two-thirds of Island County. | Gives notice to prospective buyers, renters, or lessees that the property of interest is subject to aircraft noise. A stated goal/policy objective within the city's 2003 Comprehensive Plan is to also ensure disclosure of accident potential impacts. | No. |
| **Noise Level Reduction Ordinance** | Noise Level Reduction of 25 or 30 dB for all new structures and alterations to existing structures on parcels within specified noise areas around Ault Field and OLF Coupeville: 25 dB noise level reduction within 60–70 dB DNL contours; and 30 dB noise level reduction above 70 dB DNL. | Noise Level Reduction of 25 or 30 dB for all new structures and alterations to existing structures on parcels in noise areas: 25 dB noise level reduction within 60–65 dB DNL contours (Subdistrict A); and 30 dB noise level reduction within 65–75 dB DNL contours (Subdistrict B). | No. |
| **Signs and Lighting Ordinance** | This ordinance is designed to help preserve dark skies and the rural character of the county by requiring signs to be lit from above/facing downward and any other lighting to be shielded so as not to produce glare into the night sky. The ordinance that applies to both residential and commercial entities thereby works to minimize bright lights, either directed or reflected, that can impair a pilot's vision, especially at night. | This commercial only ordinance allows for limitations to be placed on the reflective qualities of surface materials, area and intensity of illumination, location and angle of illumination, and the hours of illumination. The ordinance thereby works to minimize bright lights, either directed or reflected, that can impair a pilot's vision, especially at night. | Yes. |
| **Cell Tower Ordinance** | Requires that all communication towers comply with state and local mechanical, electrical and building codes, FCC requirements, FAA requirements (including FAR Part 77 "*Objects Affecting Navigable Airspace*"). | Towers, antennas, or other objects that penetrate the 100:1 angle slope criteria established in FAR Part 44 shall be reviewed for compatibility with airport operations. No tower, antenna, or other object shall constitute a hazard to air navigation, interfere with the safe operation of aircraft or deny the existing operational capability of Ault Field. | - |




# Figure 7-1

## Zoning and CY13 AICUZ Footprint at Ault Field

**AICUZ Footprint Sub-zones**

| | Primary Surface/ Clear Zone | APZ I | APZ II | Noise Zone Only |
|---|---|---|---|---|
| Noise Zone 1 (<65 Ldn) | N/A | N/A | II-1 | N/A |
| Noise Zone 2 (65-75 Ldn) | CZ | N/A | II-2 | 2 |
| Noise Zone 3 (>75 Ldn) | CZ | I-3 | II-3 | 3 |

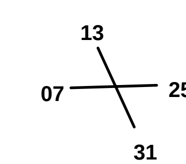
Navy Property Boundary

**Island County Zoning and Noise Contours**

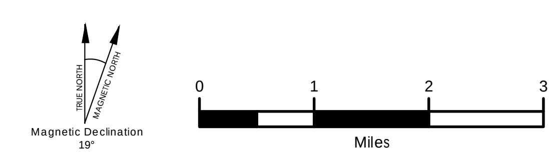
- Airport (AP)
- Commercial Agriculture (CA)
- Federal Land (FL)
- Light Manufacturing
- Municipality
- Park (PK)
- Public Facilities (PF)
- Rural (R)
- Rural Agriculture (RA)
- Rural Center (RC)
- Rural Forest (RF)
- Rural Residential (RR)
- Rural Service (RS)
- Rural Village (RV)
- Special Review District (SR)
- 60 dB; Community Noise Zone 2
- 70 dB; Community Noise Zone 3

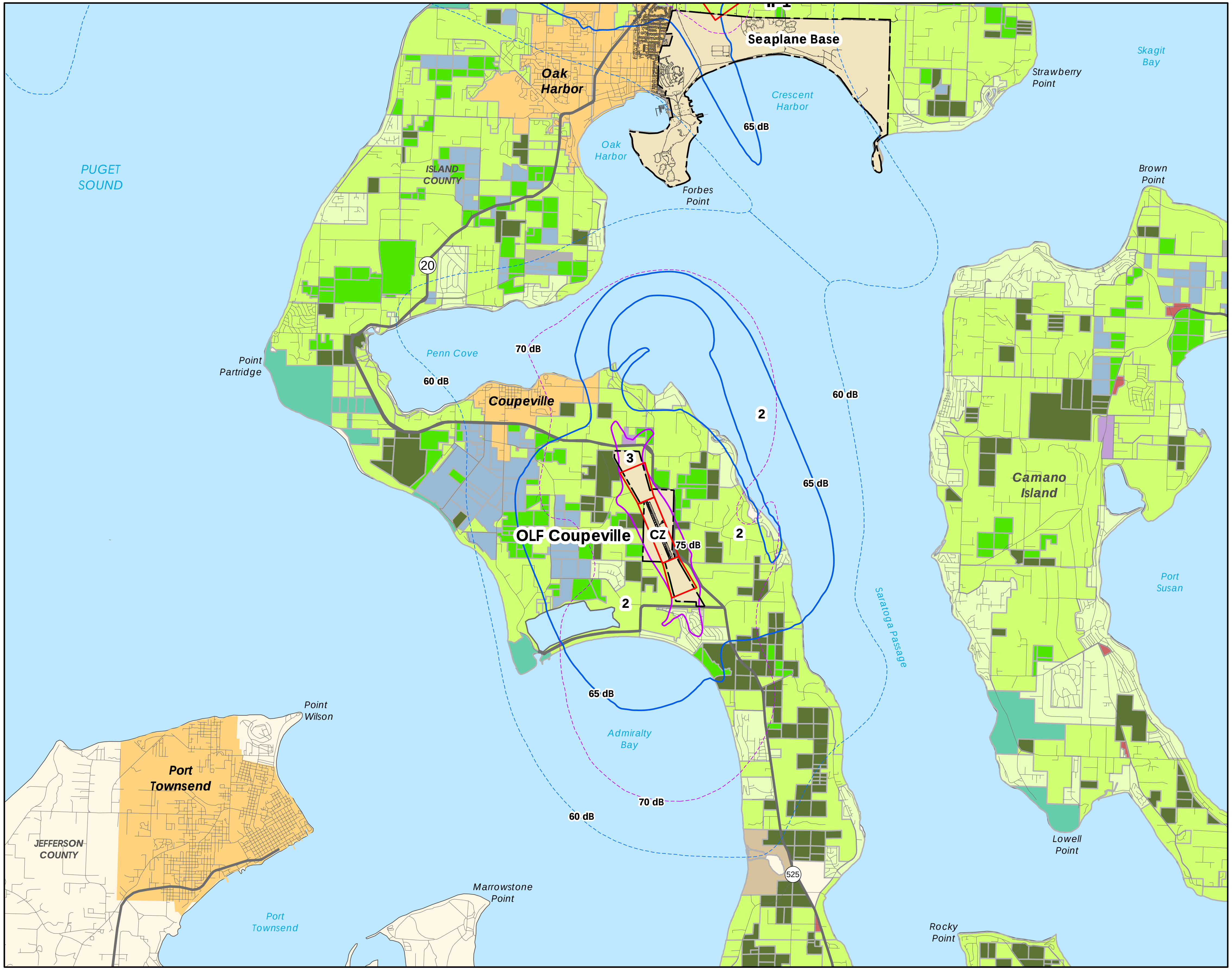
Notes:
AICUZ Air Installations Compatible Use Zone
APZ Accident Potential Zone
CZ Clear Zone
Ldn Day-Night Average Sound Level

**Ault Field Runways**




Sources:
The Onyx Group, 2004
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Island County GIS, 2004
Wyle Laboratories, 2004






# Figure 7-2

## Zoning and CY13 AICUZ Footprint at OLF Coupeville

**AICUZ Footprint Sub-zones**

| | Primary Surface / Clear Zone | APZ I | APZ II | Noise Zone Only |
|---|---|---|---|---|
| Noise Zone 1 (<65 Ldn) | N/A | N/A | N/A | N/A |
| Noise Zone 2 (65-75 Ldn) | CZ | N/A | N/A | 2 |
| Noise Zone 3 (>75 Ldn) | CZ | N/A | N/A | 3 |

Navy Property Boundary

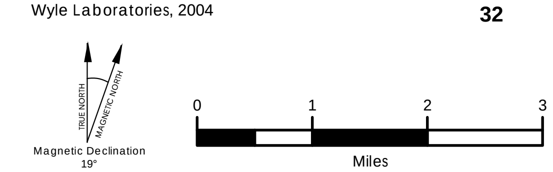
**Island County Zoning and Noise Contours**

- Airport (AP)
- Commercial Agriculture (CA)
- Federal Land (FL)
- Light Manufacturing
- Municipality
- Park (PK)
- Public Facilities (PF)
- Rural (R)
- Rural Agriculture (RA)
- Rural Center (RC)
- Rural Forest (RF)
- Rural Residential (RR)
- Rural Service (RS)
- Rural Village (RV)
- Special Review District (SR)
- 60 dB; Community Noise Zone 2
- 70 dB; Community Noise Zone 3

Notes:
AICUZ Air Installations Compatible Use Zone
APZ Accident Potential Zone
CZ Clear Zone
Ldn Day-Night Average Sound Level

Sources:
The Onyx Group, 2004
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Island County GIS, 2004
Wyle Laboratories, 2004

**OLF Coupeville Runway**
14
32



### 7.3.2 Island County and City of Oak Harbor Noise Contours

Figure 7-3 shows the 60, 65, 70, and 75 dB DNL contours for Ault Field and OLF Coupeville as reflected in Island County's and the City of Oak Harbor's current zoning ordinances.[2] Table 7-4 shows the population numbers, housing units, and area in acres within the 60 to 75+ dB DNL contours at 5 dB increments.

**Table 7-4 Island County and City of Oak Harbor Noise Exposure at Ault Field and OLF Coupeville**

| DNL (dB) | Population | Housing Units | Area (Acres) |
|---|---|---|---|
| **Ault Field** | | | |
| 60 dB to less than 65 dB | 7,682 | 3,457 | 7,715 |
| 65 dB to less than 70 dB | 4,782 | 1,972 | 4,093 |
| 70 dB to less than 75 dB | 1,502 | 657 | 3,602 |
| 75 dB + | 3,195 | 1,337 | 6,693 |
| **Totals** | **17,161** | **7,423** | **22,103** |
| **OLF Coupeville** | | | |
| 60 dB to less than 65 dB | 1,931 | 906 | 3,541 |
| 65 dB to less than 70 dB | 1,425 | 702 | 3,963 |
| 70 dB to less than 75 dB | 1,376 | 708 | 5,001 |
| 75 dB + | 1,201 | 601 | 2,981 |
| **Totals** | **5,933** | **2,917** | **15,486** |

**Notes:**
Day-Night Average Sound Level (DNL), decibels (dB).

**Source:**
Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington,* 2004.

### 7.3.3 City of Oak Harbor Zoning and Land Use Controls

The City of Oak Harbor has adopted the same noise contours as Island County, to implement the Aviation Environs Overlay Zone through the city's zoning ordinance and other elements of the municipal code. The overlay applies additional standards to properties located within underlying zoning districts. These standards include noise level reduction requirements ranging between 25 and 30 dB depending on structure type and location within the noise zones and disclosure. The City of Oak Harbor has also adopted a lighting and glare ordinance that helps to ensure the safety of aircraft operations by placing limitations on lighting that can impair a pilot's vision, especially at night.

Additionally, the *City of Oak Harbor's 2003 Comprehensive Plan* promotes residential development to occur to the southwest and away from Ault Field. The area closer to the airfield is designated as commercial and light industrial. The plan also has stated goals/policy objectives that prohibit residential development in any area above the 70 dB DNL contour and disclose accident potential. These goals/policy objectives are not currently included within the city's zoning code.

[2] As adopted with Ordinance C-59-02 [PLG-011-02] of the Island County code. The contours are also recognized in the City of Oak Harbor code.

### 7.3.4 Town of Coupeville Zoning and Land Use Controls

The town has not adopted policies or goals designed specifically to ensure development compatible with AICUZ recommendations. However, the goals and policies of the Comprehensive Plan and current zoning for the town foster minimal development on the east, where aircraft noise from OLF Coupeville has a greater impact. The plan also recommends infill development in the central core of the town, where aircraft noise has less of an impact.

*Above shows North Main Street in the Town of Coupeville. The town's plan calls for infill development within this central area.*

## 7.4 Planning and Future Land Use in Impacted Areas

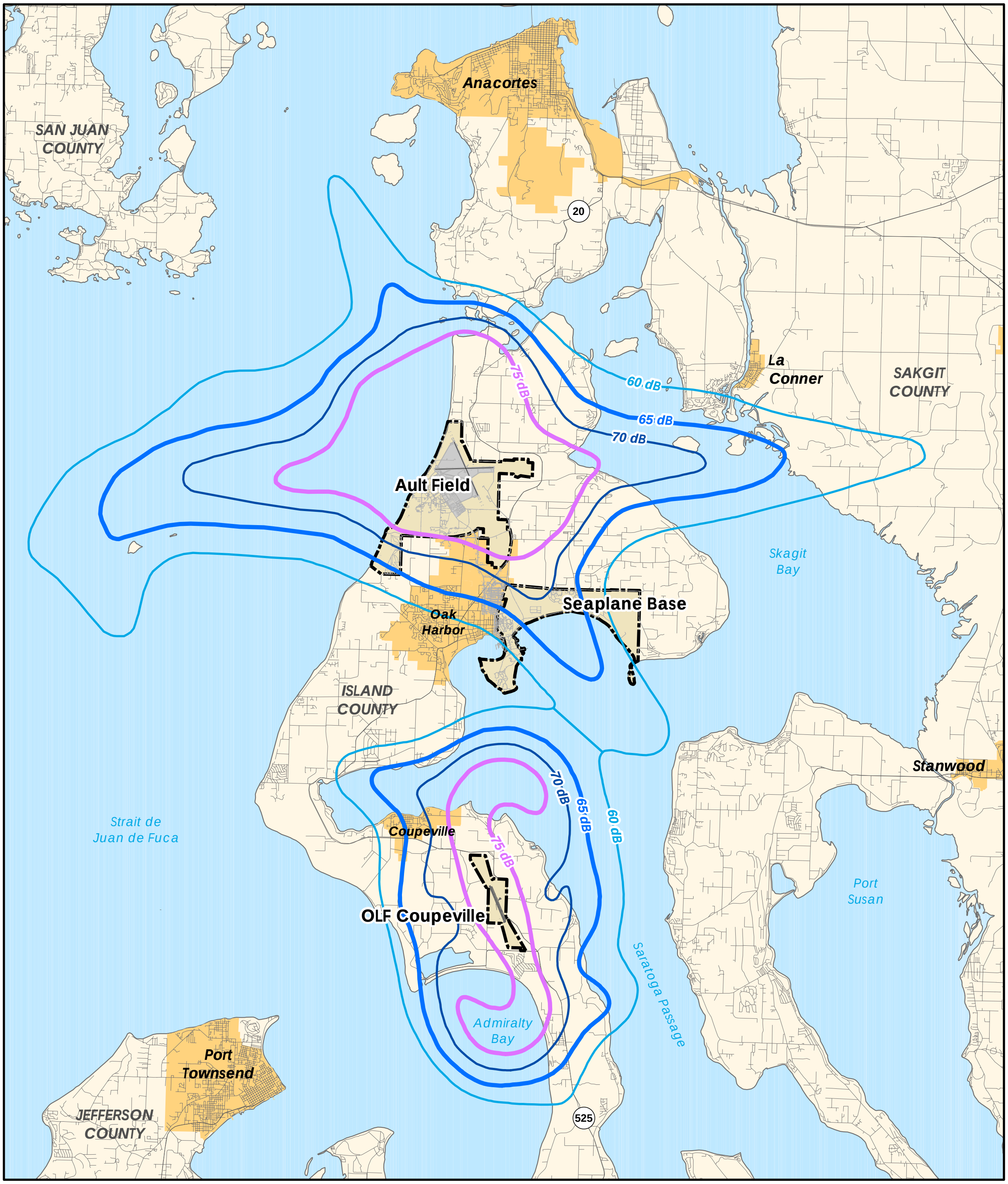
### 7.4.1 Island County Planning and Future Land Use

The Island County Comprehensive Plan was adopted in 1998 in accordance with the Washington State Growth Management Act. The plan was established to manage growth in the county through the year 2020. As mandated under RCW 36.70A.070, the elements addressed include Land Use, Rural, Housing, Capital Facilities, Utilities, Transportation, and Shoreline Management. Several optional elements are addressed in the plan as well, including Parks, Recreation and Open Space, Natural Lands, Historic Preservation, and Water Resources (Board of Island County Commissioners et al., 1998).

The Comprehensive Plan acknowledges the county's association with NAS Whidbey Island, as well as the impacts associated with aircraft operations at Ault Field and OLF Coupeville. The plan designates an "Airport and Aviation Safety Overlay," which recommends that future land use adjacent to Ault Field and OLF Coupeville be maintained as Rural (R) and Rural Agricultural (RA) Zones. These areas are designated R and RA to encourage low-density development within the air station's noise zones.

The plan also states the following—"Island County will discourage residential development in Aircraft Accident Potential Zones (APZ). To protect the operational use of military airports, Island County will ensure that future development in Accident Potential Zones (APZs) around Ault Field and Outlying Field Coupeville is at the lowest possible density consistent with the underlying land use designation."

Additionally, the comprehensive plan addresses growth issues through 2020, with the most powerful tool being the designation of Urban Growth Areas (UGAs) in which urban growth shall be encouraged and outside of which only nonurban growth may occur. Two UGAs exist near Ault Field and OLF Coupeville, as shown in Figure 7-4, the Island County Future Land Use Map. One UGA is located around the City of Oak Harbor and the second UGA is located around the Town of Coupeville. The figure illustrates that the UGA around the City of Oak Harbor actually includes an additional area outside the municipality's limits, while the UGA for the Town of Coupeville is the municipality's limits. The larger UGA around the City of Oak Harbor works to provide an urban transition area where clustered development, open space for future development, and greenbelts are envisioned. Since the Town of Coupeville has a limited water supply and sewer availability, no UGA transition area has been included.




**DNL Noise Contours**

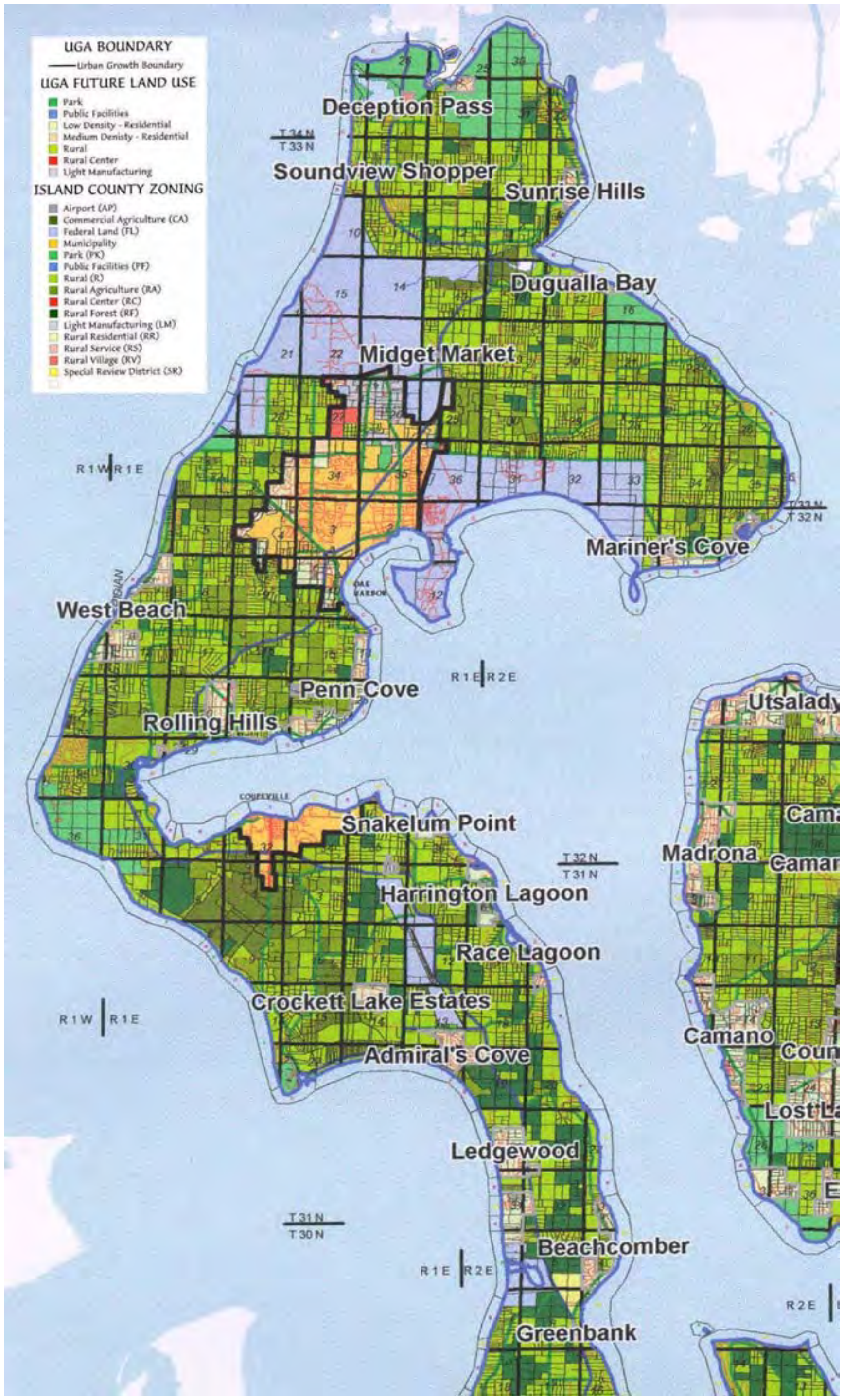
60 dB
65 dB
70 dB
75 dB

# Figure 7-3
## Island County and City of Oak Harbor Noise Contours

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Island County GIS, 2004
Wyle Laboratories, 2004

TRUE NORTH
MAGNETIC NORTH
Magnetic Declination 19°

0 1 2 3
Miles




## Figure 7-4
### Island County Future Land Use Map

Source:
Island County, 2004

### 7.4.2 City of Oak Harbor Planning and Future Land Use

The City of Oak Harbor Comprehensive Plan was adopted in 2003 in accordance with the Washington State Growth Management Act. The plan was established to manage growth in the city through the year 2013. As mandated under RCW 36.70A.070, the elements addressed include Land Use, Housing, Capital Facilities, Utilities, Transportation, and Shoreline Management, as well as several optional elements.

The Comprehensive Plan contains goals and policies that address the Navy's AICUZ land use compatibility recommendations, and an element on "City of Oak Harbor and Naval Air Station Whidbey Island Community Cooperation," which supports growth and development compatible with operations at Ault Field. The AICUZ recommendations are implemented through the city's adopted Aviation Environs Overlay Zone, noise attenuation standards, and noise disclosure requirement in the municipal code. Land uses within the Aviation Environs Overlay Zone are designated for low-density development.

The UGA around the City of Oak Harbor includes a transition zone that abuts Navy property on the southern side of Ault Field. As shown in Figure 7-4, future land use in this area is primarily designated as light manufacturing, low-density residential, and rural. These land use designations align well with AICUZ land use compatibility recommendations. For example, the area that directly abuts Navy property and occurs within Noise Zone 3 environs is designated as light manufacturing—such uses are compatible with some level of noise level reduction.

### 7.4.3 Town of Coupeville Planning and Future Land Use

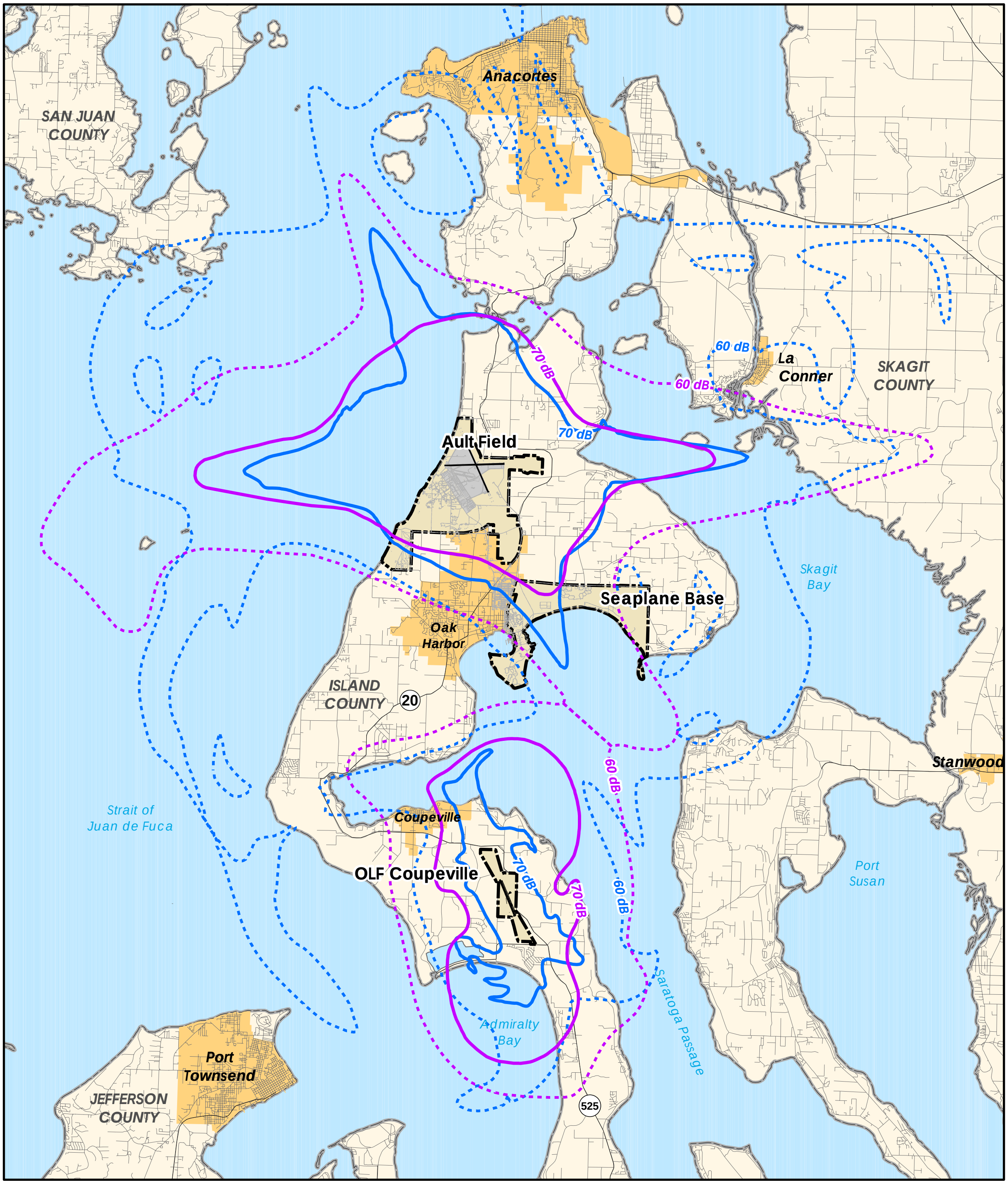
The Town of Coupeville Comprehensive Plan was adopted in 2003 in accordance with the Washington State Growth Management Act. The plan was established to manage growth in the town through the year 2013. As mandated under RCW 36.70A.070, the elements addressed include Land Use, Housing, Capital Facilities, Utilities, Transportation, and Shoreline Management, as well as several optional elements. The town has not adopted any policies or goals designed specifically to ensure development compatible with AICUZ recommendations. However, the goals and policies of the Comprehensive Plan and current zoning for the town foster minimal development on the east, where aircraft noise from OLF Coupeville has a greater impact. The plan also recommends infill development in the central core of the town, where aircraft noise has less of an impact.

## 7.5 Land Use Compatibility Summary

Island County's Rural (R) Zone and Rural Agricultural (RA) Zone around the airfields bodes well for land use compatibility—both zones allow for low-density residential development and promote "rural lifestyles" and "the long term productive use of Island County's agricultural land resources".

Noise level reduction/sound attenuation controls and fair noise disclosure enacted by Island County and the City of Oak Harbor encourage compatible land use in the airfields' environs currently. Since land use planning and zoning focus on the future, frequent changes are not normally in the public interest. It is noted that the noise contours included in the current Island County and City of Oak Harbor zoning are generally consistent with the noise contours developed as a part of this study, as shown in Figures 7-5 and 7-6. The controls based on the current zoning and land use planning regulations for Island County and the City of Oak Harbor offer good protection for future AICUZ noise conditions reflected in this update. These controls and noise contours currently included in the local regulations should be maintained to encourage long range land use planning in the area.

While current local land use and zoning regulations in Island County and City Oak Harbor offer good protection and compatible land use provisions based on aircraft noise considerations, the current zoning regulations do not address compatible land use associated with APZs. To further promote land use compatibility, Island County and the City of Oak Harbor are encouraged to adopt CY13 APZs and the accompanying compatible land use recommendations (Table 6-3) into their ordinances.




County/City

60 dB

70 dB

CY03

60 dB

70 dB

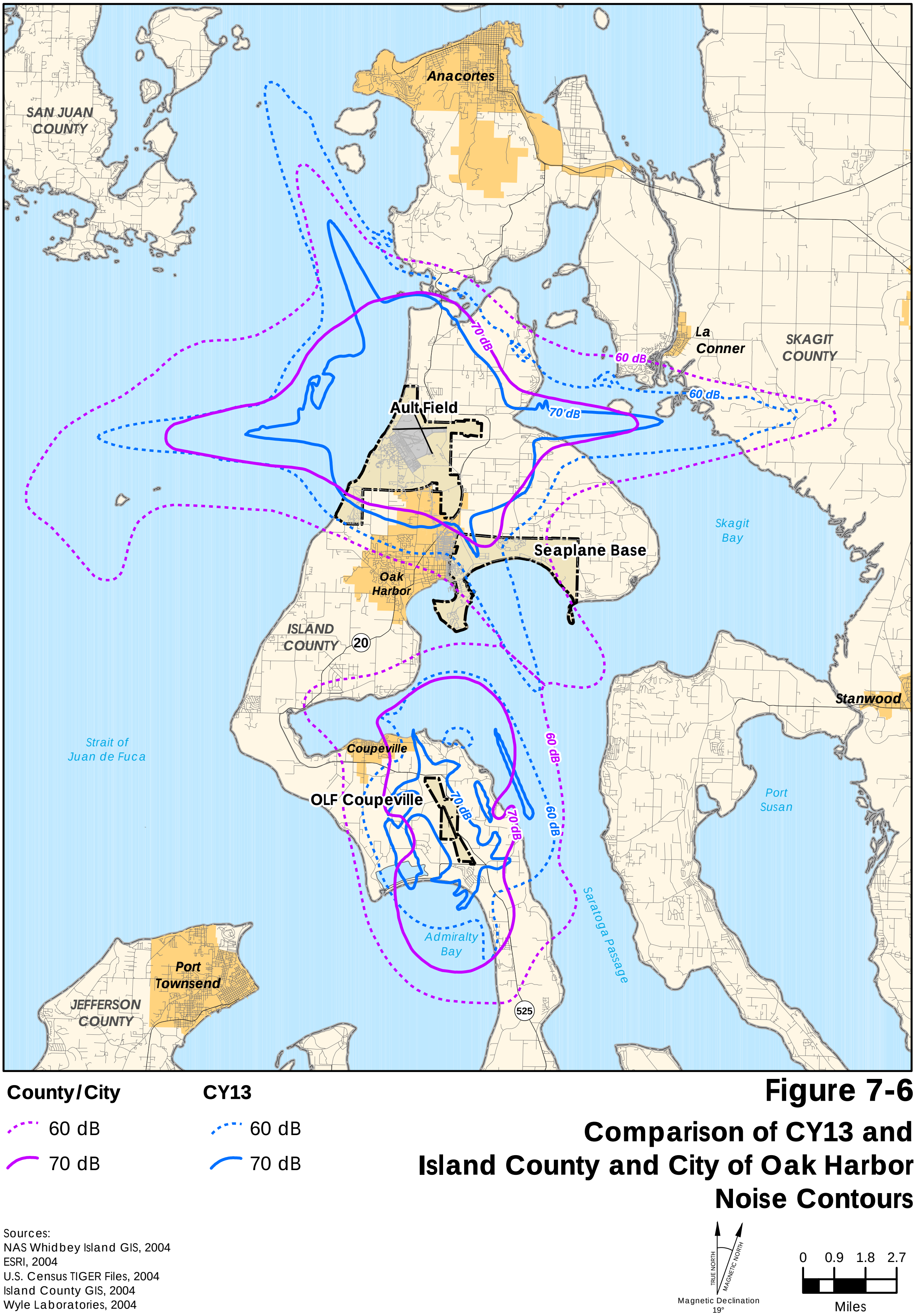
# Figure 7-5

## Comparison of CY03 and Island County and City of Oak Harbor Noise Contours

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Island County GIS, 2004
Wyle Laboratories, 2004

TRUE NORTH
MAGNETIC NORTH
Magnetic Declination 19°

0 0.9 1.8 2.7
Miles




# Figure 7-6

## Comparison of CY13 and Island County and City of Oak Harbor Noise Contours

Sources:
NAS Whidbey Island GIS, 2004
ESRI, 2004
U.S. Census TIGER Files, 2004
Island County GIS, 2004
Wyle Laboratories, 2004

# 8.0 Land Use Compatibility Strategies and Recommendations

The goals of the AICUZ program can most effectively be accomplished by active participation of all interested parties, including the Navy, local government, private citizens, real estate professionals, and builders/developers. Program implementation includes developing a current noise and safety analysis for the airfields; establishing cooperation among local, state, and federal agencies; considering operational alternatives; enacting a complaint response program for residents in surrounding communities; and developing strategies to protect the long-term viability of the airfields. This section presents tools (strategies/techniques) and recommendations for the continued implementation of a successful AICUZ program at NAS Whidbey Island.

The Navy's AICUZ program is focused on promoting land use compatibility between air installations and surrounding communities. The program recognizes the local government's responsibility to protect the public health, safety, and welfare through land use control tools such as zoning ordinances, building codes, subdivision regulations, building permits, and disclosure statements. Successful implementation of such land use controls depends on a close working relationship between the Navy and community leaders. The activity (in this case, NAS Whidbey Island) should continue to work with local governments (Island County, City of Oak Harbor, and the Town of Coupeville), state government, other federal agencies, citizens' groups, and the general public on the AICUZ program.

Although the emphasis of AICUZ program implementation is focused on areas within the AICUZ footprint (noise and safety impact area), the Navy can take a position and comment on land use issues outside the footprint that might lead to incompatible development. For example, large-scale developments bordering the AICUZ footprint or new transportation or utility corridors could make the AICUZ footprint area more desirable for development. Such development could prevent mission changes or mission expansion in the future. Therefore, Commanding Officers and their staffs should monitor proposed development beyond the AICUZ footprint, and, if needed, present those concerns in appropriate forums. The Navy should maintain records of important discussions, negotiations, and testimony with and before local officials and boards.

## 8.1 Summary of Strategies

Tools at the federal, Navy, local government, private citizen, real estate professional, and builder/developer level are available to aid in implementation of a AICUZ program. Details on these tools are contained in Appendix C.

Land use surrounding Ault Field and OLF Coupeville is kept in check with existing zoning and land use regulations that encourage compatible development in areas impacted by noise and safety issues. Island County and the City of Oak Harbor have shown a favorable attitude toward and general intent to work/plan in conjunction with NAS Whidbey Island.

### 8.1.1 Navy Potential Actions

- The continued use of a **Community Plans and Liaison Officer (CP&LO)** is a critical element in the continued implementation of the AICUZ program at NAS Whidbey Island. The CP&LO provides a central point of contact on encroachment matters and proactive Navy representation in land use matters outside the base. The CP&LO is also knowledgeable of past studies; property use and ownership in the vicinity of the airfields; operations at the airfields; and Island County ordinances and plans.

- A continued **community outreach program** is a specific implementation strategy that can provide citizens with factual information regarding the noise and safety impacts of airfield operations.

- All capital improvement projects in proximity to the airfields should be evaluated and reviewed for the potential direct and indirect impacts that such improvements may have on fostering incompatible development.

### 8.1.2 Local Government Potential Considerations

Community decision makers should continue to actively inform and seek input from NAS Whidbey Island, as a major employer and land owner in the community, regarding land use decisions that may affect the operational integrity of the airfields.

- When making land use and development decisions affecting property in proximity to the airfields, the local community should recognize that noise contours and APZs are dynamic. There is a potential for operational and/or mission changes over time that would cause changes in the AICUZ footprint. In order to ensure the military value and flexibility currently available at NAS Whidbey Island the current locally adopted comprehensive plan policies, noise contours and resulting development regulations, building code, disclosure requirements, etc. should remain unchanged .

- There are active flight tracks outside the AICUZ footprints and that residents living outside the AICUZ will hear occasional aircraft noise. The County's noise disclosure requirement for all Whidbey Island north of the Lake Hancock Target Range was adopted to specifically address this issue. Current local planning and zoning regulations also recognize this fact with the requirement for sound attenuation beginning at 60 dB DNL vice the 65 dB DNL recommended in the AICUZ program. Maintaining the current local noise contours and land development regulations are supportive of continued protection of life, safety, and welfare of the local citizens.

- The City of Oak Harbor and Island County should adopt the Accident Potential Zones (APZs) from this Update. Both jurisdictions already have goals and policies in their respective Comprehensive Plans to reduce population densities in aircraft approach and departure corridors, however the Navy has not been able to provide accurate APZs until now. Adopting the APZs from this AICUZ Study Update will protect the health, safety, and general welfare of the public.

### 8.1.3 Citizens, Real Estate Professionals, and Businesses Potential Actions

- The **citizens** can do the following:

    1. Provide sufficient and accurate information when registering a noise complaint with NAS Whidbey Island. Sufficient and accurate information is necessary to assess the potential causes resulting in the complaint and to assess any practical remedies for reducing future complaints.
    2. Become informed about the AICUZ program at NAS Whidbey Island and to learn about the goals and objectives of the program; its value in protecting the health, safety, and welfare of the population; the limits of the program; and the positive community aspects of a successful AICUZ program.
    3. Read and understand disclosure statements and contact the city, county, or NAS Whidbey Island if further information or explanation is needed.

- **Real estate professionals** can do the following:

    1. Provide written fair disclosure to prospective purchasers, renters, or lessees as required in Island County and City of Oak Harbor code.
    2. Make prospective buyers and lessees aware of the potential magnitude of noise exposure they might experience.

## 8.2 Recommendations

The following recommendations promote continued compatible development and prevent incompatible development and potential encroachment resulting from changes in land use controls/zoning regulations.

1. Maintain a Community Plans and Liaison Officer (CP&LO) in the continued implementation of the AICUZ program at NAS Whidbey Island.

2. Continue the extensive public awareness and intergovernmental coordination and cooperation in AICUZ implementation with local, regional and State government agencies.

3. Seek the update of current local planning and zoning ordinances to reflect compatible land use recommendations for APZs as outlined in this study.

4. Support maintaining current aircraft noise related compatible land use and zoning provisions, reflected in land use and zoning provisions and contours, as currently enacted by Island County and the City of Oak Harbor.

5. Seek implementation of AICUZ land use compatibility recommendations with the Town of Coupeville.

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## Appendix A– CY03 and CY13 Modeled Flight Track Utilization Tables

Source: Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington,* 2004.

Table A-1. Modeled EA-6B Flight Track Utilization for Existing CY03 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| DEPARTURE | 07 | 07D1 | 50.0% | 0.49 | 0.03 | 0.52 |
| | | 07D2 | 35.0% | 0.34 | 0.02 | 0.36 |
| | | 07D3 | 15.0% | 0.15 | 0.01 | 0.16 |
| | | 07D4 | 50.0% | 0.21 | 0.01 | 0.22 |
| | | 07D5 | 35.0% | 0.15 | 0.01 | 0.16 |
| | | 07D6 | 15.0% | 0.06 | 0.00 | 0.07 |
| | 25 | 25D1 | 50.0% | 1.66 | 0.10 | 1.76 |
| | | 25D2 | 35.0% | 1.16 | 0.07 | 1.23 |
| | | 25D3 | 15.0% | 0.50 | 0.03 | 0.53 |
| | | 25D4 | 50.0% | 0.71 | 0.04 | 0.76 |
| | | 25D5 | 35.0% | 0.50 | 0.03 | 0.53 |
| | | 25D6 | 15.0% | 0.21 | 0.01 | 0.23 |
| | 13 | 13D1 | 50.0% | 1.36 | 0.08 | 1.44 |
| | | 13D2 | 35.0% | 0.95 | 0.06 | 1.01 |
| | | 13D3 | 15.0% | 0.41 | 0.02 | 0.43 |
| | | 13D4 | 50.0% | 0.58 | 0.04 | 0.62 |
| | | 13D5 | 35.0% | 0.41 | 0.02 | 0.43 |
| | | 13D6 | 15.0% | 0.17 | 0.01 | 0.19 |
| | 31 | 31D1 | 50.0% | 0.26 | 0.02 | 0.28 |
| | | 31D2 | 35.0% | 0.18 | 0.01 | 0.20 |
| | | 31D3 | 15.0% | 0.08 | 0.00 | 0.08 |
| | | 31D4 | 50.0% | 0.11 | 0.01 | 0.12 |
| | | 31D5 | 35.0% | 0.08 | 0.00 | 0.08 |
| | | 31D6 | 15.0% | 0.03 | 0.00 | 0.04 |
| STRAIGHT-IN ARRIVAL IFR | 07 | 07A4A | 50.0% | 0.20 | 0.01 | 0.22 |
| | | 07A4B | 35.0% | 0.14 | 0.01 | 0.15 |
| | | 07A4C | 15.0% | 0.06 | 0.00 | 0.07 |
| | | 07A5A | 50.0% | 0.09 | 0.01 | 0.09 |
| | | 07A5B | 35.0% | 0.06 | 0.00 | 0.07 |
| | | 07A5C | 15.0% | 0.03 | 0.00 | 0.03 |
| | 25 | 25A4 | 100.0% | 1.39 | 0.08 | 1.47 |
| | | 25A5A | 50.0% | 0.30 | 0.02 | 0.32 |
| | | 25A5B | 35.0% | 0.21 | 0.01 | 0.22 |
| | | 25A5C | 15.0% | 0.09 | 0.01 | 0.09 |
| | 13 | 13A5A | 50.0% | 0.57 | 0.03 | 0.60 |
| | | 13A5B | 35.0% | 0.40 | 0.02 | 0.42 |
| | | 13A5C | 15.0% | 0.17 | 0.01 | 0.18 |
| | | 13A6A | 50.0% | 0.24 | 0.01 | 0.26 |
| | | 13A6B | 35.0% | 0.17 | 0.01 | 0.18 |
| | | 13A6C | 15.0% | 0.07 | 0.00 | 0.08 |
| | 31 | 31A5A | 50.0% | 0.11 | 0.01 | 0.12 |
| | | 31A5B | 35.0% | 0.08 | 0.00 | 0.08 |
| | | 31A5C | 15.0% | 0.03 | 0.00 | 0.04 |
| | | 31A6A | 50.0% | 0.05 | 0.00 | 0.05 |
| | | 31A6B | 35.0% | 0.03 | 0.00 | 0.04 |
| | | 31A6C | 15.0% | 0.01 | 0.00 | 0.02 |
| High TACAN ARRIVAL | 07 | 07AHT | 100% | 0.15 | 0.01 | 0.16 |
| | 25 | 25AHT | 100% | 0.50 | 0.03 | 0.53 |
| | 13 | 13AHT | 100% | 0.41 | 0.02 | 0.43 |
| | 31 | 31AHT | 100% | 0.08 | 0.00 | 0.08 |

Table A-1. Modeled EA-6B Flight Track Utilization for Existing CY03 Conditions - continued

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| OVERHEAD BREAK ARRIVAL | 07 | 07OD1A | 90% | 0.20 | 0.00 | 0.20 |
| | | 07OD1B | 90% | 0.20 | 0.00 | 0.20 |
| | | 07OD1C | 90% | 0.20 | 0.00 | 0.20 |
| | | 07OD2A | 10% | 0.02 | 0.00 | 0.02 |
| | | 07OD2B | 10% | 0.02 | 0.00 | 0.02 |
| | | 07OD2C | 10% | 0.02 | 0.00 | 0.02 |
| | | 07ON1A | 90% | 0.00 | 0.01 | 0.01 |
| | | 07ON1B | 90% | 0.00 | 0.01 | 0.01 |
| | | 07ON1C | 90% | 0.00 | 0.01 | 0.01 |
| | | 07ON2A | 10% | 0.00 | 0.00 | 0.00 |
| | | 07ON2B | 10% | 0.00 | 0.00 | 0.00 |
| | | 07ON2C | 10% | 0.00 | 0.00 | 0.00 |
| | 25 | 25OD1A | 90% | 0.67 | 0.00 | 0.67 |
| | | 25OD1B | 90% | 0.67 | 0.00 | 0.67 |
| | | 25OD1C | 90% | 0.67 | 0.00 | 0.67 |
| | | 25OD2A | 10% | 0.07 | 0.00 | 0.07 |
| | | 25OD2B | 10% | 0.07 | 0.00 | 0.07 |
| | | 25OD2C | 10% | 0.07 | 0.00 | 0.07 |
| | | 25ON1A | 90% | 0.00 | 0.05 | 0.05 |
| | | 25ON1B | 90% | 0.00 | 0.05 | 0.05 |
| | | 25ON1C | 90% | 0.00 | 0.05 | 0.05 |
| | | 25ON2A | 10% | 0.00 | 0.01 | 0.01 |
| | | 25ON2B | 10% | 0.00 | 0.01 | 0.01 |
| | | 25ON2C | 10% | 0.00 | 0.01 | 0.01 |
| | 13 | 13OD1A | 90% | 0.55 | 0.00 | 0.55 |
| | | 13OD1B | 90% | 0.55 | 0.00 | 0.55 |
| | | 13OD1C | 90% | 0.55 | 0.00 | 0.55 |
| | | 13OD2A | 10% | 0.06 | 0.00 | 0.06 |
| | | 13OD2B | 10% | 0.06 | 0.00 | 0.06 |
| | | 13OD2C | 10% | 0.06 | 0.00 | 0.06 |
| | | 13ON1A | 90% | 0.00 | 0.04 | 0.04 |
| | | 13ON1B | 90% | 0.00 | 0.04 | 0.04 |
| | | 13ON1C | 90% | 0.00 | 0.04 | 0.04 |
| | | 13ON2A | 10% | 0.00 | 0.00 | 0.00 |
| | | 13ON2B | 10% | 0.00 | 0.00 | 0.00 |
| | | 13ON2C | 10% | 0.00 | 0.00 | 0.00 |
| | 31 | 31OD1A | 90% | 0.11 | 0.00 | 0.11 |
| | | 31OD1B | 90% | 0.11 | 0.00 | 0.11 |
| | | 31OD1C | 90% | 0.11 | 0.00 | 0.11 |
| | | 31OD2A | 10% | 0.01 | 0.00 | 0.01 |
| | | 31OD2B | 10% | 0.01 | 0.00 | 0.01 |
| | | 31OD2C | 10% | 0.01 | 0.00 | 0.01 |
| | | 31ON1A | 90% | 0.00 | 0.01 | 0.01 |
| | | 31ON1B | 90% | 0.00 | 0.01 | 0.01 |
| | | 31ON1C | 90% | 0.00 | 0.01 | 0.01 |
| | | 31ON2A | 10% | 0.00 | 0.00 | 0.00 |
| | | 31ON2B | 10% | 0.00 | 0.00 | 0.00 |
| | | 31ON2C | 10% | 0.00 | 0.00 | 0.00 |

Table A-1. Modeled EA-6B Flight Track Utilization for Existing CY03 Conditions - continued

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| INTERFACILITY - Whidbey to Coupeville | 07 | 07WC1 | 50% | 0.09 | 0.02 | 0.11 |
| | | 07WC2 | 50% | 0.09 | 0.02 | 0.11 |
| | 25 | 25WC1 | 50% | 0.32 | 0.06 | 0.39 |
| | | 25WC2 | 50% | 0.32 | 0.06 | 0.39 |
| | 13 | 13WC1 | 50% | 0.26 | 0.05 | 0.32 |
| | | 13WC2 | 50% | 0.26 | 0.05 | 0.32 |
| | 31 | 31WC1 | 50% | 0.05 | 0.01 | 0.06 |
| | | 31WC2 | 50% | 0.05 | 0.01 | 0.06 |
| INTERFACILITY - Coupeville to Whidbey | 14 | 14CW1 | 25% | 0.18 | 0.04 | 0.22 |
| | | 14CW2 | 25% | 0.18 | 0.04 | 0.22 |
| | | 14CW3 | 25% | 0.18 | 0.04 | 0.22 |
| | | 14CW4 | 25% | 0.18 | 0.04 | 0.22 |
| | 32 | 32CW1 | 25% | 0.18 | 0.04 | 0.22 |
| | | 32CW2 | 25% | 0.18 | 0.04 | 0.22 |
| | | 32CW3 | 25% | 0.18 | 0.04 | 0.22 |
| | | 32CW4 | 25% | 0.18 | 0.04 | 0.22 |
| DEPART AND REENTER | 07 | 07DR | 100% | 0.04 | 0.00 | 0.05 |
| | 25 | 25DR | 100% | 0.14 | 0.01 | 0.15 |
| | 13 | 13DR | 100% | 0.12 | 0.01 | 0.13 |
| | 31 | 31DR | 100% | 0.02 | 0.00 | 0.02 |
| TOUCH AND GO: WHIDBEY ISLAND | 07 | 07TD1 | 12.654% | 0.22 | 0.00 | 0.22 |
| | | 07TD2 | 25.308% | 0.43 | 0.00 | 0.43 |
| | | 07TD3 | 12.654% | 0.22 | 0.00 | 0.22 |
| | | 07TN1 | 12.346% | 0.18 | 0.03 | 0.21 |
| | | 07TN2 | 24.692% | 0.36 | 0.06 | 0.42 |
| | | 07TN3 | 12.346% | 0.18 | 0.03 | 0.21 |
| | 25 | 25TD1 | 12.654% | 0.73 | 0.00 | 0.73 |
| | | 25TD2 | 25.308% | 1.46 | 0.00 | 1.46 |
| | | 25TD3 | 12.654% | 0.73 | 0.00 | 0.73 |
| | | 25TN1 | 12.346% | 0.62 | 0.10 | 0.71 |
| | | 25TN2 | 24.692% | 1.23 | 0.20 | 1.43 |
| | | 25TN3 | 12.346% | 0.62 | 0.10 | 0.71 |
| | 13 | 13TD1 | 12.654% | 0.60 | 0.00 | 0.60 |
| | | 13TD2 | 25.308% | 1.20 | 0.00 | 1.20 |
| | | 13TD3 | 12.654% | 0.60 | 0.00 | 0.60 |
| | | 13TN1 | 12.346% | 0.50 | 0.08 | 0.58 |
| | | 13TN2 | 24.692% | 1.01 | 0.16 | 1.17 |
| | | 13TN3 | 12.346% | 0.50 | 0.08 | 0.58 |
| | 31 | 31TD1 | 12.654% | 0.12 | 0.00 | 0.12 |
| | | 31TD2 | 25.308% | 0.23 | 0.00 | 0.23 |
| | | 31TD3 | 12.654% | 0.12 | 0.00 | 0.12 |
| | | 31TN1 | 12.346% | 0.10 | 0.02 | 0.11 |
| | | 31TN2 | 24.692% | 0.20 | 0.03 | 0.23 |
| | | 31TN3 | 12.346% | 0.10 | 0.02 | 0.11 |

Table A-1. Modeled EA-6B Flight Track Utilization for Existing CY03 Conditions - concluded

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| FCLP: WHIDBEY ISLAND | 07 | 07TD1 | 12.654% | 0.52 | 0.00 | 0.52 |
| | | 07TD2 | 25.308% | 1.03 | 0.00 | 1.03 |
| | | 07TD3 | 12.654% | 0.52 | 0.00 | 0.52 |
| | | 07TN1 | 12.346% | 0.44 | 0.07 | 0.50 |
| | | 07TN2 | 24.692% | 0.87 | 0.14 | 1.01 |
| | | 07TN3 | 12.346% | 0.44 | 0.07 | 0.50 |
| | 25 | 25TD1 | 12.654% | 1.75 | 0.00 | 1.75 |
| | | 25TD2 | 25.308% | 3.50 | 0.00 | 3.50 |
| | | 25TD3 | 12.654% | 1.75 | 0.00 | 1.75 |
| | | 25TN1 | 12.346% | 1.47 | 0.24 | 1.71 |
| | | 25TN2 | 24.692% | 2.94 | 0.47 | 3.42 |
| | | 25TN3 | 12.346% | 1.47 | 0.24 | 1.71 |
| | 13 | 13TD1 | 12.654% | 1.43 | 0.00 | 1.43 |
| | | 13TD2 | 25.308% | 2.86 | 0.00 | 2.86 |
| | | 13TD3 | 12.654% | 1.43 | 0.00 | 1.43 |
| | | 13TN1 | 12.346% | 1.20 | 0.19 | 1.40 |
| | | 13TN2 | 24.692% | 2.41 | 0.39 | 2.79 |
| | | 13TN3 | 12.346% | 1.20 | 0.19 | 1.40 |
| | 31 | 31TD1 | 12.654% | 0.28 | 0.00 | 0.28 |
| | | 31TD2 | 25.308% | 0.56 | 0.00 | 0.56 |
| | | 31TD3 | 12.654% | 0.28 | 0.00 | 0.28 |
| | | 31TN1 | 12.346% | 0.23 | 0.04 | 0.27 |
| | | 31TN2 | 24.692% | 0.47 | 0.07 | 0.54 |
| | | 31TN3 | 12.346% | 0.23 | 0.04 | 0.27 |
| GCA BOX | 07 | 07G1 | 50.0% | 0.18 | 0.16 | 0.34 |
| | | 07G2 | 20.0% | 0.07 | 0.07 | 0.14 |
| | | 07G3 | 30.0% | 0.11 | 0.10 | 0.21 |
| | 25 | 25G1 | 50.0% | 0.61 | 0.55 | 1.16 |
| | | 25G2 | 20.0% | 0.24 | 0.22 | 0.47 |
| | | 25G3 | 30.0% | 0.37 | 0.33 | 0.70 |
| | 13 | 13G1 | 50.0% | 0.50 | 0.45 | 0.95 |
| | | 13G2 | 20.0% | 0.20 | 0.18 | 0.38 |
| | | 13G3 | 30.0% | 0.30 | 0.27 | 0.57 |
| | 31 | 31G1 | 50.0% | 0.10 | 0.09 | 0.19 |
| | | 31G2 | 20.0% | 0.04 | 0.04 | 0.07 |
| | | 31G3 | 30.0% | 0.06 | 0.05 | 0.11 |
| FCLP: COUPEVILLE | 14 | 14TD1 | 83.181% | 1.09 | 0.00 | 1.09 |
| | | 14TD2 | 83.181% | 2.19 | 0.00 | 2.19 |
| | | 14TD3 | 83.181% | 1.09 | 0.00 | 1.09 |
| | | 14TN1 | 16.819% | 0.14 | 0.08 | 0.22 |
| | | 14TN2 | 16.819% | 0.29 | 0.15 | 0.44 |
| | | 14TN3 | 16.819% | 0.14 | 0.08 | 0.22 |
| | 32 | 32TD1 | 83.181% | 1.09 | 0.00 | 1.09 |
| | | 32TD2 | 83.181% | 2.19 | 0.00 | 2.19 |
| | | 32TD3 | 83.181% | 1.09 | 0.00 | 1.09 |
| | | 32TN1 | 16.819% | 0.14 | 0.08 | 0.22 |
| | | 32TN2 | 16.819% | 0.29 | 0.15 | 0.44 |
| | | 32TN3 | 16.819% | 0.14 | 0.08 | 0.22 |

Table A-2. Modeled P-3 Flight Track Utilization for Existing CY03 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
|---|---|---|---|---|---|---|
| DEPARTURE | 07 | 07D2 | 50% | 0.26 | 0.01 | 0.27 |
| | | 07D3 | 50% | 0.26 | 0.01 | 0.27 |
| | | 07D5 | 50% | 0.39 | 0.02 | 0.41 |
| | | 07D6 | 50% | 0.39 | 0.02 | 0.41 |
| | 25 | 25D2 | 50% | 0.88 | 0.03 | 0.92 |
| | | 25D3 | 50% | 0.88 | 0.03 | 0.92 |
| | | 25D5 | 50% | 1.33 | 0.05 | 1.38 |
| | | 25D6 | 50% | 1.33 | 0.05 | 1.38 |
| | 13 | 13D2 | 50% | 0.72 | 0.03 | 0.75 |
| | | 13D3 | 50% | 0.72 | 0.03 | 0.75 |
| | | 13D5 | 50% | 1.09 | 0.04 | 1.13 |
| | | 13D6 | 50% | 1.09 | 0.04 | 1.13 |
| | 31 | 31D2 | 50% | 0.14 | 0.01 | 0.15 |
| | | 31D3 | 50% | 0.14 | 0.01 | 0.15 |
| | | 31D5 | 50% | 0.21 | 0.01 | 0.22 |
| | | 31D6 | 50% | 0.21 | 0.01 | 0.22 |
| Low TACAN DEPARTURE | 07 | 07DLT | 100% | 1.53 | 0.03 | 1.56 |
| | 25 | 25DLT | 100% | 5.17 | 0.10 | 5.27 |
| | 13 | 13DLT | 100% | 4.23 | 0.08 | 4.31 |
| | 31 | 31DLT | 100% | 0.82 | 0.02 | 0.84 |
| STRAIGHT-IN ARRIVAL VFR | 07 | 07A1 | 100% | 0.61 | 0.01 | 0.62 |
| | | 07A2 | 50% | 0.46 | 0.01 | 0.47 |
| | | 07A3 | 50% | 0.46 | 0.01 | 0.47 |
| | 25 | 25A1 | 100% | 2.07 | 0.04 | 2.11 |
| | | 25A2 | 50% | 1.55 | 0.03 | 1.58 |
| | | 25A3 | 50% | 1.55 | 0.03 | 1.58 |
| | 13 | 13A1 | 50% | 0.85 | 0.02 | 0.86 |
| | | 13A2 | 50% | 0.85 | 0.02 | 0.86 |
| | | 13A3 | 50% | 1.27 | 0.02 | 1.29 |
| | | 13A4 | 50% | 1.27 | 0.02 | 1.29 |
| | 31 | 31A1 | 50% | 0.16 | 0.00 | 0.17 |
| | | 31A2 | 50% | 0.16 | 0.00 | 0.17 |
| | | 31A3 | 50% | 0.25 | 0.00 | 0.25 |
| | | 31A4 | 50% | 0.25 | 0.00 | 0.25 |
| STRAIGHT-IN ARRIVAL IFR | 07 | 07A4B | 50.0% | 0.13 | 0.01 | 0.14 |
| | | 07A4C | 50.0% | 0.13 | 0.01 | 0.14 |
| | | 07A5B | 50.0% | 0.20 | 0.01 | 0.20 |
| | | 07A5C | 50.0% | 0.20 | 0.01 | 0.20 |
| | 25 | 25A4 | 100.0% | 0.88 | 0.03 | 0.92 |
| | | 25A5B | 50.0% | 0.66 | 0.03 | 0.69 |
| | | 25A5C | 50.0% | 0.66 | 0.03 | 0.69 |
| | 13 | 13A5B | 50.0% | 0.36 | 0.01 | 0.38 |
| | | 13A5C | 50.0% | 0.36 | 0.01 | 0.38 |
| | | 13A6B | 50.0% | 0.54 | 0.02 | 0.56 |
| | | 13A6C | 50.0% | 0.54 | 0.02 | 0.56 |
| | 31 | 31A5B | 50.0% | 0.07 | 0.00 | 0.07 |
| | | 31A5C | 50.0% | 0.07 | 0.00 | 0.07 |
| | | 31A6B | 50.0% | 0.11 | 0.00 | 0.11 |
| | | 31A6C | 50.0% | 0.11 | 0.00 | 0.11 |
| Low TACAN ARRIVAL | 07 | 07ALT | 100.0% | 0.65 | 0.03 | 0.68 |
| | 25 | 25ALT | 100.0% | 2.21 | 0.09 | 2.30 |
| | 13 | 13ALT | 100.0% | 1.81 | 0.07 | 1.88 |
| | 31 | 31ALT | 100.0% | 0.35 | 0.01 | 0.37 |

Table A-2. Modeled P-3 Flight Track Utilization for Existing CY03 Conditions - concluded

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| TOUCH AND GO: WHIDBEY ISLAND | 07 | 07TN1 | 25% | 0.57 | 0.00 | 0.57 |
| | | 07TN2 | 50% | 1.15 | 0.00 | 1.15 |
| | | 07TN3 | 25% | 0.57 | 0.00 | 0.57 |
| | 07 | 07TN1 | 25% | 0.00 | 0.01 | 0.01 |
| | | 07TN2 | 50% | 0.00 | 0.02 | 0.02 |
| | | 07TN3 | 25% | 0.00 | 0.01 | 0.01 |
| | 25 | 25TN1 | 25% | 1.94 | 0.00 | 1.94 |
| | | 25TN2 | 50% | 3.88 | 0.00 | 3.88 |
| | | 25TN3 | 25% | 1.94 | 0.00 | 1.94 |
| | 25 | 25TN1 | 25% | 0.00 | 0.04 | 0.04 |
| | | 25TN2 | 50% | 0.00 | 0.07 | 0.07 |
| | | 25TN3 | 25% | 0.00 | 0.04 | 0.04 |
| | 13 | 13TN1 | 25% | 1.59 | 0.00 | 1.59 |
| | | 13TN2 | 50% | 3.17 | 0.00 | 3.17 |
| | | 13TN3 | 25% | 1.59 | 0.00 | 1.59 |
| | 13 | 13TN1 | 25% | 0.00 | 0.03 | 0.03 |
| | | 13TN2 | 50% | 0.00 | 0.06 | 0.06 |
| | | 13TN3 | 25% | 0.00 | 0.03 | 0.03 |
| | 31 | 31TN1 | 25% | 0.31 | 0.00 | 0.31 |
| | | 31TN2 | 50% | 0.62 | 0.00 | 0.62 |
| | | 31TN3 | 25% | 0.31 | 0.00 | 0.31 |
| | 31 | 31TN1 | 25% | 0.00 | 0.01 | 0.01 |
| | | 31TN2 | 50% | 0.00 | 0.01 | 0.01 |
| | | 31TN3 | 25% | 0.00 | 0.01 | 0.01 |
| GCA BOX | 07 | 07G2 | 100.0% | 0.42 | 0.02 | 0.43 |
| | | 07G3 | 100.0% | 0.42 | 0.02 | 0.43 |
| | 25 | 25G2 | 100.0% | 1.40 | 0.05 | 1.46 |
| | | 25G3 | 100.0% | 1.40 | 0.05 | 1.46 |
| | 13 | 13G2 | 100.0% | 1.15 | 0.04 | 1.19 |
| | | 13G3 | 100.0% | 1.15 | 0.04 | 1.19 |
| | 31 | 31G2 | 100.0% | 0.22 | 0.01 | 0.23 |
| | | 31G3 | 100.0% | 0.22 | 0.01 | 0.23 |

Table A-3. Modeled C-9 Flight Track Utilization for Existing CY03 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| DEPARTURE | 07 | 07D2 | 50% | 0.02 | 0.00 | 0.02 |
| | | 07D3 | 50% | 0.02 | 0.00 | 0.02 |
| | | 07D5 | 50% | 0.03 | 0.00 | 0.03 |
| | | 07D6 | 50% | 0.03 | 0.00 | 0.03 |
| | 25 | 25D2 | 50% | 0.08 | 0.00 | 0.08 |
| | | 25D3 | 50% | 0.08 | 0.00 | 0.08 |
| | | 25D5 | 50% | 0.11 | 0.00 | 0.12 |
| | | 25D6 | 50% | 0.11 | 0.00 | 0.12 |
| | 13 | 13D2 | 50% | 0.06 | 0.00 | 0.06 |
| | | 13D3 | 50% | 0.06 | 0.00 | 0.06 |
| | | 13D5 | 50% | 0.09 | 0.00 | 0.10 |
| | | 13D6 | 50% | 0.09 | 0.00 | 0.10 |
| | 31 | 31D2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D3 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D5 | 50% | 0.02 | 0.00 | 0.02 |
| | | 31D6 | 50% | 0.02 | 0.00 | 0.02 |
| STRAIGHT-IN ARRIVAL VFR | 07 | 07A1 | 100% | 0.05 | 0.00 | 0.05 |
| | | 07A2 | 50% | 0.03 | 0.00 | 0.03 |
| | | 07A3 | 50% | 0.03 | 0.00 | 0.03 |
| | 25 | 25A1 | 100% | 0.15 | 0.00 | 0.16 |
| | | 25A2 | 50% | 0.12 | 0.00 | 0.12 |
| | | 25A3 | 50% | 0.12 | 0.00 | 0.12 |
| | 13 | 13A1 | 50% | 0.06 | 0.00 | 0.06 |
| | | 13A2 | 50% | 0.06 | 0.00 | 0.06 |
| | | 13A3 | 50% | 0.09 | 0.00 | 0.10 |
| | | 13A4 | 50% | 0.09 | 0.00 | 0.10 |
| | 31 | 31A1 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A3 | 50% | 0.02 | 0.00 | 0.02 |
| | | 31A4 | 50% | 0.02 | 0.00 | 0.02 |

Table A-4. Modeled C-12 Flight Track Utilization for Existing CY03 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| DEPARTURE | 07 | 07D2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 07D3 | 50% | 0.01 | 0.00 | 0.01 |
| | | 07D5 | 50% | 0.01 | 0.00 | 0.01 |
| | | 07D6 | 50% | 0.01 | 0.00 | 0.01 |
| | 25 | 25D2 | 50% | 0.02 | 0.00 | 0.02 |
| | | 25D3 | 50% | 0.02 | 0.00 | 0.02 |
| | | 25D5 | 50% | 0.03 | 0.00 | 0.04 |
| | | 25D6 | 50% | 0.03 | 0.00 | 0.04 |
| | 13 | 13D2 | 50% | 0.02 | 0.00 | 0.02 |
| | | 13D3 | 50% | 0.02 | 0.00 | 0.02 |
| | | 13D5 | 50% | 0.03 | 0.00 | 0.03 |
| | | 13D6 | 50% | 0.03 | 0.00 | 0.03 |
| | 31 | 31D2 | 50% | 0.00 | 0.00 | 0.00 |
| | | 31D3 | 50% | 0.00 | 0.00 | 0.00 |
| | | 31D5 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D6 | 50% | 0.01 | 0.00 | 0.01 |
| STRAIGHT-IN ARRIVAL VFR | 07 | 07A1 | 100% | 0.01 | 0.00 | 0.01 |
| | | 07A2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 07A3 | 50% | 0.01 | 0.00 | 0.01 |
| | 25 | 25A1 | 100% | 0.05 | 0.00 | 0.05 |
| | | 25A2 | 50% | 0.04 | 0.00 | 0.04 |
| | | 25A3 | 50% | 0.04 | 0.00 | 0.04 |
| | 13 | 13A1 | 50% | 0.02 | 0.00 | 0.02 |
| | | 13A2 | 50% | 0.02 | 0.00 | 0.02 |
| | | 13A3 | 50% | 0.03 | 0.00 | 0.03 |
| | | 13A4 | 50% | 0.03 | 0.00 | 0.03 |
| | 31 | 31A1 | 50% | 0.00 | 0.00 | 0.00 |
| | | 31A2 | 50% | 0.00 | 0.00 | 0.00 |
| | | 31A3 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A4 | 50% | 0.01 | 0.00 | 0.01 |

Table A-5. Modeled Transient Flight Track Utilization for Existing CY03 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| DEPARTURE | 07 | 07D2 | 50% | 0.02 | 0.00 | 0.02 |
| | | 07D3 | 50% | 0.02 | 0.00 | 0.02 |
| | | 07D5 | 50% | 0.03 | 0.00 | 0.03 |
| | | 07D6 | 50% | 0.03 | 0.00 | 0.03 |
| | 25 | 25D2 | 50% | 0.06 | 0.00 | 0.06 |
| | | 25D3 | 50% | 0.06 | 0.00 | 0.06 |
| | | 25D5 | 50% | 0.09 | 0.00 | 0.09 |
| | | 25D6 | 50% | 0.09 | 0.00 | 0.09 |
| | 13 | 13D2 | 50% | 0.05 | 0.00 | 0.05 |
| | | 13D3 | 50% | 0.05 | 0.00 | 0.05 |
| | | 13D5 | 50% | 0.07 | 0.00 | 0.07 |
| | | 13D6 | 50% | 0.07 | 0.00 | 0.07 |
| | 31 | 31D2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D3 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D5 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D6 | 50% | 0.01 | 0.00 | 0.01 |
| STRAIGHT-IN ARRIVAL VFR | 07 | 07A1 | 100% | 0.04 | 0.00 | 0.04 |
| | | 07A2 | 50% | 0.03 | 0.00 | 0.03 |
| | | 07A3 | 50% | 0.03 | 0.00 | 0.03 |
| | 25 | 25A1 | 100% | 0.12 | 0.00 | 0.12 |
| | | 25A2 | 50% | 0.09 | 0.00 | 0.09 |
| | | 25A3 | 50% | 0.09 | 0.00 | 0.09 |
| | 13 | 13A1 | 50% | 0.05 | 0.00 | 0.05 |
| | | 13A2 | 50% | 0.05 | 0.00 | 0.05 |
| | | 13A3 | 50% | 0.07 | 0.00 | 0.07 |
| | | 13A4 | 50% | 0.07 | 0.00 | 0.07 |
| | 31 | 31A1 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A3 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A4 | 50% | 0.01 | 0.00 | 0.01 |

Table A-6. Modeled EA-18G Flight Track Utilization for Projected CY13 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| DEPARTURE - A/B (80%) | 07 | 07D1 | 50.0% | 0.37 | 0.02 | 0.40 |
| | | 07D2 | 35.0% | 0.26 | 0.02 | 0.28 |
| | | 07D3 | 15.0% | 0.11 | 0.01 | 0.12 |
| | | 07D4 | 50.0% | 0.16 | 0.01 | 0.17 |
| | | 07D5 | 35.0% | 0.11 | 0.01 | 0.12 |
| | | 07D6 | 15.0% | 0.05 | 0.00 | 0.05 |
| | 25 | 25D1 | 50.0% | 1.27 | 0.08 | 1.34 |
| | | 25D2 | 35.0% | 0.89 | 0.05 | 0.94 |
| | | 25D3 | 15.0% | 0.38 | 0.02 | 0.40 |
| | | 25D4 | 50.0% | 0.54 | 0.03 | 0.58 |
| | | 25D5 | 35.0% | 0.38 | 0.02 | 0.40 |
| | | 25D6 | 15.0% | 0.16 | 0.01 | 0.17 |
| | 13 | 13D1 | 50.0% | 1.04 | 0.06 | 1.10 |
| | | 13D2 | 35.0% | 0.72 | 0.04 | 0.77 |
| | | 13D3 | 15.0% | 0.31 | 0.02 | 0.33 |
| | | 13D4 | 50.0% | 0.44 | 0.03 | 0.47 |
| | | 13D5 | 35.0% | 0.31 | 0.02 | 0.33 |
| | | 13D6 | 15.0% | 0.13 | 0.01 | 0.14 |
| | 31 | 31D1 | 50.0% | 0.20 | 0.01 | 0.21 |
| | | 31D2 | 35.0% | 0.14 | 0.01 | 0.15 |
| | | 31D3 | 15.0% | 0.06 | 0.00 | 0.06 |
| | | 31D4 | 50.0% | 0.09 | 0.01 | 0.09 |
| | | 31D5 | 35.0% | 0.06 | 0.00 | 0.06 |
| | | 31D6 | 15.0% | 0.03 | 0.00 | 0.03 |
| DEPARTURE - MIL (20%) | 07 | 07D1 | 50.0% | 0.09 | 0.01 | 0.10 |
| | | 07D2 | 35.0% | 0.07 | 0.00 | 0.07 |
| | | 07D3 | 15.0% | 0.03 | 0.00 | 0.03 |
| | | 07D4 | 50.0% | 0.04 | 0.00 | 0.04 |
| | | 07D5 | 35.0% | 0.03 | 0.00 | 0.03 |
| | | 07D6 | 15.0% | 0.01 | 0.00 | 0.01 |
| | 25 | 25D1 | 50.0% | 0.32 | 0.02 | 0.34 |
| | | 25D2 | 35.0% | 0.22 | 0.01 | 0.23 |
| | | 25D3 | 15.0% | 0.09 | 0.01 | 0.10 |
| | | 25D4 | 50.0% | 0.14 | 0.01 | 0.14 |
| | | 25D5 | 35.0% | 0.09 | 0.01 | 0.10 |
| | | 25D6 | 15.0% | 0.04 | 0.00 | 0.04 |
| | 13 | 13D1 | 50.0% | 0.26 | 0.02 | 0.27 |
| | | 13D2 | 35.0% | 0.18 | 0.01 | 0.19 |
| | | 13D3 | 15.0% | 0.08 | 0.00 | 0.08 |
| | | 13D4 | 50.0% | 0.11 | 0.01 | 0.12 |
| | | 13D5 | 35.0% | 0.08 | 0.00 | 0.08 |
| | | 13D6 | 15.0% | 0.03 | 0.00 | 0.04 |
| | 31 | 31D1 | 50.0% | 0.05 | 0.00 | 0.05 |
| | | 31D2 | 35.0% | 0.04 | 0.00 | 0.04 |
| | | 31D3 | 15.0% | 0.02 | 0.00 | 0.02 |
| | | 31D4 | 50.0% | 0.02 | 0.00 | 0.02 |
| | | 31D5 | 35.0% | 0.02 | 0.00 | 0.02 |
| | | 31D6 | 15.0% | 0.01 | 0.00 | 0.01 |

Table A-6. Modeled EA-18G Flight Track Utilization for Projected CY13 Conditions - continued

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| STRAIGHT-IN ARRIVAL IFR | 07 | 07A4A | 50.0% | 0.20 | 0.01 | 0.21 |
| | | 07A4B | 35.0% | 0.14 | 0.01 | 0.15 |
| | | 07A4C | 15.0% | 0.06 | 0.00 | 0.06 |
| | | 07A5A | 50.0% | 0.08 | 0.01 | 0.09 |
| | | 07A5B | 35.0% | 0.06 | 0.00 | 0.06 |
| | | 07A5C | 15.0% | 0.03 | 0.00 | 0.03 |
| | 25 | 25A4 | 100.0% | 1.32 | 0.08 | 1.40 |
| | | 25A5A | 50.0% | 0.28 | 0.02 | 0.30 |
| | | 25A5B | 35.0% | 0.20 | 0.01 | 0.21 |
| | | 25A5C | 15.0% | 0.08 | 0.01 | 0.09 |
| | 13 | 13A5A | 50.0% | 0.54 | 0.03 | 0.57 |
| | | 13A5B | 35.0% | 0.38 | 0.02 | 0.40 |
| | | 13A5C | 15.0% | 0.16 | 0.01 | 0.17 |
| | | 13A6A | 50.0% | 0.23 | 0.01 | 0.25 |
| | | 13A6B | 35.0% | 0.16 | 0.01 | 0.17 |
| | | 13A6C | 15.0% | 0.07 | 0.00 | 0.07 |
| | 31 | 31A5A | 50.0% | 0.11 | 0.01 | 0.11 |
| | | 31A5B | 35.0% | 0.07 | 0.00 | 0.08 |
| | | 31A5C | 15.0% | 0.03 | 0.00 | 0.03 |
| | | 31A6A | 50.0% | 0.05 | 0.00 | 0.05 |
| | | 31A6B | 35.0% | 0.03 | 0.00 | 0.03 |
| | | 31A6C | 15.0% | 0.01 | 0.00 | 0.01 |
| High TACAN ARRIVAL | 07 | 07AHT | 100% | 0.14 | 0.01 | 0.15 |
| | 25 | 25AHT | 100% | 0.47 | 0.03 | 0.50 |
| | 13 | 13AHT | 100% | 0.39 | 0.02 | 0.41 |
| | 31 | 31AHT | 100% | 0.08 | 0.00 | 0.08 |

Table A-6. Modeled EA-18G Flight Track Utilization for Projected CY13 Conditions - continued

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| OVERHEAD BREAK ARRIVAL | 07 | 07OD1A | 90% | 0.19 | 0.00 | 0.19 |
| | | 07OD1B | 90% | 0.19 | 0.00 | 0.19 |
| | | 07OD1C | 90% | 0.19 | 0.00 | 0.19 |
| | | 07OD2A | 10% | 0.02 | 0.00 | 0.02 |
| | | 07OD2B | 10% | 0.02 | 0.00 | 0.02 |
| | | 07OD2C | 10% | 0.02 | 0.00 | 0.02 |
| | | 07ON1A | 90% | 0.00 | 0.01 | 0.01 |
| | | 07ON1B | 90% | 0.00 | 0.01 | 0.01 |
| | | 07ON1C | 90% | 0.00 | 0.01 | 0.01 |
| | | 07ON2A | 10% | 0.00 | 0.00 | 0.00 |
| | | 07ON2B | 10% | 0.00 | 0.00 | 0.00 |
| | | 07ON2C | 10% | 0.00 | 0.00 | 0.00 |
| | 25 | 25OD1A | 90% | 0.64 | 0.00 | 0.64 |
| | | 25OD1B | 90% | 0.64 | 0.00 | 0.64 |
| | | 25OD1C | 90% | 0.64 | 0.00 | 0.64 |
| | | 25OD2A | 10% | 0.07 | 0.00 | 0.07 |
| | | 25OD2B | 10% | 0.07 | 0.00 | 0.07 |
| | | 25OD2C | 10% | 0.07 | 0.00 | 0.07 |
| | | 25ON1A | 90% | 0.00 | 0.05 | 0.05 |
| | | 25ON1B | 90% | 0.00 | 0.05 | 0.05 |
| | | 25ON1C | 90% | 0.00 | 0.05 | 0.05 |
| | | 25ON2A | 10% | 0.00 | 0.01 | 0.01 |
| | | 25ON2B | 10% | 0.00 | 0.01 | 0.01 |
| | | 25ON2C | 10% | 0.00 | 0.01 | 0.01 |
| | 13 | 13OD1A | 90% | 0.52 | 0.00 | 0.52 |
| | | 13OD1B | 90% | 0.52 | 0.00 | 0.52 |
| | | 13OD1C | 90% | 0.52 | 0.00 | 0.52 |
| | | 13OD2A | 10% | 0.06 | 0.00 | 0.06 |
| | | 13OD2B | 10% | 0.06 | 0.00 | 0.06 |
| | | 13OD2C | 10% | 0.06 | 0.00 | 0.06 |
| | | 13ON1A | 90% | 0.00 | 0.04 | 0.04 |
| | | 13ON1B | 90% | 0.00 | 0.04 | 0.04 |
| | | 13ON1C | 90% | 0.00 | 0.04 | 0.04 |
| | | 13ON2A | 10% | 0.00 | 0.00 | 0.00 |
| | | 13ON2B | 10% | 0.00 | 0.00 | 0.00 |
| | | 13ON2C | 10% | 0.00 | 0.00 | 0.00 |
| | 31 | 31OD1A | 90% | 0.10 | 0.00 | 0.10 |
| | | 31OD1B | 90% | 0.10 | 0.00 | 0.10 |
| | | 31OD1C | 90% | 0.10 | 0.00 | 0.10 |
| | | 31OD2A | 10% | 0.01 | 0.00 | 0.01 |
| | | 31OD2B | 10% | 0.01 | 0.00 | 0.01 |
| | | 31OD2C | 10% | 0.01 | 0.00 | 0.01 |
| | | 31ON1A | 90% | 0.00 | 0.01 | 0.01 |
| | | 31ON1B | 90% | 0.00 | 0.01 | 0.01 |
| | | 31ON1C | 90% | 0.00 | 0.01 | 0.01 |
| | | 31ON2A | 10% | 0.00 | 0.00 | 0.00 |
| | | 31ON2B | 10% | 0.00 | 0.00 | 0.00 |
| | | 31ON2C | 10% | 0.00 | 0.00 | 0.00 |
| INTERFACILITY - Whidbey to Coupeville | 07 | 07WC1 | 50% | 0.09 | 0.02 | 0.11 |
| | | 07WC2 | 50% | 0.09 | 0.02 | 0.11 |
| | 25 | 25WC1 | 50% | 0.31 | 0.06 | 0.37 |
| | | 25WC2 | 50% | 0.31 | 0.06 | 0.37 |
| | 13 | 13WC1 | 50% | 0.25 | 0.05 | 0.30 |
| | | 13WC2 | 50% | 0.25 | 0.05 | 0.30 |
| | 31 | 31WC1 | 50% | 0.05 | 0.01 | 0.06 |
| | | 31WC2 | 50% | 0.05 | 0.01 | 0.06 |

Table A-6. Modeled EA-18G Flight Track Utilization for Projected CY13 Conditions - continued

| Operation Type | Runway | Track ID | Track Mix | Operations Daytime 0700-2200 | Operations Nighttime 2200-0700 | Operations TOTAL |
|---|---|---|---|---|---|---|
| INTERFACILITY - Coupeville to Whidbey | 14 | 14CW1 | 25% | 0.17 | 0.04 | 0.21 |
| | | 14CW2 | 25% | 0.17 | 0.04 | 0.21 |
| | | 14CW3 | 25% | 0.17 | 0.04 | 0.21 |
| | | 14CW4 | 25% | 0.17 | 0.04 | 0.21 |
| | 32 | 32CW1 | 25% | 0.17 | 0.04 | 0.21 |
| | | 32CW2 | 25% | 0.17 | 0.04 | 0.21 |
| | | 32CW3 | 25% | 0.17 | 0.04 | 0.21 |
| | | 32CW4 | 25% | 0.17 | 0.04 | 0.21 |
| DEPART AND REENTER | 07 | 07DR | 100% | 0.04 | 0.00 | 0.04 |
| | 25 | 25DR | 100% | 0.14 | 0.01 | 0.15 |
| | 13 | 13DR | 100% | 0.11 | 0.01 | 0.12 |
| | 31 | 31DR | 100% | 0.02 | 0.00 | 0.02 |
| TOUCH AND GO: WHIDBEY ISLAND | 07 | 07TD1 | 12.654% | 0.21 | 0.00 | 0.21 |
| | | 07TD2 | 25.308% | 0.41 | 0.00 | 0.41 |
| | | 07TD3 | 12.654% | 0.21 | 0.00 | 0.21 |
| | | 07TN1 | 12.346% | 0.17 | 0.03 | 0.20 |
| | | 07TN2 | 24.692% | 0.35 | 0.06 | 0.40 |
| | | 07TN3 | 12.346% | 0.17 | 0.03 | 0.20 |
| | 25 | 25TD1 | 12.654% | 0.70 | 0.00 | 0.70 |
| | | 25TD2 | 25.308% | 1.39 | 0.00 | 1.39 |
| | | 25TD3 | 12.654% | 0.70 | 0.00 | 0.70 |
| | | 25TN1 | 12.346% | 0.59 | 0.09 | 0.68 |
| | | 25TN2 | 24.692% | 1.17 | 0.19 | 1.36 |
| | | 25TN3 | 12.346% | 0.59 | 0.09 | 0.68 |
| | 13 | 13TD1 | 12.654% | 0.57 | 0.00 | 0.57 |
| | | 13TD2 | 25.308% | 1.14 | 0.00 | 1.14 |
| | | 13TD3 | 12.654% | 0.57 | 0.00 | 0.57 |
| | | 13TN1 | 12.346% | 0.48 | 0.08 | 0.56 |
| | | 13TN2 | 24.692% | 0.96 | 0.15 | 1.11 |
| | | 13TN3 | 12.346% | 0.48 | 0.08 | 0.56 |
| | 31 | 31TD1 | 12.654% | 0.11 | 0.00 | 0.11 |
| | | 31TD2 | 25.308% | 0.22 | 0.00 | 0.22 |
| | | 31TD3 | 12.654% | 0.11 | 0.00 | 0.11 |
| | | 31TN1 | 12.346% | 0.09 | 0.01 | 0.11 |
| | | 31TN2 | 24.692% | 0.19 | 0.03 | 0.22 |
| | | 31TN3 | 12.346% | 0.09 | 0.01 | 0.11 |

Table A-6. Modeled EA-18G Flight Track Utilization for Projected CY13 Conditions - concluded

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| FCLP: WHIDBEY ISLAND | 07 | 07TD1 | 12.654% | 0.41 | 0.00 | 0.41 |
| | | 07TD2 | 25.308% | 0.82 | 0.00 | 0.82 |
| | | 07TD3 | 12.654% | 0.41 | 0.00 | 0.41 |
| | | 07TN1 | 12.346% | 0.35 | 0.06 | 0.40 |
| | | 07TN2 | 24.692% | 0.69 | 0.11 | 0.80 |
| | | 07TN3 | 12.346% | 0.35 | 0.06 | 0.40 |
| | 25 | 25TD1 | 12.654% | 1.39 | 0.00 | 1.39 |
| | | 25TD2 | 25.308% | 2.79 | 0.00 | 2.79 |
| | | 25TD3 | 12.654% | 1.39 | 0.00 | 1.39 |
| | | 25TN1 | 12.346% | 1.17 | 0.19 | 1.36 |
| | | 25TN2 | 24.692% | 2.35 | 0.38 | 2.72 |
| | | 25TN3 | 12.346% | 1.17 | 0.19 | 1.36 |
| | 13 | 13TD1 | 12.654% | 1.14 | 0.00 | 1.14 |
| | | 13TD2 | 25.308% | 2.28 | 0.00 | 2.28 |
| | | 13TD3 | 12.654% | 1.14 | 0.00 | 1.14 |
| | | 13TN1 | 12.346% | 0.96 | 0.15 | 1.11 |
| | | 13TN2 | 24.692% | 1.92 | 0.31 | 2.23 |
| | | 13TN3 | 12.346% | 0.96 | 0.15 | 1.11 |
| | 31 | 31TD1 | 12.654% | 0.22 | 0.00 | 0.22 |
| | | 31TD2 | 25.308% | 0.44 | 0.00 | 0.44 |
| | | 31TD3 | 12.654% | 0.22 | 0.00 | 0.22 |
| | | 31TN1 | 12.346% | 0.19 | 0.03 | 0.22 |
| | | 31TN2 | 24.692% | 0.37 | 0.06 | 0.43 |
| | | 31TN3 | 12.346% | 0.19 | 0.03 | 0.22 |
| GCA BOX | 07 | 07G1 | 50.0% | 0.17 | 0.16 | 0.33 |
| | | 07G2 | 20.0% | 0.07 | 0.06 | 0.13 |
| | | 07G3 | 30.0% | 0.10 | 0.09 | 0.20 |
| | 25 | 25G1 | 50.0% | 0.58 | 0.53 | 1.11 |
| | | 25G2 | 20.0% | 0.23 | 0.21 | 0.44 |
| | | 25G3 | 30.0% | 0.35 | 0.32 | 0.67 |
| | 13 | 13G1 | 50.0% | 0.48 | 0.43 | 0.91 |
| | | 13G2 | 20.0% | 0.19 | 0.17 | 0.36 |
| | | 13G3 | 30.0% | 0.29 | 0.26 | 0.54 |
| | 31 | 31G1 | 50.0% | 0.09 | 0.08 | 0.18 |
| | | 31G2 | 20.0% | 0.04 | 0.03 | 0.07 |
| | | 31G3 | 30.0% | 0.06 | 0.05 | 0.11 |
| FCLP: COUPEVILLE | 14 | 14TD1 | 83.181% | 0.87 | 0.00 | 0.87 |
| | | 14TD2 | 83.181% | 1.74 | 0.00 | 1.74 |
| | | 14TD3 | 83.181% | 0.87 | 0.00 | 0.87 |
| | | 14TN1 | 16.819% | 0.12 | 0.06 | 0.18 |
| | | 14TN2 | 16.819% | 0.23 | 0.12 | 0.35 |
| | | 14TN3 | 16.819% | 0.12 | 0.06 | 0.18 |
| | 32 | 32TD1 | 83.181% | 0.87 | 0.00 | 0.87 |
| | | 32TD2 | 83.181% | 1.74 | 0.00 | 1.74 |
| | | 32TD3 | 83.181% | 0.87 | 0.00 | 0.87 |
| | | 32TN1 | 16.819% | 0.12 | 0.06 | 0.18 |
| | | 32TN2 | 16.819% | 0.23 | 0.12 | 0.35 |
| | | 32TN3 | 16.819% | 0.12 | 0.06 | 0.18 |

Table A-7. Modeled P-3 Flight Track Utilization for Existing CY13 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| DEPARTURE | 07 | 07D2 | 50% | 0.26 | 0.01 | 0.27 |
| | | 07D3 | 50% | 0.26 | 0.01 | 0.27 |
| | | 07D5 | 50% | 0.39 | 0.02 | 0.41 |
| | | 07D6 | 50% | 0.39 | 0.02 | 0.41 |
| | 25 | 25D2 | 50% | 0.88 | 0.03 | 0.92 |
| | | 25D3 | 50% | 0.88 | 0.03 | 0.92 |
| | | 25D5 | 50% | 1.33 | 0.05 | 1.38 |
| | | 25D6 | 50% | 1.33 | 0.05 | 1.38 |
| | 13 | 13D2 | 50% | 0.72 | 0.03 | 0.75 |
| | | 13D3 | 50% | 0.72 | 0.03 | 0.75 |
| | | 13D5 | 50% | 1.09 | 0.04 | 1.13 |
| | | 13D6 | 50% | 1.09 | 0.04 | 1.13 |
| | 31 | 31D2 | 50% | 0.14 | 0.01 | 0.15 |
| | | 31D3 | 50% | 0.14 | 0.01 | 0.15 |
| | | 31D5 | 50% | 0.21 | 0.01 | 0.22 |
| | | 31D6 | 50% | 0.21 | 0.01 | 0.22 |
| Low TACAN DEPARTURE | 07 | 07DLT | 100% | 1.53 | 0.03 | 1.56 |
| | 25 | 25DLT | 100% | 5.17 | 0.10 | 5.27 |
| | 13 | 13DLT | 100% | 4.23 | 0.08 | 4.31 |
| | 31 | 31DLT | 100% | 0.82 | 0.02 | 0.84 |
| STRAIGHT-IN ARRIVAL VFR | 07 | 07A1 | 100% | 0.61 | 0.01 | 0.62 |
| | | 07A2 | 50% | 0.46 | 0.01 | 0.47 |
| | | 07A3 | 50% | 0.46 | 0.01 | 0.47 |
| | 25 | 25A1 | 100% | 2.07 | 0.04 | 2.11 |
| | | 25A2 | 50% | 1.55 | 0.03 | 1.58 |
| | | 25A3 | 50% | 1.55 | 0.03 | 1.58 |
| | 13 | 13A1 | 50% | 0.85 | 0.02 | 0.86 |
| | | 13A2 | 50% | 0.85 | 0.02 | 0.86 |
| | | 13A3 | 50% | 1.27 | 0.02 | 1.29 |
| | | 13A4 | 50% | 1.27 | 0.02 | 1.29 |
| | 31 | 31A1 | 50% | 0.16 | 0.00 | 0.17 |
| | | 31A2 | 50% | 0.16 | 0.00 | 0.17 |
| | | 31A3 | 50% | 0.25 | 0.00 | 0.25 |
| | | 31A4 | 50% | 0.25 | 0.00 | 0.25 |
| STRAIGHT-IN ARRIVAL IFR | 07 | 07A4B | 50.0% | 0.13 | 0.01 | 0.14 |
| | | 07A4C | 50.0% | 0.13 | 0.01 | 0.14 |
| | | 07A5B | 50.0% | 0.20 | 0.01 | 0.20 |
| | | 07A5C | 50.0% | 0.20 | 0.01 | 0.20 |
| | 25 | 25A4 | 100.0% | 0.88 | 0.03 | 0.92 |
| | | 25A5B | 50.0% | 0.66 | 0.03 | 0.69 |
| | | 25A5C | 50.0% | 0.66 | 0.03 | 0.69 |
| | 13 | 13A5B | 50.0% | 0.36 | 0.01 | 0.38 |
| | | 13A5C | 50.0% | 0.36 | 0.01 | 0.38 |
| | | 13A6B | 50.0% | 0.54 | 0.02 | 0.56 |
| | | 13A6C | 50.0% | 0.54 | 0.02 | 0.56 |
| | 31 | 31A5B | 50.0% | 0.07 | 0.00 | 0.07 |
| | | 31A5C | 50.0% | 0.07 | 0.00 | 0.07 |
| | | 31A6B | 50.0% | 0.11 | 0.00 | 0.11 |
| | | 31A6C | 50.0% | 0.11 | 0.00 | 0.11 |
| Low TACAN ARRIVAL | 07 | 07ALT | 100.0% | 0.65 | 0.03 | 0.68 |
| | 25 | 25ALT | 100.0% | 2.21 | 0.09 | 2.30 |
| | 13 | 13ALT | 100.0% | 1.81 | 0.07 | 1.88 |
| | 31 | 31ALT | 100.0% | 0.35 | 0.01 | 0.37 |

Table A-7. Modeled P-3 Flight Track Utilization for Existing CY03 Conditions - concluded

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| TOUCH AND GO: WHIDBEY ISLAND | 07 | 07TN1 | 25% | 0.57 | 0.00 | 0.57 |
| | | 07TN2 | 50% | 1.15 | 0.00 | 1.15 |
| | | 07TN3 | 25% | 0.57 | 0.00 | 0.57 |
| | 07 | 07TN1 | 25% | 0.00 | 0.01 | 0.01 |
| | | 07TN2 | 50% | 0.00 | 0.02 | 0.02 |
| | | 07TN3 | 25% | 0.00 | 0.01 | 0.01 |
| | 25 | 25TN1 | 25% | 1.94 | 0.00 | 1.94 |
| | | 25TN2 | 50% | 3.88 | 0.00 | 3.88 |
| | | 25TN3 | 25% | 1.94 | 0.00 | 1.94 |
| | 25 | 25TN1 | 25% | 0.00 | 0.04 | 0.04 |
| | | 25TN2 | 50% | 0.00 | 0.07 | 0.07 |
| | | 25TN3 | 25% | 0.00 | 0.04 | 0.04 |
| | 13 | 13TN1 | 25% | 1.59 | 0.00 | 1.59 |
| | | 13TN2 | 50% | 3.17 | 0.00 | 3.17 |
| | | 13TN3 | 25% | 1.59 | 0.00 | 1.59 |
| | 13 | 13TN1 | 25% | 0.00 | 0.03 | 0.03 |
| | | 13TN2 | 50% | 0.00 | 0.06 | 0.06 |
| | | 13TN3 | 25% | 0.00 | 0.03 | 0.03 |
| | 31 | 31TN1 | 25% | 0.31 | 0.00 | 0.31 |
| | | 31TN2 | 50% | 0.62 | 0.00 | 0.62 |
| | | 31TN3 | 25% | 0.31 | 0.00 | 0.31 |
| | 31 | 31TN1 | 25% | 0.00 | 0.01 | 0.01 |
| | | 31TN2 | 50% | 0.00 | 0.01 | 0.01 |
| | | 31TN3 | 25% | 0.00 | 0.01 | 0.01 |
| GCA BOX | 07 | 07G2 | 100.0% | 0.42 | 0.02 | 0.43 |
| | | 07G3 | 100.0% | 0.42 | 0.02 | 0.43 |
| | 25 | 25G2 | 100.0% | 1.40 | 0.05 | 1.46 |
| | | 25G3 | 100.0% | 1.40 | 0.05 | 1.46 |
| | 13 | 13G2 | 100.0% | 1.15 | 0.04 | 1.19 |
| | | 13G3 | 100.0% | 1.15 | 0.04 | 1.19 |
| | 31 | 31G2 | 100.0% | 0.22 | 0.01 | 0.23 |
| | | 31G3 | 100.0% | 0.22 | 0.01 | 0.23 |

Table A-9. Modeled C-9 Flight Track Utilization for Existing CY13 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| DEPARTURE | 07 | 07D2 | 50% | 0.02 | 0.00 | 0.02 |
| | | 07D3 | 50% | 0.02 | 0.00 | 0.02 |
| | | 07D5 | 50% | 0.03 | 0.00 | 0.03 |
| | | 07D6 | 50% | 0.03 | 0.00 | 0.03 |
| | 25 | 25D2 | 50% | 0.08 | 0.00 | 0.08 |
| | | 25D3 | 50% | 0.08 | 0.00 | 0.08 |
| | | 25D5 | 50% | 0.11 | 0.00 | 0.12 |
| | | 25D6 | 50% | 0.11 | 0.00 | 0.12 |
| | 13 | 13D2 | 50% | 0.06 | 0.00 | 0.06 |
| | | 13D3 | 50% | 0.06 | 0.00 | 0.06 |
| | | 13D5 | 50% | 0.09 | 0.00 | 0.10 |
| | | 13D6 | 50% | 0.09 | 0.00 | 0.10 |
| | 31 | 31D2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D3 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D5 | 50% | 0.02 | 0.00 | 0.02 |
| | | 31D6 | 50% | 0.02 | 0.00 | 0.02 |
| STRAIGHT-IN ARRIVAL VFR | 07 | 07A1 | 100% | 0.05 | 0.00 | 0.05 |
| | | 07A2 | 50% | 0.03 | 0.00 | 0.03 |
| | | 07A3 | 50% | 0.03 | 0.00 | 0.03 |
| | 25 | 25A1 | 100% | 0.15 | 0.00 | 0.16 |
| | | 25A2 | 50% | 0.12 | 0.00 | 0.12 |
| | | 25A3 | 50% | 0.12 | 0.00 | 0.12 |
| | 13 | 13A1 | 50% | 0.06 | 0.00 | 0.06 |
| | | 13A2 | 50% | 0.06 | 0.00 | 0.06 |
| | | 13A3 | 50% | 0.09 | 0.00 | 0.10 |
| | | 13A4 | 50% | 0.09 | 0.00 | 0.10 |
| | 31 | 31A1 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A3 | 50% | 0.02 | 0.00 | 0.02 |
| | | 31A4 | 50% | 0.02 | 0.00 | 0.02 |

Table A-10. Modeled Transient Flight Track Utilization for Existing CY13 Conditions

| Operation Type | Runway | Track ID | Track Mix | Operations | | |
|---|---|---|---|---|---|---|
| | | | | Daytime 0700-2200 | Nighttime 2200-0700 | TOTAL |
| DEPARTURE | 07 | 07D2 | 50% | 0.02 | 0.00 | 0.02 |
| | | 07D3 | 50% | 0.02 | 0.00 | 0.02 |
| | | 07D5 | 50% | 0.03 | 0.00 | 0.03 |
| | | 07D6 | 50% | 0.03 | 0.00 | 0.03 |
| | 25 | 25D2 | 50% | 0.06 | 0.00 | 0.06 |
| | | 25D3 | 50% | 0.06 | 0.00 | 0.06 |
| | | 25D5 | 50% | 0.09 | 0.00 | 0.09 |
| | | 25D6 | 50% | 0.09 | 0.00 | 0.09 |
| | 13 | 13D2 | 50% | 0.05 | 0.00 | 0.05 |
| | | 13D3 | 50% | 0.05 | 0.00 | 0.05 |
| | | 13D5 | 50% | 0.07 | 0.00 | 0.07 |
| | | 13D6 | 50% | 0.07 | 0.00 | 0.07 |
| | 31 | 31D2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D3 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D5 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31D6 | 50% | 0.01 | 0.00 | 0.01 |
| STRAIGHT-IN ARRIVAL VFR | 07 | 07A1 | 100% | 0.04 | 0.00 | 0.04 |
| | | 07A2 | 50% | 0.03 | 0.00 | 0.03 |
| | | 07A3 | 50% | 0.03 | 0.00 | 0.03 |
| | 25 | 25A1 | 100% | 0.12 | 0.00 | 0.12 |
| | | 25A2 | 50% | 0.09 | 0.00 | 0.09 |
| | | 25A3 | 50% | 0.09 | 0.00 | 0.09 |
| | 13 | 13A1 | 50% | 0.05 | 0.00 | 0.05 |
| | | 13A2 | 50% | 0.05 | 0.00 | 0.05 |
| | | 13A3 | 50% | 0.07 | 0.00 | 0.07 |
| | | 13A4 | 50% | 0.07 | 0.00 | 0.07 |
| | 31 | 31A1 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A2 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A3 | 50% | 0.01 | 0.00 | 0.01 |
| | | 31A4 | 50% | 0.01 | 0.00 | 0.01 |

# Appendix B– Discussion of Noise and Its Effects on the Environment

Source: Wyle Laboratories, *Wyle Report 04-26 Aircraft Noise Study for NAS Whidbey Island and OLF Coupeville, Washington*, 2004.

# Appendix B
# Discussion of Noise and Its Effect on The Environment

## B.1 Basics of Sound

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

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

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration. First, intensity is a measure of the acoustic energy of the sound vibrations and is expressed in terms of sound pressure. The greater the sound pressure, the more energy carried by the sound and the louder the perception of that sound. The second important physical characteristic of sound is frequency, which is the number of times per second the air vibrates or oscillates. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches. The third important characteristic of sound is duration or the length of time the sound can be detected.

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. Because of this vast range, using a linear scale to represent the intensity of sound becomes very unwieldy. As a result, a logarithmic unit known as the decibel (abbreviated dB) is used to represent the intensity of a sound. Such a representation is called a sound level. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB; sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 to 140 dB are felt as pain (Berglund and Lindvall 1995).

Because of the logarithmic nature of the decibel unit, sound levels cannot be arithmetically added or subtracted and are somewhat cumbersome to handle mathematically. However, some simple rules are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. For example:

60 dB + 60 dB = 63 dB, and

80 dB + 80 dB = 83 dB.

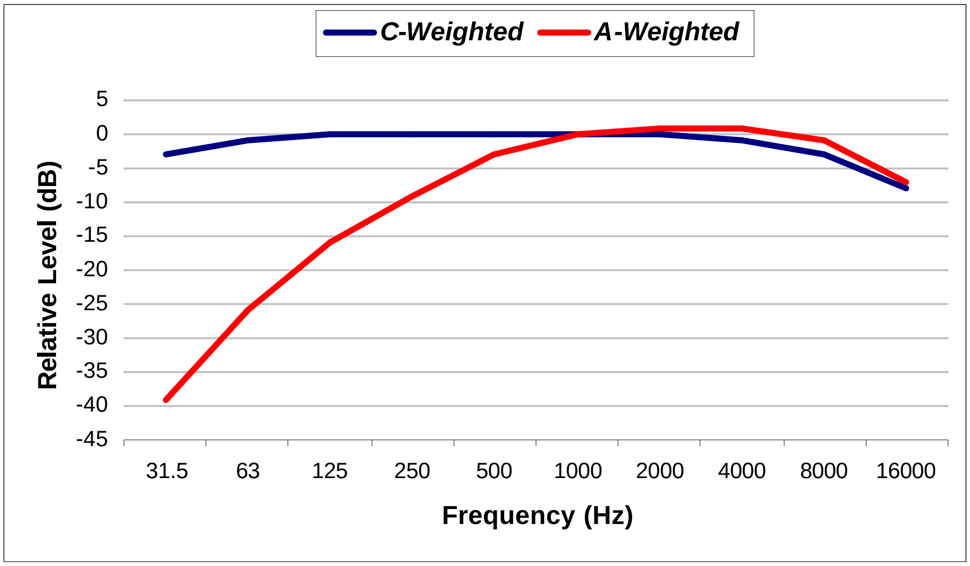
Second, the total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

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

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

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




Source: ANSI S1.4 -1983 “Specification of Sound Level Meters”

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

*A-Weighted Sound Level*

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

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

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

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

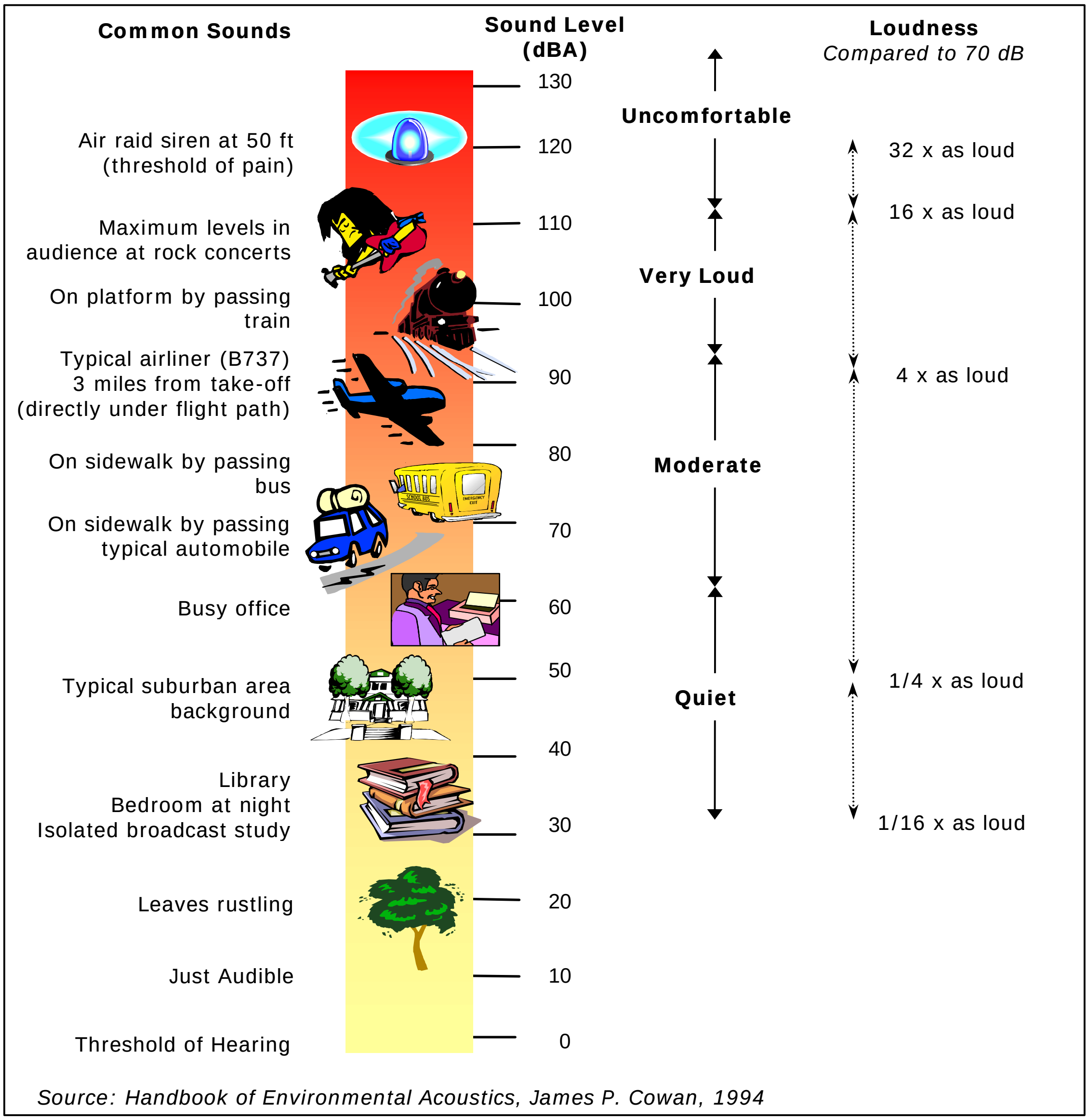



**Figure B-2. Typical A-Weighted Sound Levels of Common Sounds**

*C-weighted Sound Level*

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

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

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

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

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

## B.2 Noise Metrics

As used in environmental noise analyses, a metric refers to the unit or quantity that quantitatively measures the effect of noise on the environment. To quantify these effects, the Department of Defense and the Federal Aviation Administration use three noise-measuring techniques, or metrics: first, a measure of the highest sound level occurring during an individual aircraft overflight (single event); second, a combination of the maximum level of that single event with its duration; and third, a description of the noise environment based on the cumulative flight and engine maintenance activity. Single noise events can be described with Sound Exposure Level or Maximum Sound Level. Another measure of instantaneous level is the Peak Sound Pressure Level. The cumulative energy noise metric used is the Day/Night Average Sound Level. Metrics related to DNL include the Onset-Rate Adjusted Day/Night Average Sound Level, and the Equivalent Sound Level. In the state of California, it is mandated that average noise be described in terms of Community Noise Equivalent Level (State of California 1990). CNEL represents the Day/Evening/Night average noise exposure, calculated over a 24-hour period. Metrics and their uses are described below.

### *Maximum Sound Level ($L_{max}$)*

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

During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. The maximum sound level indicates the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8 second, and is denoted as "fast" response (American National Standards Institute 1988). Slowly varying or steady sounds are generally measured over a period of one second, denoted "slow" response. The maximum sound level is important in judging the interference caused by a noise event with conversation, TV or radio listening, sleep, or other common activities. Although it provides some measure of the intrusiveness of the event, it does not completely describe the total event, because it does not include the period of time that the sound is heard.

### *Peak Sound Pressure Level (Lpk)*

The peak sound pressure level, is the highest instantaneous level obtained by a sound level measurement device. The peak sound pressure level is typically measured using a 20 microseconds or faster sampling rate, and is typically based on unweighted or linear response of the meter.

### *Sound Exposure Level (SEL)*

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

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

*Day-Night Average Sound Level (DNL) and Community Noise Equivalent Level (CNEL)*

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

The above-described metrics are average quantities, mathematically representing the continuous A-weighted or C-weighted sound level that would be present if all of the variations in sound level that occur over a 24-hour period were smoothed out so as to contain the same total sound energy. These composite metrics account for the maximum noise levels, the duration of the events (sorties or operations), and the number of events that occur over a 24-hour period. Like SEL, neither DNL nor CNEL represent the sound level heard at any particular time, but quantifies the total sound energy received. While it is normalized as an average, it represents all of the sound energy, and is therefore a cumulative measure.

The penalties added to both the DNL and CNEL metrics account for the added intrusiveness of sounds that occur during normal sleeping hours, both because of the increased sensitivity to noise during those hours and because ambient sound levels during nighttime are typically about 10 dB lower than during daytime hours.

The inclusion of daytime and nighttime periods in the computation of the DNL and CNEL reflects their basic 24-hour definition. It can, however, be applied over periods of multiple days. For application to civil airports, where operations are consistent from day to day, DNL and CNEL are usually applied as an annual average. For some military airbases, where operations are not necessarily consistent from day to day, a common practice is to compute a 24-hour DNL or CNEL based on an average busy day, so that the calculated noise is not diluted by periods of low activity.

Although DNL and CNEL provide a single measure of overall noise impact, they do not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. For example, a daily average sound level of 65 dB could result from a very few noisy events or a large number of quieter events.

Daily average sound levels are typically used for the evaluation of community noise effects (i.e., long-term annoyance), and particularly aircraft noise effects. In general, scientific studies and social surveys have found a high correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL (U.S. Environmental Protection Agency 1978 and Schultz 1978). The correlation from Schultz's original 1978 study is shown in Figure B-3. It represents the results of a large number of social surveys relating community responses to various types of noises, measured in day-night average sound level.

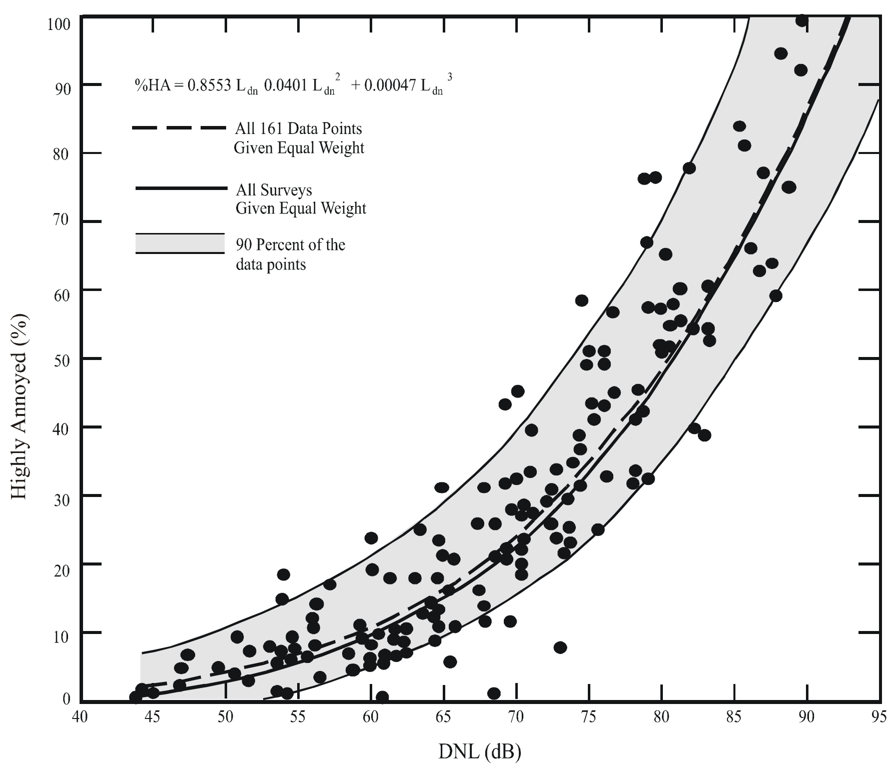



**Figure B-3. Community Surveys of Noise Annoyance**

A more recent study has reaffirmed this relationship (Fidell, et al. 1991). Figure B-4 (Federal Interagency Committee On Noise 1992) shows an updated form of the curve fit (Finegold, et al. 1994) in comparison with the original. The updated fit, which does not differ substantially from the original, is the current preferred form. In general, correlation coefficients of 0.85 to 0.95 are found between the percentages of groups of people highly annoyed and the level of average noise exposure. The correlation coefficients for the annoyance of individuals are relatively low, however, on the order of 0.5 or less. This is not surprising, considering the varying personal factors that influence the manner in which individuals react to noise. However, for the evaluation of community noise impacts, the scientific community has endorsed the use of DNL (American National Standards Institute 1980; American National Standards Institute 1988; U.S. Environmental Protection Agency 1972; Federal Interagency Committee On Urban Noise 1980 and Federal Interagency Committee On Noise 1992).

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

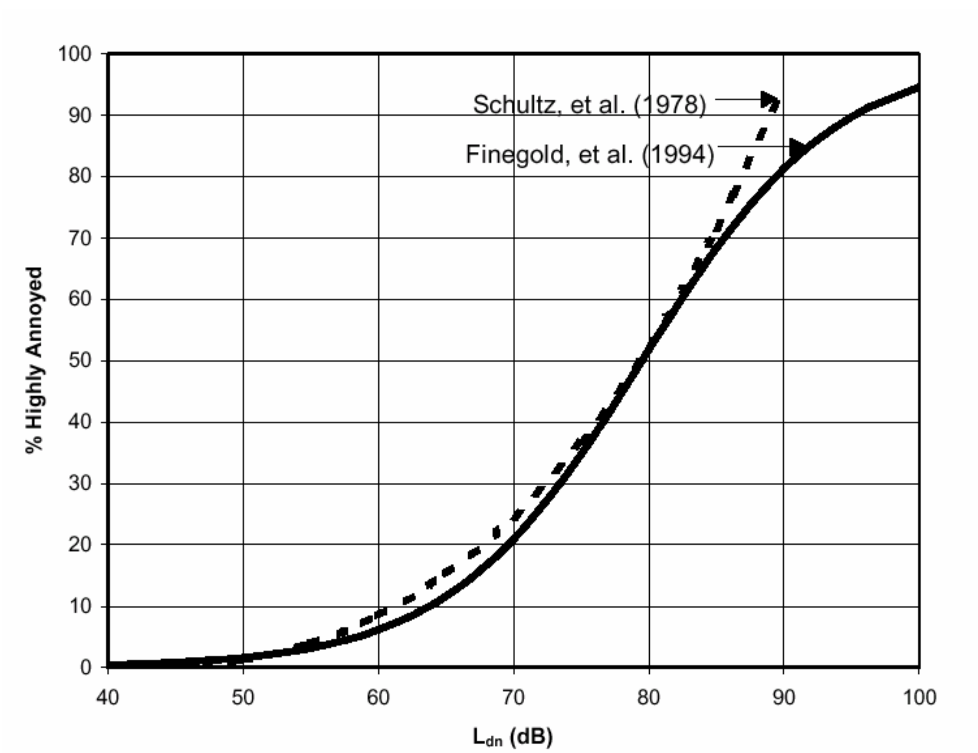



**Figure B-4. Response of Communities to Noise; Comparison of Original (Schultz, 1978) and Current (Finegold, et al. 1994) Curve Fits**

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

As a simple example of this characteristic, consider a case in which only one aircraft overflight occurs 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 day-night average sound level 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 day-night average sound level 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.

*Equivalent Sound Level ($L_{eq}$)*

Another cumulative noise metric that is useful in describing noise is the equivalent sound level. $L_{eq}$ is calculated to determine the steady-state noise level over a specified time period. The $L_{eq}$ metric can provide a more accurate quantification of noise exposure for a specific period, particularly for daytime periods when the nighttime penalty under the DNL metric is inappropriate.

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

*Onset-Rate Adjusted Day-Night Average Sound Level ($L_{dnr}$)*

Military aircraft flying on Military Training Routes (MTRs) and in Restricted Areas/Ranges generate a noise environment that is somewhat different from that associated with airfield operations. As opposed to patterned or continuous noise environments associated with airfields, overflights along MTRs are highly sporadic, ranging from 10 per hour to less than one per week. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-airspeed flyover can have a rather sudden onset, exhibiting a rate of increase in sound level (onset rate) of up to 150 dB per second.

To represent these differences, the conventional DNL metric is adjusted to account for the "surprise" effect of the sudden onset of aircraft noise events on humans with an adjustment ranging up to 11 dB above the normal Sound Exposure Level (Stusnick, et al. 1992). Onset rates between 15 to 150 dB per second require an adjustment of 0 to 11 dB, while onset rates below 15 dB per second require no adjustment. The adjusted DNL is designated as the onset-rate adjusted day-night average sound level ($L_{dnr}$).

Because of the sporadic occurrences of aircraft overflights along MTRs and in Restricted Areas/Ranges, the number of daily operations is determined from the number of flying days in the calendar month with the highest number of operations in the affected airspace or MTR in order to avoid seasonal periods of low activity. This monthly average is denoted $L_{dnmr}$. In the state of California, a variant of the Ldnmr includes a penalty for evening operations (7 p.m. to 10 p.m) and is denoted $CNEL_{mr}$.

## B.3 Noise Effects

### B.3.1 Annoyance

The primary effect of aircraft noise on exposed communities is one of long-term annoyance. Noise annoyance is defined by the EPA as any negative subjective reaction on the part of an individual or group (U.S. Environmental Protection Agency 1972). As noted in the discussion of DNL above, community annoyance is best measured by that metric.

The results of attitudinal surveys, conducted to find percentages of people who express various degrees of annoyance when exposed to different levels of DNL, are very consistent. The most useful metric for assessing people's responses to noise impacts is the percentage of the exposed population expected to be "highly annoyed." A wide variety of responses have been used to determine intrusiveness of noise and disturbances of speech, sleep, television or radio listening, and outdoor living. The concept of "percent highly annoyed" has provided the most consistent response of a community to a particular noise environment. The response is remarkably complex, and when considered on an individual basis, widely varies for any given noise level (Federal Interagency Committee On Noise 1992).

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

*Emotional Variables*

- Feelings about the necessity or preventability of the noise;
- Judgment of the importance and value of the activity that is producing the noise;
- Activity at the time an individual hears the noise;
- Attitude about the environment;

- General sensitivity to noise;
- Belief about the effect of noise on health; and
- Feeling of fear associated with the noise.

*Physical Variables*

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

### B.3.2 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance to individuals on the ground. The disruption of routine activities such as radio or television listening, telephone use, or family conversation gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings and can cause fatigue and vocal strain in those who attempt to communicate over the noise. Speech is an acoustic signal characterized by rapid fluctuations in sound level and frequency pattern. It is essential for optimum speech intelligibility to recognize these continually shifting sound patterns. Not only does noise diminish the ability to perceive the auditory signal, but it also reduces a listener's ability to follow the pattern of signal fluctuation. In general, interference with speech communication occurs when intrusive noise exceeds about 60 dB (Federal Interagency Committee On Noise 1992).

Indoor speech interference can be expressed as a percentage of sentence intelligibility among two people speaking in relaxed conversation approximately 3 feet apart in a typical living room or bedroom (U.S. Environmental Protection Agency 1972). The percentage of sentence intelligibility is a non-linear function of the (steady) indoor background A-weighted sound level. Such a curve-fit yields 100 percent sentence intelligibility for background levels below 57 dB and yields less than 10 percent intelligibility for background levels above 73 dB. The function is especially sensitive to changes in sound level between 65 dB and 75 dB. As an example of the sensitivity, a 1 dB increase in background sound level from 70 dB to 71 dB yields a 14 percent decrease in sentence intelligibility. The sensitivity of speech interference to noise at 65 dB and above is consistent with the criterion of DNL 65 dB generally taken from the Schultz curve. This is consistent with the observation that speech interference is the primary cause of annoyance.

### B.3.3 Sleep Interference

Sleep interference is another source of annoyance and potential health concern associated with aircraft noise. Because of the intermittent nature and content of aircraft noise, it is more disturbing than continuous noise of equal energy. Given that quality sleep is requisite for good health, repeated occurrences of sleep interference could have an effect on overall health.

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

Sleep is not a continuous, uniform condition but a complex series of states through which the brain progresses in a cyclical pattern. Arousal from sleep is a function of a number of factors that include age, sex, sleep stage, noise level, frequency of noise occurrences, noise quality, and pre-sleep activity. Because individuals differ in their physiology, behavior, habitation, and ability to adapt to noise, few studies have attempted to establish noise criterion levels for sleep disturbance.

Lukas (1978) concluded the following with regard to human sleep response to noise:

- Children 5 to 8 years of age are generally unaffected by noise during sleep.
- Older people are more sensitive to sleep disturbance than younger people.
- Women are more sensitive to noise than men, in general.
- There is a wide variation in the sensitivity of individuals to noise even within the same age group.
- Sleep arousal is directly proportional to the sound intensity of aircraft flyover. While there have been several studies conducted to assess the effect of aircraft noise on sleep, none have produced quantitative dose-response relationships in terms of noise exposure level, DNL, and sleep disturbance. Noise-sleep disturbance relationships have been developed based on single-event noise exposure.

An analysis sponsored by the U.S. Air Force summarized 21 published studies concerning the effects of noise on sleep (Pearsons, et al. 1989). The analysis concluded that a lack of reliable studies in homes, combined with large differences among the results from the various laboratory studies, did not permit development of an acceptably accurate assessment procedure. The noise events used in the laboratory studies and in contrived in-home studies were presented at much higher rates of occurrence than would normally be experienced in the home. None of the laboratory studies were of sufficiently long duration to determine any effects of habituation, such as that which would occur under normal community conditions.

A study of the effects of nighttime noise exposure on the in-home sleep of residents near one military airbase, near one civil airport, and in several households with negligible nighttime aircraft noise exposure, revealed SEL as the best noise metric predicting noise-related awakenings. It also determined that out of 930 subject nights, the average spontaneous (not noise-related) awakenings per night was 2.07 compared to the average number of noise-related awakenings per night of 0.24 (Fidell, et al. 1994). Additionally, a 1995 analysis of sleep disturbance studies conducted both in the laboratory environment and in the field (in the sleeping quarters of homes) showed that when measuring awakening to noise, a 10 dB increase in SEL was associated with only an 8 percent increase in the probability of awakening in the laboratory studies, but only a 1 percent increase in the field (Pearsons, et al. 1995). Pearsons, et al. (1995), reported that even SEL values as high as 85 dB produced no awakenings or arousals in at least one study. This observation suggests a strong influence of habituation on susceptibility to noise-induced sleep disturbance. A 1984 study (Kryter 1984) indicates that an indoor SEL of 65 dB or lower should awaken less than 5 percent of exposed individuals.

Nevertheless, some guidance is available in judging sleep interference. The EPA identified an indoor DNL of 45 dB as necessary to protect against sleep interference (U.S. Environmental Protection Agency 1978). Assuming a very conservative structural noise insulation of 20 dB for typical dwelling units, this corresponds to an outdoor day-night average sound level of 65 dB to minimize sleep interference.

In 1997, the Federal Interagency Committee on Aviation Noise (FICAN) adopted an interim guideline for sleep awakening prediction. The new curve, based on studies in England (Ollerhead, et al. 1992) and at two U.S. airports (Los Angeles International and Denver International), concluded that the incidence of sleep awakening from aircraft noise was less than identified in a 1992 study (Federal Interagency Committee On Noise 1992). Using indoor single-event noise levels represented by SELs, potential sleep awakening can be predicted using the curve presented in Figure B-5. Typically, homes in the United States provide 15 dB of sound attenuation with windows open and 25 dB with windows closed and air conditioning operating. Hence, the outdoor SEL of 107 dB would be 92 dB indoors with windows open and 82 dB indoors with windows closed and air conditioning operating.

Using Figure B-5, the potential sleep awakening would be 15% with windows open and 10% with windows closed in the above example.

The new FICAN curve does not address habituation over time by sleeping subjects and is applicable only to adult populations. Nevertheless, this curve provides a reasonable guideline for assessing sleep awakening. It is conservative, representing the upper envelope of field study results.

The FICAN curve shown in Figure B-5 represents awakenings from single events. To date, no exact quantitative dose-response relationship exists for noise-related sleep interference from multiple events; yet, based on studies conducted to date and the USEPA guideline of a 45 DNL to protect sleep interference, useful ways to assess sleep interference have emerged. If homes are conservatively estimated to have a 20-dB noise insulation, an average of 65 DNL would produce an indoor level of 45 DNL and would form a reasonable guideline for evaluating sleep interference. This also corresponds well to the general guideline for assessing speech interference. Annoyance that may result from sleep disturbance is accounted for in the calculation of DNL, which includes a 10-dB penalty for each sortie occurring after 10 pm or before 7 am.

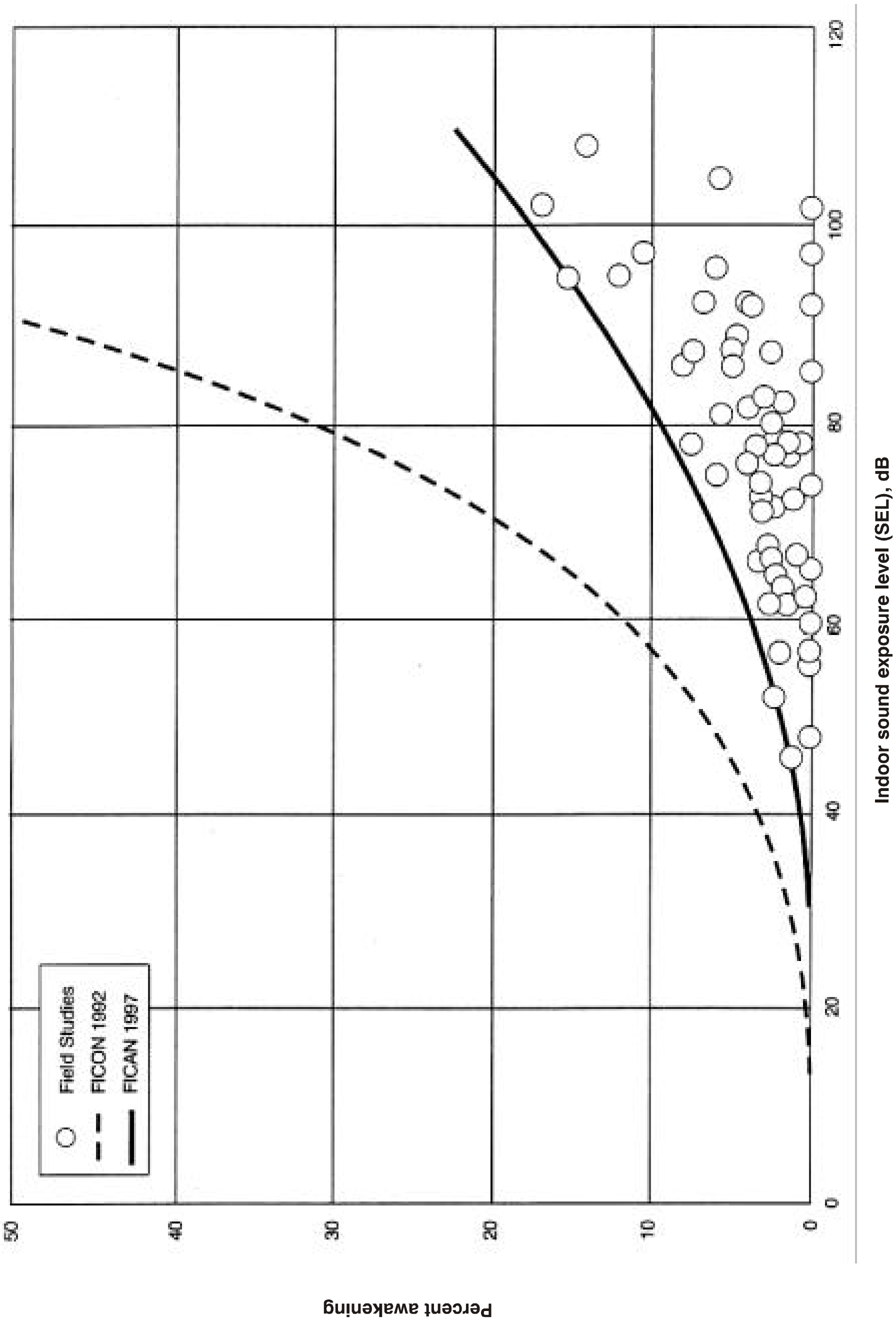



**Figure B-5. Recommended Sleep Disturbance Dose-Response Relationship**

### B.3.4 Hearing Loss

Considerable data on hearing loss have been collected and analyzed. It has been well established that continuous exposure to high noise levels will damage human hearing (U.S. Environmental Protection Agency 1978). People are normally capable of hearing up to 120 dB over a wide frequency range. Hearing loss is generally interpreted as the shifting of a higher sound level of the ear's sensitivity or acuity to perceive sound. This change can either be temporary, called a temporary threshold shift (TTS), or permanent, called a permanent threshold shift (PTS) (Berger, et al. 1995).

The EPA has established 75 dB for an 8-hour exposure and 70 dB for a 24-hour exposure as the average noise level standard requisite to protect 96% of the population from greater than a 5 dB PTS (U.S. Environmental Protection Agency 1978). Similarly, the National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) identified 75 dB as the minimum level at which hearing loss may occur (Committee on Hearing, Bioacoustics, and Biomechanics 1977). However, it is important to note that continuous, long-term (40 years) exposure is assumed by both EPA and CHABA before hearing loss may occur.

Federal workplace standards for protection from hearing loss allow a time-average level of 90 dB over an 8-hour work period or 85 dB over a 16-hour period. Even the most protective criterion (no measurable hearing loss for the most sensitive portion of the population at the ear's most sensitive frequency, 4,000 Hz, after a 40-year exposure) is a time-average sound level of 70 dB over a 24-hour period.

Studies on community hearing loss from exposure to aircraft flyovers near airports showed that there is no danger, under normal circumstances, of hearing loss due to aircraft noise (Newman and Beattie 1985).

A laboratory study measured changes in human hearing from noise representative of low-flying aircraft on MTRs. (Nixon, et al. 1993). In this study, participants were first subjected to four overflight noise exposures at A-weighted levels of 115 dB to 130 dB. One-half of the subjects showed no change in hearing levels, one-fourth had a temporary 5-dB increase in sensitivity (the people could hear a 5-dB wider range of sound than before exposure), and one-fourth had a temporary 5-dB decrease in sensitivity (the people could hear a 5-dB narrower range of sound than before exposure). In the next phase, participants were subjected to a single overflight at a maximum level of 130 dB for eight successive exposures, separated by 90 seconds or until a temporary shift in hearing was observed. The temporary hearing threshold shifts resulted in the participants hearing a wider range of sound, but within 10 dB of their original range.

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

Because it is unlikely that airport neighbors will remain outside their homes 24 hours per day for extended periods of time, there is little possibility of hearing loss below a day-night average sound level of 75 dB, and this level is extremely conservative.

### B.3.5 Nonauditory Health Effects

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

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

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

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

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

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

Most studies of nonauditory health effects of long-term noise exposure have found that noise exposure levels established for hearing protection will also protect against any potential nonauditory health effects, at least in workplace conditions. One of the best scientific summaries of these findings is contained in the lead paper at the National Institutes of Health Conference on Noise and Hearing Loss, held on 22 to 24 January 1990 in Washington, D.C.:

> "The nonauditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease, and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dBA for complete protection against hearing loss for an 8-hour day). At the recent (1988) International Congress on Noise as a Public Health Problem, most studies attempting to clarify such health effects did not find them at levels below the criteria protective of noise-induced hearing loss, and even above these criteria, results regarding such health effects were ambiguous. Consequently, one comes to the

> conclusion that establishing and enforcing exposure levels protecting against noise-induced hearing loss would not only solve the noise-induced hearing loss problem, but also any potential nonauditory health effects in the work place." (von Gierke 1990)

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

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

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

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

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

### B.3.6 Performance Effects

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

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

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

### B.3.7 Noise Effects on Children

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

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

#### B.3.7.1 Effects on Learning and Cognitive Abilities

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

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

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

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

Specifically, elementary school children attending schools near New York City's two airports demonstrated lower reading scores than children living farther away from the flight paths (Green, et al. 1982). Researchers have found that tasks involving central processing and language comprehension (such as reading, attention, problem solving, and memory) appear to be the most affected by noise (Evans and Lepore 1993; Hygge 1994; and Evans, et al. 1995). It has been demonstrated that chronic exposure of first- and second-grade children to aircraft noise can result in reading deficits and impaired speech perception (i.e., the ability to hear common, low-frequency [vowel] sounds but not high frequencies [consonants] in speech) (Evans and Maxwell 1997).

The Evans and Maxwell (1997) study found that chronic exposure to aircraft noise resulted in reading deficits and impaired speech perception for first- and second-grade children. Other studies found that children residing near the Los Angeles International Airport had more difficulty solving cognitive problems and did not perform as well as children from quieter schools in puzzle-solving and attentiveness (Bronzaft 1997; Cohen, et al. 1980). Children attending elementary schools in high aircraft noise areas near London's Heathrow Airport demonstrated poorer reading comprehension and selective cognitive impairments (Haines, et al. 2001a, b). Similarly, a study conducted by Hygge (1994) found that students exposed to aircraft noise (76 dBA) scored 20% lower on recall ability tests than students exposed to ambient noise (42-44 dBA). Similar studies involving the testing of attention, memory, and reading comprehension of schoolchildren located near airports showed that their tests exhibited reduced performance results compared to those of similar groups of children who were located in quieter environments (Evans, et al. 1995; Haines, et al. 1998). The Haines and Stansfeld study indicated that there may be some long-term effects associated with exposure, as one-year follow-up testing still demonstrated lowered scores for children in higher noise schools (Haines and Stansfield 2001b). In contrast, a study conducted by Hygge, et al. (2002) found that although children living near the old Munich airport scored lower in standardized reading and long-term memory tests than a control group, their performance on the same tests was equal to that of the control group once the airport was closed.

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

### B.3.7.2 Health Effects

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

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

Although the literature appears limited, relatively recent studies focused on the wide range of potential effects of aircraft noise on school children have also investigated hormonal levels between groups of children exposed to aircraft noise compared to those in a control group.

Specifically, Haines, et al. (2001b and 2001c) analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise. In both instances, there were no differences between the aircraft-noise-exposed children and the control groups.

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

### B.3.8 Effects on Domestic Animals and Wildlife

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

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

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

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

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

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

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

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

### B.3.8.1 Domestic Animals

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

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

*Cattle*

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

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

A study examined the causes of 1,763 abortions in Wisconsin dairy cattle over a one-year time period and none were associated with aircraft disturbances (U.S.Air Force 1993). In 1987, Anderson contacted seven livestock operators for production data, and no effects of low-altitude and supersonic flights were noted. Three out of 43 cattle previously exposed to low-altitude flights showed a startle response to an F/A-18 aircraft flying overhead at 500 feet above ground level and 400 knots by running less than 10 meters. They resumed normal activity within one minute (U.S.Air Force 1994b). Beyer (1983) found that helicopters caused more reaction than other low-aircraft overflights, and that the helicopters at 30 to 60 feet overhead did not affect milk production and pregnancies of 44 cows and heifers in a 1964 study (U.S. Air Force 1994b). Additionally, Beyer reported that five pregnant dairy cows in a pasture did not exhibit fright-flight tendencies or disturb their pregnancies after being overflown by 79 low-altitude helicopter flights and 4 low-altitude, subsonic jet aircraft flights (U.S. Air Force 1994b). A 1956 study found that the reactions of dairy and beef cattle to noise from low-altitude, subsonic aircraft were similar to those caused by paper blowing about, strange persons, or other moving objects (U.S. Air Force 1994b).

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

*Horses*

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

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

*Swine*

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

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

*Domestic Fowl*

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

The typical reaction of domestic fowl after exposure to sudden, intense noise is a short-term startle response. The reaction ceases as soon as the stimulus is ended, and within a few minutes all activity returns to normal. More severe responses are possible depending on the number of birds, the frequency of exposure, and environmental conditions. Large crowds of birds, and birds not previously exposed, are more likely to pile up in response to a noise stimulus (U.S. Air Force 1994a). According to studies and interviews with growers, it is typically the previously unexposed birds that incite panic crowding, and the tendency to do so is markedly reduced within five exposures to the stimulus (U.S. Air Force 1994a). This suggests that the birds habituate relatively quickly. Egg productivity was not adversely affected by infrequent noise bursts, even at exposure levels as high as 120 to 130 dBA.

Between 1956 and 1988, there were 100 recorded claims against the Navy for alleged damage to domestic fowl. The number of claims averaged three per year, with peak numbers of claims following publications of studies on the topic in the early 1960s (U.S. Air Force 1994a). Many of the claims were disproved or did not have sufficient supporting evidence. The claims were filed for the following alleged damages: 55% for panic reactions, 31% for decreased production, 6% for reduced hatchability, 6% for weight loss, and less than 1% for reduced fertility (U.S. Air Force 1994a).

*Turkeys*

The review of the existing literature suggests that there has not been a concerted or widespread effort to study the effects of aircraft noise on commercial turkeys. One study involving turkeys examined the differences between simulated versus actual overflight aircraft noise, turkey responses to the noise, weight gain, and evidence of habituation (Bowles, et al. 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 1994a).

### B.3.8.2 Wildlife

Studies on the effects of overflights and sonic booms on wildlife have been focused mostly on avian species and ungulates such as caribou and bighorn sheep. Few studies have been conducted on marine mammals, small terrestrial mammals, reptiles, amphibians, and carnivorous mammals. Generally, species that live entirely below the surface of the water have also been ignored due to the fact they do not experience the same level of sound as terrestrial species (National Park Service 1994). Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock (Manci, et al. 1988). This may be due to previous exposure to disturbances. One common factor appears to be that low-altitude flyovers seem to be more disruptive in terrain where there is little cover (Manci, et al. 1988).

#### B.3.8.2.1 Mammals

*Terrestrial Mammals*

Studies of terrestrial mammals have shown that noise levels of 120 dBA can damage mammals' ears, and levels at 95 dBA can cause temporary loss of hearing acuity. Noise from aircraft has affected other large carnivores by causing changes in home ranges, foraging patterns, and breeding behavior. One study recommended that aircraft not be allowed to fly at altitudes below 2,000 feet above ground level over important grizzly and polar bear habitat (Dufour 1980). Wolves have been frightened by low-altitude flights that were 25 to 1,000 feet off the ground. However, wolves have been found to adapt to aircraft overflights and noise as long as they were not being hunted from aircraft (Dufour 1980).

Wild ungulates (American bison, caribou, bighorn sheep) appear to be much more sensitive to noise disturbance than domestic livestock (Weisenberger, et al. 1996). Behavioral reactions may be related to the past history of disturbances by such things as humans and aircraft. Common reactions of reindeer kept in an enclosure exposed to aircraft noise disturbance were a slight startle response, raising of the head, pricking ears, and scenting of the air. Panic reactions and extensive changes in behavior of individual animals were not observed. Observations of caribou in Alaska exposed to fixed-wing aircraft and helicopters showed running and panic reactions occurred when overflights were at an altitude of 200 feet or less. The reactions decreased with increased altitude of overflights, and, with more than 500 feet in altitude, the panic reactions stopped. Also, smaller groups reacted less strongly than larger groups. One negative effect of the running and avoidance behavior is increased expenditure of energy. For a 90-kg animal, the calculated expenditure due to aircraft harassment is 64 kilocalories per minute when running and 20 kilocalories per minute when walking. When conditions are favorable, this expenditure can be counteracted with increased feeding; however, during harsh winter conditions, this may not be possible. Incidental observations of wolves and bears exposed to fixed-wing aircraft and helicopters in the northern regions suggested that wolves are less disturbed than wild ungulates, while grizzly bears showed the greatest response of any animal species observed.

It has been proven that low-altitude overflights do induce stress in animals. Increased heart rates, an indicator of excitement or stress, have been found in pronghorn antelope, elk, and bighorn sheep. As such reactions occur naturally as a response to predation, infrequent overflights may not, in and of themselves, be detrimental. However, flights at high frequencies over a long period of time may cause harmful effects. The consequences of this disturbance, while cumulative, is not additive. It may be that aircraft disturbance may not cause obvious and serious health effects, but coupled with a harsh winter, it may have an adverse impact. Research has shown that stress induced by other types of disturbances produces long-term decreases in metabolism and hormone balances in wild ungulates.

Behavioral responses can range from mild to severe. Mild responses include head raising, body shifting, or turning to orient toward the aircraft. Moderate disturbance may be nervous behaviors, such as trotting a short distance. Escape is the typical severe response.

*Marine Mammals*

The physiological composition of the ear in aquatic and marine mammals exhibits adaptation to the aqueous environment. These differences (relative to terrestrial species) manifest themselves in the auricle and middle ear (Manci, et al. 1988). Some mammals use echolocation to perceive objects in their surroundings and to determine the directions and locations of sound sources (Simmons 1983 in Manci, et al. 1988).

The Acoustical Society of America reported in 1980 that more studies were needed to assess the potential impacts of aircraft noise on marine mammals. Since 1980 it appears that research on responses of aquatic mammals to aircraft noise and sonic booms has been limited. Research conducted on northern fur seals, sea lions, and ringed seals indicated that there are some differences in how various animal groups receive frequencies of sound. It was observed that these species exhibited varying intensities of a startle response to airborne noise, which was habituated over time. The rates of habituation appeared to vary with species, populations, and demographics (age, sex). Time of day of exposure was also a factor (Muyberg 1978 in Manci, et al. 1988).

Studies accomplished near the Channel Islands were conducted near the area where the space shuttle launches occur. It was found that there were some response differences between species relative to the loudness of sonic booms. Those booms that were between 80 and 89 dBA caused a greater intensity of startle reactions than lower-intensity booms at 72 to 79 dBA. However, the duration of the startle responses to louder sonic booms was shorter (Jehl and Cooper 1980 in Manci, et al. 1988).

Jehl and Cooper (1980) indicated that low-flying helicopters, loud boat noises, and humans were the most disturbing to pinnipeds. According to the research, while the space launch and associated operational activity noises have not had a measurable effect on the pinniped population, it also suggests that there was a greater “disturbance level” exhibited during launch activities. There was a recommendation to continue observations for behavioral effects and to perform long-term population monitoring (Jehl and Cooper 1980).

The continued presence of single or multiple noise sources could cause marine mammals to leave a preferred habitat. However, it does not appear likely that overflights could cause migration from suitable habitats as aircraft noise over water is mobile and would not persist over any particular area. Aircraft noise, including supersonic noise, currently occurs in the overwater airspace of Eglin, Tyndall, and Langley AFBs from sorties predominantly involving jet aircraft. Survey results reported in Davis, et al. (2000), indicate that cetaceans (i.e., dolphins) occur under all of the Eglin and Tyndall marine airspace. The continuing presence of dolphins indicates that aircraft noise does not discourage use of the area and apparently does not harm the locally occurring population.

In a summary by the National Parks Service (1994) on the effects of noise on marine mammals, it was determined that gray whales and harbor porpoises showed no outward behavioral response to aircraft noise or overflights. Bottlenose dolphins showed no obvious reaction in a study involving helicopter overflights at 1,200 to 1,800 feet above the water. Neither did they show any reaction to survey aircraft unless the shadow of the aircraft passed over them, at which point there was some observed tendency to dive (Richardson, et al. 1995). Other anthropogenic noises in the marine environment from ships and pleasure craft may have more of an effect on marine mammals than aircraft noise (U.S. Air Force 2000). The noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna along the coast of California have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc. 1997).

Manatees appear relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats [although their hearing is actually similar to that of pinnipeds (Bullock, et al. 1980)]. Little is known about the importance of acoustic communication to manatees, although they are known to produce at least ten different types of sounds and are thought to have sensitive hearing (Richardson, et al. 1995). Manatees continue to occupy canals near Miami International Airport, which suggests that they have become habituated to human disturbance and noise (Metro-Dade County 1995). Since manatees spend most of their time below the surface and do not startle readily, no effect of aircraft overflights on manatees would be expected (Bowles, et al. 1991).

B.3.8.2.2 Birds

Auditory research conducted on birds indicates that they fall between the reptiles and the mammals relative to hearing sensitivity. According to Dooling (1978), within the range of 1 to 5 kHz, birds show a level of hearing sensitivity similar to that of the more sensitive mammals. In contrast to mammals, bird sensitivity falls off at a greater rate to increasing and decreasing frequencies. Passive observations and studies examining aircraft bird strikes indicate that birds nest and forage near airports. Aircraft noise in the vicinity of commercial airports apparently does not inhibit bird presence and use.

High-noise events (like a low-altitude aircraft overflight) may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests (Ellis, et al. 1991). These activities impose an energy cost on the birds that, over the long term, may affect survival or growth. In addition, the birds may spend less time engaged in necessary activities like feeding, preening, or caring for their young because they spend time in noise-avoidance activity. However, the long-term significance of noise-related impacts is less clear. Several studies on nesting raptors have indicated that birds become habituated to aircraft overflights and that long-term reproductive success is not affected (Grubb and King 1991; Ellis, et al. 1991). Threshold noise levels for significant responses range from 62 dB for Pacific black brant (Branta bernicla nigricans) (Ward and Stehn 1990) to 85 dB for crested tern (Sterna bergii) (Brown 1990).

Songbirds were observed to become silent prior to the onset of a sonic boom event (F-111 jets), followed by “raucous discordant cries.” There was a return to normal singing within 10 seconds after the boom (Higgins 1974 in Manci, et al., 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

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

A recent study, conducted cooperatively between the DoD and the USFWS, assessed the response of the red-cockaded woodpecker to a range of military training noise events, including artillery, small arms, helicopter, and maneuver noise (Pater, et al. 1999). The project findings show that the red-cockaded woodpecker successfully acclimates to military noise events. Depending on the noise level that ranged from innocuous to very loud, the birds responded by flushing from their nest cavities. When the noise source was closer and the noise level was higher, the number of flushes increased proportionately. In all cases, however, the birds returned to their nests within a relatively short period of time (usually within 12 minutes). Additionally, the noise exposure did not result in any mortality or statistically detectable changes in reproductive success (Pater, et al.

1999). Red-cockaded woodpeckers did not flush when artillery simulators were more than 122 meters away and SEL noise levels were 70 dBA.

Lynch and Speake (1978) studied the effects of both real and simulated sonic booms on the nesting and brooding eastern wild turkey (Meleagris gallopavo silvestris) in Alabama. Hens at four nest sites were subjected to between 8 and 11 combined real and simulated sonic booms. All tests elicited similar responses, including quick lifting of the head and apparent alertness for between 10 and 20 seconds. No apparent nest failure occurred as a result of the sonic booms.

Twenty-one brood groups were also subjected to simulated sonic booms. Reactions varied slightly between groups, but the largest percentage of groups reacted by standing motionless after the initial blast. Upon the sound of the boom, the hens and poults fled until reaching the edge of the woods (approximately 4 to 8 meters). Afterward, the poults resumed feeding activities while the hens remained alert for a short period of time (approximately 15 to 20 seconds). In no instances were poults abandoned, nor did they scatter and become lost. Every observation group returned to normal activities within a maximum of 30 seconds after a blast.

###### B.3.8.2.2.1 Raptors

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

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

Short-term behavior responses were also noted. Overflights at a distance of 150 m or less produced few significant responses and no severe responses. Typical responses consisted of crouching or, very rarely, flushing from the perch site. Significant responses were most evident before egg laying and after young were "well grown." Incubating or brooding adults never burst from the nest, thus preventing egg breaking or knocking chicks out of the nest. Jet passes and sonic booms often caused noticeable alarm; however, significant negative responses were rare and did not appear to limit productivity or reoccupancy. Due to the locations of some of the nests, some birds may have been habituated to aircraft noise. There were some test sites located at distances far from zones of frequent military aircraft usage, and the test stimuli were often closer, louder, and more frequent than would be likely for a normal training situation.

Manci, et al. (1988), noted that a female northern harrier was observed hunting on a bombing range in Mississippi during bombing exercises. The harrier was apparently unfazed by the exercises, even when a bomb exploded within 200 feet. In a similar case of habituation/non-disturbance, a study on the Florida snail-kite stated the greatest reaction to overflights (approximately 98 dBA) was “watching the aircraft fly by.” No detrimental impacts to distribution, breeding success, or behavior were noted.

*Bald Eagle*

A study by Grubb and King (1991) on the reactions of the bald eagle to human disturbances showed that terrestrial disturbances elicited the greatest response, followed by aquatic (i.e., boats) and aerial disturbances. The disturbance regime of the area where the study occurred was predominantly characterized by aircraft noise. The study found that pedestrians consistently caused responses that were greater in both frequency and duration. Helicopters elicited the highest level of aircraft-related responses. Aircraft disturbances, although the most common form of disturbance, resulted in the lowest levels of response. This low response level may have been due to habituation; however, flights less than 170 meters away caused reactions similar to other disturbance types. Ellis, et al. (1991), showed that eagles typically respond to the proximity of a disturbance, such as a pedestrian or aircraft within 100 meters, rather than the noise level. Fleischner and Weisberg (1986) stated that reactions of bald eagles to commercial jet flights, although minor (e.g., looking), were twice as likely to occur when the jets passed at a distance of 0.5 mile or less. They also noted that helicopters were four times more likely to cause a reaction than a commercial jet and 20 times more likely to cause a reaction than a propeller plane.

The USFWS advised Cannon AFB that flights at or below 2,000 feet AGL from October 1 through March 1 could result in adverse impacts to wintering bald eagles (U.S. Fish and Wildlife Serice 1998). However, Fraser, et al. (1985), suggested that raptors habituate to overflights rapidly, sometimes tolerating aircraft approaches of 65 feet or less.

*Osprey*

A study by Trimper, et al. (1998), in Goose Bay, Labrador, Canada, focused on the reactions of nesting osprey to military overflights by CF-18 Hornets. Reactions varied from increased alertness and focused observation of planes to adjustments in incubation posture. No overt reactions (e.g., startle response, rapid nest departure) were observed as a result of an overflight. Young nestlings crouched as a result of any disturbance until they grew to 1 to 2 weeks prior to fledging. Helicopters, human presence, float planes, and other ospreys elicited the strongest reactions from nesting ospreys. These responses included flushing, agitation, and aggressive displays. Adult osprey showed high nest occupancy rates during incubation regardless of external influences.

The osprey observed occasionally stared in the direction of the flight before it was audible to the observers. The birds may have been habituated to the noise of the flights; however, overflights were strictly controlled during the experimental period. Strong reactions to float planes and helicopter may have been due to the slower flight and therefore longer duration of visual stimuli rather than noise-related stimuli.

*Red-tailed Hawk*

Anderson, et al. (1989), conducted a study that investigated the effects of low-level helicopter overflights on 35 red-tailed hawk nests. Some of the nests had not been flown over prior to the study. The hawks that were naïve (i.e., not previously exposed) to helicopter flights exhibited stronger avoidance behavior (nine of 17 birds flushed from their nests) than those that had experienced prior overflights. The overflights did not appear to affect nesting success in either study group. These findings were consistent with the belief that red-tailed hawks habituate to low-level air traffic, even during the nesting period.

B.3.8.2.2.3 Migratory Waterfowl

A study of caged American black ducks was conducted by Fleming, et al., in 1996. It was determined that noise had negligible energetic and physiologic effects on adult waterfowl. Measurements included body weight, behavior, heart rate, and enzymatic activity. Experiments also showed that adult ducks exposed to high noise events acclimated rapidly and showed no effects.

The study also investigated the reproductive success of captive ducks, which indicated that duckling growth and survival rates at Piney Island, North Carolina, were lower than those at a background location. In contrast, observations of several other reproductive indices (i.e., pair formation, nesting, egg production, and hatching success) showed no difference between Piney Island and the background location. Potential effects on wild duck populations may vary, as wild ducks at Piney Island have presumably acclimated to aircraft overflights. It was not demonstrated that noise was the cause of adverse impacts. A variety of other factors, such as weather conditions, drinking water and food availability and variability, disease, and natural variability in reproduction, could explain the observed effects. Fleming noted that drinking water conditions (particularly at Piney Island) deteriorated during the study, which could have affected the growth of young ducks. Further research would be necessary to determine the cause of any reproductive effects.

Another study by Conomy, et al. (1998) exposed previously unexposed ducks to 71 noise events per day that equaled or exceeded 80 dBA. It was determined that the proportion of time black ducks reacted to aircraft activity and noise decreased from 38 percent to 6 percent in 17 days and remained stable at 5.8 percent thereafter. In the same study, the wood duck did not appear to habituate to aircraft disturbance. This supports the notion that animal response to aircraft noise is species-specific. Because a startle response to aircraft noise can result in flushing from nests, migrants and animals living in areas with high concentrations of predators would be the most vulnerable to experiencing effects of lowered birth rates and recruitment over time. Species that are subjected to infrequent overflights do not appear to habituate to overflight disturbance as readily.

Black brant studied in the Alaska Peninsula were exposed to jets and propeller aircraft, helicopters, gunshots, people, boats, and various raptors. Jets accounted for 65% of all the disturbances. Humans, eagles, and boats caused a greater percentage of brant to take flight. There was markedly greater reaction to Bell-206-B helicopter flights than fixed wing, single-engine aircraft (Ward, et al. 1986).

The presence of humans and low-flying helicopters in the Mackenzie Valley North Slope area did not appear to affect the population density of Lapland longspurs, but the experimental group was shown to have reduced hatching and fledging success and higher nest abandonment. Human presence appeared to have a greater impact on the incubating behavior of the black brant, common eider, and Arctic tern than fixed-wing aircraft (Gunn and Livingston 1974).

Gunn and Livingston (1974) found that waterfowl and seabirds in the Mackenzie Valley and North Slope of Alaska and Canada became acclimated to float plane disturbance over the course of three days. Additionally, it was observed that potential predators (bald eagle) caused a number of birds to leave their nests. Non-breeding birds were observed to be more reactive than breeding birds. Waterfowl were affected by helicopter flights, while snow geese were disturbed by Cessna 185 flights. The geese flushed when the planes were under 1,000 feet, compared to higher flight elevations. An overall reduction in flock sizes was observed. It was recommended that aircraft flights be reduced in the vicinity of premigratory staging areas.

Manci, et al. 1988 reported that waterfowl were particularly disturbed by aircraft noise. The most sensitive appeared to be snow geese. Canada geese and snow geese were thought to be more sensitive than other animals such as turkey vultures, coyotes, and raptors (Edwards, et al. 1979).

B.3.8.2.2.4 Wading and Shore Birds

Black, et al. (1984), studied the effects of low-altitude (less than 500 feet AGL) military training flights with sound levels from 55 to 100 dBA on wading bird colonies (i.e., great egret, snowy egret, tricolored heron, and little blue heron). The training flights involved three or four aircraft, which occurred once or twice per day. This study concluded that the reproductive activity--including nest success, nestling survival, and nestling chronology--was independent of F-16 overflights. Dependent variables were more strongly related to ecological factors, including location and physical characteristics of the colony and climatology. Another study on the effects of circling fixed-wing aircraft and helicopter overflights on wading bird colonies found that at altitudes of 195 to 390 feet, there was no reaction in nearly 75% of the 220 observations. Ninety percent displayed no reaction or merely looked toward the direction of the noise source. Another 6 percent stood up, 3 percent walked from the nest, and 2 percent flushed (but were without active nests) and returned within 5 minutes (Kushlan 1978). Apparently, non-nesting wading birds had a slightly higher incidence of reacting to overflights than nesting birds. Seagulls observed roosting near a colony of wading birds in another study remained at their roosts when subsonic aircraft flew overhead (Burger 1981). Colony distribution appeared to be most directly correlated to available wetland community types and was found to be distributed randomly with respect to military training routes. These results suggest that wading bird species presence was most closely linked to habitat availability and that they were not affected by low-level military overflights (U.S. Air Force 2000).

Burger (1986) studied the response of migrating shorebirds to human disturbance and found that shorebirds did not fly in response to aircraft overflights, but did flush in response to more localized intrusions (i.e., humans and dogs on the beach). Burger (1981) studied the effects of noise from JFK Airport in New York on herring gulls that nested less than 1 kilometer from the airport. Noise levels over the nesting colony were 85 to 100 dBA on approach and 94 to 105 dBA on takeoff. Generally, there did not appear to be any prominent adverse effects of subsonic aircraft on nesting, although some birds flushed when the concorde flew overhead and, when they returned, engaged in aggressive behavior. Groups of gulls tended to loaf in the area of the nesting colony, and these birds remained at the roost when the concorde flew overhead. Up to 208 of the loafing gulls flew when supersonic aircraft flew overhead. These birds would circle around and immediately land in the loafing flock (U.S. Air Force 2000).

Sonic booms were incidentally linked to the reproductive failure of sooty terns in the Dry Tortugas. Birds were observed to rise from their nests quickly and, in a panic-type mode, fly over the island before settling back down on the nests. The authors felt that the sonic booms may have had an effect on the incubating rhythm of the sooty terns, which resulted in greater incidences of nest desertion (Austin, et al. 1970 in Manci, et al. 1988).

Conversely, 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.

### B.3.8.3 Fish, Reptiles, and Amphibians

The effects of overflight noise on fish, reptiles, and amphibians have been poorly studied, but conclusions regarding their expected responses have involved speculation based upon known physiologies and behavioral traits of these taxa (Gladwin, et al. 1988). Although fish do startle in response to low-flying aircraft noise, and probably to the shadows of aircraft, they have been found to habituate to the sound and overflights. Reptiles and amphibians that respond to low frequencies and those that respond to ground vibration, such as spadefoots (genus Scaphiopus), may be affected by noise. Limited information is available on the effects of short-duration noise events on reptiles. Dufour (1980) and Manci, et al. (1988), summarized a few studies of reptile responses to noise. Some reptile species tested under laboratory conditions experienced at least temporary threshold shifts or hearing loss after exposure to 95 dB for several minutes. Crocodilians in general have the most highly developed hearing of all reptiles. Crocodile ears have lids that can be closed when the animal goes under water. These lids can reduce the noise intensity by 10 to 12 dB (Wever and Vernon 1957). On Homestead Air Reserve Station, Florida, two crocodilians (the American Alligator and the Spectacled Caiman) reside in wetlands and canals along the base runway suggesting that they can coexist with existing noise levels of an active runway including DNLs of 85 dB.

### B.3.8.4 Summary

Some physiological/behavioral responses such as increased hormonal production, increased heart rate, and reduction in milk production have been described in a small percentage of studies. A majority of the studies focusing on these types of effects have reported short-term or no effects.

The relationships between physiological effects and how species interact with their environments have not been thoroughly studied. Therefore, the larger ecological context issues regarding physiological effects of jet aircraft noise (if any) and resulting behavioral pattern changes are not well understood.

Animal species exhibit a wide variety of responses to noise. It is therefore difficult to generalize animal responses to noise disturbances or to draw inferences across species, as reactions to jet aircraft noise appear to be species-specific. Consequently, some animal species may be more sensitive than other species and/or may exhibit different forms or intensities of behavioral responses. For instance, wood ducks appear to be more sensitive and more resistant to acclimation to jet aircraft noise than Canada geese in one study. Similarly, wild ungulates seem to be more easily disturbed than domestic animals.

The literature does suggest that common responses include the "startle" or "fright" response and, ultimately, habituation. It has been reported that the intensities and durations of the startle response decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects. The majority of the literature suggests that domestic animal species (cows, horses, chickens) and wildlife species exhibit adaptation, acclimation, and habituation after repeated exposure to jet aircraft noise and sonic booms.

Animal responses to aircraft noise appear to be somewhat dependent on, or influenced by, the size, shape, speed, proximity (vertical and horizontal), engine noise, color, and flight profile of planes. Helicopters also appear to induce greater intensities and durations of disturbance behavior as compared to fixed-wing aircraft. Some studies showed that animals that had been previously exposed to jet aircraft noise exhibited greater degrees of alarm and disturbance to other objects creating noise, such as boats, people, and objects blowing across the landscape. Other factors influencing response to jet aircraft noise may include wind direction, speed, and local air turbulence; landscape structures (i.e., amount and type of vegetative cover); and, in the case of bird species, whether the animals are in the incubation / nesting phase.

### B.3.9 Property Values

Property within a noise zone (or Accident Potential Zone) may be affected by the availability of federally guaranteed loans. According to U.S. Department of Housing and Urban Development (HUD), Federal Housing Administration (FHA), and Veterans Administration (VA) guidance, sites are acceptable for program assistance, subsidy, or insurance for housing in noise zones of less than 65 DNL, and sites are conditionally acceptable with special approvals and noise attenuation in the 65 to 75 DNL noise zone and the greater than 75 DNL noise zone. HUD's position is that noise is not the only determining factor for site acceptability, and properties should not be rejected only because of airport influences if there is evidence of acceptability within the market and if use of the dwelling is expected to continue. Similar to the Navy's Air Installation Compatible Use Zone Program, HUD, FHA, and VA recommend sound attenuation for housing in the higher noise zones and written disclosures to all prospective buyers or lessees of property within a noise zone (or Accident Potential Zone).

Real property values are dynamic. They are determined by a combination of factors, including market conditions, neighborhood characteristics, and individual real property characteristics (e.g., the age of the property, its size, and amenities). The degree to which a particular factor may affect property values is influenced by many other factors that fluctuate widely with time and market conditions. Accordingly, the impact of aircraft noise on individual property cannot be measured, given the many factors in the real estate market that influence property values. Given the dynamic nature of the real estate market, and the varying degree to which any combination of factors affect the value of a particular property, it is not possible to quantify whether an increase in noise from military aircraft will negatively or positively affect property values. Any discussion of changes in property values would, therefore, be too speculative for inclusion in this document.

### B.3.10 Noise Effects on Structures

Normally, the most sensitive components of a structure to airborne noise are the windows and, infrequently, the plastered walls and ceilings. An evaluation of the peak sound pressures impinging on the structure is normally used to determine the possibility of damage. In general, with peak sound levels above 130 dB, there is the possibility of the excitation of structural component resonances. 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 sound level of 130 dB are potentially damaging to structural components (Committee on Hearing, Bioacoustics, and Biomechanics 1977).

Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations, or rattling of objects within the dwelling such as hanging pictures, dishes, plaques, and bric-a-brac. Window panes may also vibrate noticeably when exposed to high levels of airborne noise. In general, such noise-induced vibrations occur at peak sound levels of 110 dB or greater. Thus, assessments of noise exposure levels for compatible land use should also be protective of noise-induced secondary vibrations.

### B.3.11 Noise Effects on Terrain

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

### B.3.12 Noise Effects on Historical and Archaeological Sites

Because of the potential for increased fragility of structural components of historical buildings and other historical sites, aircraft noise may affect such sites more severely than newer, modern structures. Particularly in older structures, seemingly insignificant surface cracks initiated by vibrations from aircraft noise may lead to greater damage from natural forces (Hanson, et al. 1991). There are few scientific studies of such effects to provide guidance for their assessment.

One study involved the measurements of sound levels and structural vibration levels in a superbly restored plantation house, originally built in 1795, and now situated approximately 1,500 feet from the centerline at the departure end of Runway 19L at Washington Dulles International Airport. These measurements were made in connection with the proposed scheduled operation of the supersonic Concorde airplane at Dulles (Wesler 1977). There was special concern for the building's windows, since roughly half of the 324 panes were original. No instances of structural damage were found. Interestingly, despite the high levels of noise during Concorde takeoffs, the induced structural vibration levels were actually less than those induced by touring groups and vacuum cleaning.

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

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# Appendix C– Tools for Implementing an AICUZ Program

## Federal Level Tools

- **Executive Order 12372, Intergovernmental Review of Federal Programs.** As a result of the Intergovernmental Cooperation Act of 1968, the Office of Management and Budget requires, through Circular A-95, that all federal aid development projects must be coordinated with and reinforce state, regional, and local planning. As such, if land use compatibility suggestions as set forth in this AICUZ study are adopted by local government agencies, the A-95 review process can divert federal monies away from any projects that support incompatible development.

- **National Environmental Policy Act (NEPA) of 1969.** NEPA mandates full disclosure of environmental effects resulting from proposed federal actions. An environmental impact statement (EIS) disclosure provides a public open forum for review and for negotiating changes to federal actions of other agencies that would be incompatible with local AICUZ recommendations and objectives. An environmental assessment (EA) is less detailed than an EIS. The EA discusses impact and alternative measures of a proposed action but has no public open forum for review.

- **Agreements to Limit Encroachments and Other Constraints on Military Training, Testing, and Operations.** United States Code, Title 10, Chapter 159, Section 2684a states that the Secretary of Defense or the Secretary of a military department is authorized to enter into agreements with state or local governments, as well as private entities with a stated principal purpose of conservation, restoration, or preservation of land and natural resources, to address the use or development of real property in the vicinity of a military installation. Agreements may include the limiting of incompatible development or use of the property with regards to the mission of the installation, or preserving habitat on the property in keeping with environmental requirements to eliminate or relieve current or anticipated environmental restrictions that may restrict, impede, or interfere with current or anticipated military training, testing, or operations on the installation. Agreements may provide for the acquisition of right, title, or interest in real property, with the consent of the property owner, as well as the purchase of water rights from any available source. Funds authorized to be appropriated for operation and maintenance of the installation may be used to enter into these agreements.

## Navy Level Tools

*Noise Complaint Response Program in place at NAS Whidbey Island.*

- **Noise Complaint Response Program.** A noise complaint response and abatement program can be implemented to log and track noise complaints, analyze complaint locations and times, and identify the flights/operations that generated the complaints. Possible adjustment of operational procedures then can be discussed and implemented to avoid future conflicts.

- **Property and Property Rights Acquisition.** The acquisition of property or property rights may be exercised to achieve compatible uses in locations where other measures have failed or are not feasible. Acquisition may take on several forms, including easements, leaseholds, and fee simple purchase. Documentation of a community's unwillingness or inability to institute adequate controls that promote compatible land use is required to support acquisition projects. The first priority for acquisition should be any land within clear zone that is not controlled by the Navy. Other APZs and noise zones located on land not controlled by the Navy may be considered for acquisition only when the operational integrity of the airfields is manifestly threatened.

*A CP&LO is in place at NAS Whidbey Island and performs Public Outreach functions.*

- **Emphasis on Public Outreach** promotes close working relationships among the range, community leaders, and citizens. A carefully designed program of public relations and education can promote community awareness of the importance of the range and the Navy's desire to be a good neighbor. The Navy can use community forums, brochures, and local speaking engagements (e.g., Rotary Club, Lions Club, Navy League, etc.) to inform the general public about the AICUZ program and the need for compatible development around the range. Commanding Officers and their Community Plans and Liaison Officers (CP&LOs) should take every opportunity to meet with and make presentations to the local governments, particularly the planning and zoning agencies.

## Local Government Tools

*Zoning, Comprehensive Plans, Building Codes, Subdivision Plans, Capital Improvements Plans, and Real Estate Disclosure are all tools used by the local governments near NAS Whidbey Island.*

The AICUZ footprints for Ault Field and OLF Coupeville primarily impact lands within Island County, Washington. Island County officials have several approaches at their disposal to promote compatible land use and limit incompatibilities and conflicts within the AICUZ footprint:

- **Zoning** is an exercise of the police powers of state and local governments that designates the uses permitted on each parcel of land. It normally consists of a zoning ordinance that delineates the various use districts and includes a zoning map based on the community's vision of the future. As this vision changes over time, the zoning can be changed to suit new ideas. Hence, for zoning to be an effective control against AICUZ-incompatible land uses, it must be monitored over time. Zoning can and should be used constructively to increase the value and productivity of land within the AICUZ footprint. Used within its limitations, zoning is the preferred method of controlling land use in AICUZ impacted areas.

The following limitations must be considered when using zoning as a compatibility implementation tool:

1. Zoning is usually not retroactive. That is, changing a zone primarily for the purpose of prohibiting a use that already exists is normally not possible. However, if such zoning is accomplished, the use must be permitted to remain as a "nonconforming" element until the owners have had ample opportunity to recoup investment.

2. Zoning is jurisdiction-limited and requires coordination of all involved jurisdictions. Zoning that implements a compatibility plan will often be composed of existing and new zoning districts within each of the zoning jurisdictions covered by the plan. Each jurisdiction is likely to have a different base zoning ordinance, with districts having different responsibilities for implementing the compatibility plan.

3. Zoning is not permanent. In any jurisdiction, zoning can be changed by the current governmental body; also, it is not bound by prior zoning actions. Consequently, zoning that achieves compatibility is subject to continual pressure for change from both urban expansion and enterprises that might profit from such changes. When these changes are proposed, the environmental impacts may require assessment. Also, from time to time the entire zoning ordinance for a jurisdiction will be updated to accommodate increased growth or incorporate new land use concepts.

4. Zoning Board of Adjustment actions granting variances to the zoning district or exceptions written into the zoning ordinance can permit development (e.g., schools or churches) that may be incompatible.

- **Comprehensive Planning Programs** create plans for the future development or redevelopment of a community. Comprehensive plans, or policy guides for physical development and land management practices within a local jurisdiction, consist of smaller master plans relating to the various elements of a community (e.g., land use plan, transportation plan, public utilities plan, and housing plan). A comprehensive plan coordinated with the AICUZ land use objectives will reinforce the overall vision and objectives of the county, help potential developers to stay in tune with the long-range goals for the county, and help promote compatible uses in the areas impacted by range operations.

- **Subdivision Regulations** are a means by which local government can ensure that proper lot layout, design, and improvements are included in new residential developments. These regulations specifically set guidelines that developers must follow when constructing their subdivisions, including minimum requirements for road widths, lot arrangements, allocation of facilities, the relationship of the subdivision to the surrounding area, and the dedication of property. Subdivision regulations are used to ensure that the health and habitability of each new residential development are maintained. All subdivision reviews should include an analysis of the potential effect the AICUZ would have on the proposed development. Modifications could then be instituted in the development plan to minimize any potentially adverse effects. All local government subdivision regulations require some type of dedication of open space to the public.

- **Building Codes** govern the construction and physical modification of structures, providing a means to control noise. Although the building codes contain requirements more specifically keyed to local construction needs, these codes also include provisions concerning administration and enforcement. Building codes could serve as an implementation mechanism strategy not only for areas within the defined AICUZ but also for surrounding areas, which are affected by the noise levels to a lesser degree. Minimum amounts of noise-suppression materials in new structures could be related to the location of the structure in relation to the noise sources. Existing structures, however, would generally not be affected by new code modifications, the need for which would depend on the level of noise and types of land uses affected. On the federal level, incentives have been implemented to encourage home thermal insulation and the installation of solar heating units. Similar incentives could be used to encourage the installation of noise-suppression materials. To some extent, thermal building insulation measures would also assist in noise suppression.

- **Capital Improvements Programming** is the multiyear scheduling of physical upgrades to public property. A capital improvements program (CIP) is a planning tool used by local jurisdictions to phase the installation of needed public facilities (e.g., water and sewer, roads, schools) on a priority basis. A CIP projects three to six years into the future. It specifies what public improvements will be constructed. Scheduling is based on studies of fiscal resources available and improvements needed. A CIP is an important component of a growth management system. The CIP precedes preparation of a capital improvements budget (CIB). A CIB identifies the methods by which improvements will be financed and the source of the funds. Usually, development occurs where capital improvements are located. Extension of municipal services into an area makes that area more attractive to developers than sites without the improvements (i.e., the developer saves both time and money). Local governments should avoid extending capital improvements into the AICUZ impacted areas and the immediate vicinity of the footprint to avoid the possibility of incompatible uses.

- **Real Estate Disclosure** can be approached as a voluntary or regulatory practice. These provisions require that developers or landowners who own property within the AICUZ area must notify any prospective purchaser of such property of the noise and safety considerations. This concept could be strengthened by having each buyer or renter execute a "disclosure statement" that contains the acknowledgment that the buyer or renter has been advised that the property is near a military installation and its location has noise or safety concerns associated with military operations conducted on the range.

- **Public Purchase of Land** can work toward AICUZ objectives if the community's intention is to leave the land undeveloped or open space.

## Private Citizens, Real Estate Professionals, and Businesses

- **Private Citizens** have the ability to not purchase property within high noise and/or APZs.

- **Real Estate Professionals** have the ability to ensure that prospective buyers or lease holders/renters are fully aware of what it means to be within high noise zones and/or APZs.

- **Acquisition, Development, and Construction Loan Review to Private Contractors** works to encourage a review of noise and safety hazards as part of a lender's investigation of potential loans to private interests for real estate acquisition and development. Diligent lending practices will promote compatible development and protect lenders and developers alike. Local banking and financial institutions should be encouraged to incorporate a "due diligence review" of all loan applications, including a determination of possible noise or APZ impacts on the mortgaged property.

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