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Civil Engineering

AIR FORCE NOISE PROGRAM

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This instruction implements Department of Defense Instruction (DoDI) 4715.13, *Noise Program* and interfaces with Air Force Instruction (AFI) 32-7061, as promulgated in 32 Code of Federal Regulations (CFR) 989, *Environmental Impact Analysis Process (EIAP)*; AFI 32-7062, *Base Comprehensive Planning*; AFI 32-7063, *Air Installations Compatible Use Zones (AICUZ) Program*; AFI 32-7064, *Integrated Natural Resources Management;* AFI 32-7065, *Cultural Resources Management;* AFI 90-2001, *Encroachment Management*; AFI 35-108, *Environmental Public Affairs (PA),* and AFI 51-501, *Tort Claims*. It consolidates existing guidance related to weapon system noise found in multiple AFIs into one primary guidance document and provides more detailed direction. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

This publication applies to active Air Force, Air National Guard (ANG), Air Force Reserve installations, and government owned, contractor operated facilities located in the United States, its territories, and possessions. The following paragraphs do not apply to Air Force Reserve Stations and Air National Guard units at civil airports: Sections 2.22.1.2, 2.22.3.5, 2.22.3.6, 2.22.3.7, 2.22.5, 2.22.6, 2.22.7, 2.22.8, 2.22.9, 2.22.10, and 2.22.11. This AFI directs the use of noise models and metrics, provides information that can be used to manage and explain noise exposure to off-base populations, and analyzing the effects of noise on the natural and human environments when conducting environmental impact analysis. It supports compatible land use analysis, comprehensive planning, management of noise inquiries/complaints, and the Air Force EIAP program. The AFI assigns responsibilities for administration of the Air Force Noise Program, sets policy and describes Major Command (MAJCOM), Direct Reporting Units (DRU), and installation roles for implementing the Air Force Noise Program across the

installation complex including air-to-ground ranges, ground ranges, Special Use Airspace (SUA), and Airspace for Special Use (ASU). Refer to AFI 48-127, *Occupational Noise and Hearing Conservation Program* for information regarding occupational noise.

This AFI may be supplemented at any level, but all supplements must be routed through the Office of Primary Responsibility for coordination and prior to certification and approval. Refer recommended changes and questions about this publication to the Office of Primary Responsibility using the Air Force Form 847, *Recommendation for Change of Publication*; route Air Force Forms 847 from the field through appropriate chain of command. Ensure that all records created as a result of processes prescribed in this publication are maintained IAW Air Force Manual (AFMAN) 33-363, Management of Records, and disposed of IAW the Air Force Records Disposition Schedule (RDS) in the Air Force Records Information Management System (AFRIMS). The authorities to waive wing/unit level requirements in this publication are identified with a Tier ("T-0, T-1, T-2, T-3") number following the compliance statement. See AFI 33-360, *Publications and Forms* Management, Table 1.1 for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier Waiver approval authority, or alternately, to the Publication OPR for non-tiered compliance items.

CHAPTER 1

INTRODUCTION

1.1. The *Noise Control Act* of 1972 established a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. The Act's regulatory authority is limited to the manufacture, labeling and importation of "products" to ensure they meet noise emission standards; however, the act specifically excludes aircraft, aircraft engines, military weapons or equipment designed for combat from the definition of "product." Despite this exclusion, the Air Force is still required to assess noise impacts under the *National Environmental Policy Act* (NEPA) (42 United States Code [USC] 4321 *et seq.*) and to comply with other laws such as the *Endangered Species Act* of 1973 (16 USC 1531 *et seq.*), and the *National Historic Preservation Act* of 1966 (54 USC § 300101 et seq.).

1.2. A general definition of noise is unwanted sound and it is up to the individual to determine whether they consider the sounds they are hearing as "noise. " It also means that the issue of noise is very subjective, and is typically influenced by an individual's experiences and sensitivity. Both terms, noise and sound, are used in this instruction depending on the context of the discussion. The Air Force Noise Program is focused on noise from the operation of aircraft, small arms, tanks, guns, artillery, missiles, bombs, rockets, mortars, and explosives that may affect people, animals (domestic or wild), or structures on or in areas within close proximity of a military installation, military test and training ranges, and within the SUA/ASU. To distinguish it from "occupational or workplace noise, which is falls under the Air Force Aerospace Medicine program, the term "environmental" or "community" noise is used." The reader may also see the term "operational noise" associated with the Army's noise program. For purposes of the Air Force Noise Program the terms environmental, community, and operational noise are considered synonymous.

1.3. Aircraft overflights, weapon system operations, or munition use have the potential to produce sound levels that may cause annoyance, speech interference, sleep disturbance, or damage to structures (i.e., broken windows). The public typically registers their noise concerns/issues by filing complaints. If the public is not satisfied with the Air Force or installation response, noise complaints can quickly escalate into political interest or pressure if members of the public contact their elected officials or Congressman. Threats of litigation may arise, or if there is perceived physical damage to property there may be damage claims. To minimize possible impacts to the Air Force mission or tort claims, and in compliance with Department of Defense (DoD) policy and directives, Commanders need to fully understand and actively manage the installation complex's noise environment.

1.4. This instruction provides direction and policies and roles and responsibilities for implementing the Air Force Noise Program. It also directs which models are to be used for the various noise sources and identifies primary and supplemental noise metrics. The instruction also provides guidance on handling noise-related complaints and inquiries, educating airmen, and communicating with the public. This instruction does not address occupational noise exposure in the workplace, underwater sound, or other transportation related noise sources.

CHAPTER 2

ROLES AND RESPONSIBILITIES

2.1. Assistant Secretary of the Air Force for Acquisition (SAF/AQ) will:

2.1.1. Provide appropriate direction to acquisition and sustainment program managers that they ensure environmental noise management is included in the program's efforts to integrate Environment, Safety, and Occupational Health (ESOH) considerations into the overall systems engineering process. In this effort, program offices will:

2.1.1.1. Support the Lead Command for the program in its efforts to identify specific installation-level system environmental noise management requirements and the associated funding needed by the program office.

2.1.1.2. Address environmental noise management in the ESOH design consideration portion of the program office's Systems Engineering Plan (SEP) and in the Life Cycle Sustainment Plan (LCSP).

2.1.1.3. Include all environmental noise data and related information generated by the program office in the Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE) document.

2.1.2. Ensure through policy, guidance, and oversight that Air Force acquisition and sustainment program managers support the Lead Command and User Commands installations compliance with the EIAP program requirements applicable to the program managers' system as it is being operated on those installations.

2.1.2.1. For air systems (manned and unmanned), program managers will include, as appropriate, collection and reporting of measured ground-to-ground (near-field) and recorded air-to-ground (far-field) noise signatures (3rd Octave Band) of all new air system during early development stages and provide the collected data to 711 HPW/RHCB.

2.1.2.2. When these data are required, program managers will coordinate with 711 HPW/RHCB to determine the appropriate method of collecting data to ensure the noise signature data is collected is at the level of detail necessary to create noise data-files used for modeling fixed wing aircraft in NOISEMAP (with the Advanced Acoustics Model).

2.2. The Deputy General Counsel for Installations, Energy and Environment (SAF/GCN) will:

2.2.1. Serve as the principal legal adviser to SECAF/SAF/IE, SAF/IEI and SAF/IEE on noise issues.

2.2.2. Serve as the principal AF legal representative on all noise-related issues involving the OSD office of General Counsel or the General Counsel offices of other federal agencies.

2.3. The Deputy Assistant Secretary of the Air Force for Installations (SAF/IEI) will:

2.3.1. Ensure the potential for changes in the acoustic environment is considered early in the enterprise-wide basing process.

2.3.2. Approve the use of noise monitors as part of a monitoring and mitigation strategy.

2.4. The Director, Public Affairs, Office of the Secretary of the Air Force (SAF/PA) will:

2.4.1. Provide guidance in AFI 35-108, *Environmental Public Affairs*, consistent with this AFI for MAJCOM and Installation PA offices for implementing the noise inquiry/complaint element of the Air Force Noise Program.

2.4.2. Support A4C in developing messages and strategic communications related to noise generated by the operation of Air Force weapons (e.g., aircraft noise, sonic booms, ordnance, etc.) as needed.

2.5. The Deputy Chief of Staff, Operations (A3) will develop and coordinate responses to Congressional noise complaints/inquiries.

2.6. The Director Ranges, Airspace and Operations Sustainment (A3OJR) will:

2.6.1. Ensure guidance on responding to noise complaints/inquiries in airspace and range policy and guidance is consistent with the Air Force Noise Program requirements.

2.6.2. As current and future test and training needs are recognized, inform A4C of any potential noise related issues in support of effective planning, programming, budgeting, and execution of Air Force and DoD noise program requirements.

2.7. The Director of Civil Engineers (AF/A4C) will:

2.7.1. Develop policy and guidance for the Air Force Noise Program.

2.7.2. Ensure the requirements of the Air Force Noise Program are integrated appropriately into the Environmental Impact Analysis Process, and the AICUZ, Comprehensive Planning and Air Force Encroachment Management Programs.

2.7.3. Designate the Air Force representative to the DoD Noise Working Group in accordance with DoDI 4715.13, *Noise Program*.

2.8. The Chief, of the Air Force Civil Engineer Center, Comprehensive Planning Division (AFCEC/CPP) will:

2.8.1. Ensure Air Force Noise Program requirements are implemented appropriately within the EIAP, AICUZ, Comprehensive Planning, and Encroachment Management Programs **(T-1)**.

2.8.2. Identify requirements and advocate for funds to address noise related challenges to current and future testing and training, including research, maintenance of noise models, and development of other tools and strategies as necessary **(T-2)**.

2.8.3. Ensure any necessary noise attenuation and mitigation techniques incorporated into Installation Development Plans, and during the siting process, are consistent with the guidelines found in the Air Force Noise Program Noise Toolbox **(T-2)**.

2.8.4. Retain version control of NOISEFILE, BASEOPS, NOISEMAP, and Military Operating Area and Range Noise Model (MR_NMAP) models **(T-1)**.

2.8.5. Ensure availability of the most current validated version of BASEOPS, NOISEMAP, NOISEFILE, MR_NMAP, PCBOOM, and BOOMAP.

2.8.6. Provide instructions for obtaining other noise programs such as the Advanced Acoustic Model (AAM), Aviation Environmental Design Tool (AEDT), Blast Noise Model (BNOISE 2), and Small Arms Range Noise Assessment Model (SARNAM) **(T-1)**.

2.8.7. Identify issues and funds fixes/updates to the NOISEMAP suite of programs, MR_NMAP, and the BASEOPS and coordinates the work with 711 HPW/RHCB **(T-1)**.

2.8.8. Establish and maintains a repository of all computer noise model input and output files used for modeling noise from military operations at airfields, ranges (air-to-ground, and ground ranges for weapon system and munitions use), and for SUA/ASU airspace **(T-1)**.

2.8.9. Ensure archived files are fully documented and contain all information necessary to replicate results **(T-1)**.

2.8.10. Provide the most current documentation and noise input files to other organizations needing baseline information for all studies requiring operational data to determine noise effects, as requested **(T-2)**.

2.8.11. Determine need for updated baseline noise input files during the early planning stages of Air Force proposed actions. Notify the proponent of all update requirements to ensure the appropriate level of effort is considered during the preparation of contracting actions **(T-1)**.

2.8.12. Provide baseline files to be used as Government Furnished Information during updating actions **(T-2)**.

2.8.13. Provide technical assistance and training to installations, MAJCOMs, and other clients pertaining to the Air Force Noise Program and in the use of noise models **(T-1)**.

2.8.14. Provide technical assistance to MAJCOMs and installations in identifying appropriate mitigation strategies for minimizing negative impacts to noise sensitive areas, local communities, and installations and their mission **(T-1)**.

2.8.15. Develop and maintains a "Noise Toolbox" file on AFCEC/CPP's SharePoint® site with tools, briefings, bullet background papers, and educational materials pertaining to aircraft and weapon system noise to facilitate education and communication of installation personnel and the public. **(T-1)**.

2.8.16. Provide training on noise, handling noise complaints and risk communications in support of the AICUZ, Encroachment Management and EIAP programs upon request **(T-2)**.

2.8.17. Maintain and updates, as needed, a digital library of reference documents cited in NEPA and AICUZ documents and provides a list of these references as part of government supplied material for any contracted environmental analysis and AICUZ studies **(T-2)**.

2.8.18. Retain an in-house capability to use of NOISEMAP, AAM, and MR_NMAP calculate noise levels based on a full range of metrics **(T-1)**.

2.8.19. Ensure the Defense Noise Working Group coordinates all noise related research or study recommendations made during the consultation process with other agencies prior to final commitment to minimize duplication of effort and cost between Services **(T-2)**.

2.8.20. Maintain an library of noise related technical references (electronic or hard copy) used by contractors in their analysis of noise impacts in NEPA documents and maintain and provide a current list of all references to AFCEC/CZN for inclusion in their EIAP SOWs **(T-2)**.

2.8.21. Ensure that all statements of work for development of noise zones for AICUZ studies require that the latest approved version (see paragraph A2.2) of NOISEMAP be used for modeling, and that BASOPS be used for all data input into NOISEMAP unless otherwise approved by the AFCEC/CPP **(T-1)**.

2.8.22. Establish an Aircraft Noise Model User Forum to include military customers, contractors, representatives from other Services to discuss and identify problems using the aircraft noise models, needed model updates, training needs and to share best practices **(T-2)**.

2.9. The Chief, Air Force Civil Engineer Center National Environmental Policy Act Division (AFCEC/CZN) will:

2.9.1. Ensure the analysis of noise impacts in environmental analysis documents is executed consistent with the Air Force Noise Program **(T-1).**

2.9.2. Ensure all data files used to produce noise predictions for NEPA analysis at airfields, ranges (i.e., air-to-ground and ground ranges for weapon systems and munitions use), and in the airspace are fully documented and provided AFCEC/CPP for archiving in the Noise Repository **(T-1)**.

2.9.3. Ensure the operational data used for noise analysis in any NEPA analysis is also used for preparing any necessary air conformity analysis (ref AFI 32-7040) **(T-2)**.

2.9.4. Ensure mitigation measures designed to reduce noise impacts are included in a monitoring and mitigation plan in compliance with 32 CFR 989.22 (T-0) for implementation of the action (T-2).

2.9.5. Inform AFCEC/CZT of any requirements for mitigation of impacts to endangered species or cultural resources or studies required as a result of consultations under the Endangered Species Act Section 7 and/or National Historic Preservation Act Section 106 to support compliance with NEPA **(T-2)**.

2.9.6. Inform AFCEC/CPP of all noise related studies or research recommendations made during the consultation process with other agencies prior to final commitment to allow for the proposed studies or research efforts to be coordinated with other Services through the Defense Noise Working Group to minimize duplication **(T-1)**.

2.9.7. Work with AFCEC/CPP to identify gaps in research needed to support the environmental analysis of noise impacts **(T-3)**.

2.9.8. Provide contractors preparing NEPA analysis, a copy of the titles in the AFCEC/CPP technical reference library as government provided material and require in the EIAP SOW that contractors provide copies of any additional reference documents used in the development of the environmental analysis as part of the administrative record. AFCEC/CZN will forward copies of these additional documents to AFCEC/CPP for inclusion in the library that will be established under paragraph 2.8.20 **(T-2)**.

2.9.9. Ensure that all statements of work for environmental analysis that require modeling of aircraft noise require the latest approved version (see paragraph A2.2) of NOISEMAP will be used for modeling, and that BASOPS will be used (see paragraph A2.2.1) for all data input into NOISEMAP unless otherwise approved by the AFCEC/CPP **(T-1)**.

2.10. Chief, Air Force Civil Engineer Center, Environmental Technical Support Division (CZT) will: Ensure that any mitigations of impacts identified as a result of proposed Air Force actions required as a result of Endangered Species Act Section 7 and/or National Historic Preservation Act Section 106 consultations and identified in NEPA documents are incorporated into Air Force Integrated Natural Resource Management Plans (INRMPS) and/or Integrated Cultural Resource Management Plans (ICRMPS) in accordance with AFI 32-7064 and AFI 32-7065 as appropriate (T-2).

2.11. Director of the Human Performance Wing (711 HPW/RHCB) will:

2.11.1. Provide Air Force technical expertise in physical acoustics and bioacoustics and act as the technical subject matter experts in acoustics for all fixed-wing noise **(T-1)**.

2.11.2. Maintain and recommend improved field measurement capability for ground run-up and flyover noise measurements identifying unique acoustic characteristics of new aircraft **(T-1)**.

2.11.3. Maintain and improve all aircraft noise files and noise spheres for fixed-wing aircraft used for modeling and analyzing aircraft environmental and personnel noise as defined in the Air Force Noise Program **(T-1)**.

2.11.4. Develop and execute research and development programs and identifies noise related research gaps necessary to address needs/requirements identified through the Air Force or DoD Noise programs **(T-1)**.

2.11.4.1. Reviews all research statements of need and research/study proposals or designs prior to funding by any Air Force organization to ensure the acoustic element of any research project or study is appropriately characterized **(T-1)**.

2.11.4.2. Review results of all noise related research/study efforts and present the results to the Defense Noise Working Group prior to acceptance and use of the findings in future public documents, including NEPA analysis, prepared by the Air Force or other Services **(T-2)**.

2.11.5. Coordinate on noise measurements from field studies for DoD fixed wing aircraft **(T-1)**.

2.11.6. Assist AFCEC/CPP in identifying appropriate aircraft to be used as a surrogate for modeling noise and predicting impacts when noise data for a specific aircraft is unavailable **(T-1)**.

2.11.7. Advise and provide subject matter expertise to Headquarters Air Force, AFCEC/CPP, AFCEC/CZN and the Air Force Legal Operations Agency (AFLOA) on fixed wing noise measurements, sonic boom noise, and/or measurement techniques as requested **(T-2)**.

2.11.8. Provide updates, improvements, revisions, and validations of fixed wing aircraft noise models and propagation tools or coordinates on fixes/updates funded by AFCEC/CPP **(T-1)**.

2.11.9. Provide acoustic technical consultation and support to aircraft acquisition program offices **(T-1)**.

2.11.10. Provide any measured near-field data (for maintainer positions) collected by program managers for new air systems to USAFSAM/OEC and USAFSAM/OET.

2.11.11. Assist with development of and validate supplemental noise metrics to be used by the Air Force support of the Air Force noise program **(T-1)**.

2.11.12. Identify a representative to participate on the Defense Noise Working Group **(T-1)**.

2.11.13. Identify a representative to participate in the Federal Interagency Committee on Aviation Noise (FICAN) to brief research efforts related to aviation noise **(T-1)**.

2.12. The Air Force Legal Operations Agency, Civil Law and Litigation Directorate (AFLOA/JAC) will:

2.12.1. Serve as the expert on legal aspects of the Air Force Noise Program through AFLOA/JACE, including providing legal opinions on noise management for all levels of the Air Force **(T-1)**.

2.12.2. Provide litigation support and advice related to noise issues through AFLOA/JACE, including such matters as administrative hearings **(T-1)**.

2.12.3. Process claims relating to damage allegedly caused by noise and vibrations associated with the use of military aircraft, weapons systems, or munitions through AFLOA/JACC in accordance with AFI 51-501, *Tort Claims*, or other applicable law **(T-0)**.

2.13. Headquarters Air Force Installation Mission Support Center (AFIMSC) will:

2.13.1. Advocate for and support funding needed to implement the Air Force noise program and Air Force responsibilities associated with DoD Noise Program.

2.13.2. Work with MAJCOM A3 and A5/8/9 through AFIMSC detachment engineers, when the MAJCOM is the Lead Command for a system (aircraft, munitions, weapons, support equipment, etc.) in acquisition or sustainment, to identify system specific installation-level environmental noise data requirements; include those requirements, as appropriate, in the system's Joint Capabilities Integration and Development System (JCIDS) documents; and advocate for the necessary funding in the MAJCOM's corporate budgeting process for the program office to meet those requirements.

2.14. The MAJCOM Director of Operations (A3) will:

2.14.1. Work with MAJCOM PA and AFCEC/CPP staff as needed to ensure the content on noise metrics and methodologies in any strategic communication plans or other communication strategies/messages needed for noise issues in MAJCOM controlled or managed airspace and range environments, are consistent with Air Force Noise program guidance on metrics and methodologies.

2.14.2. Work with MAJCOM A5/8/9, and installation operational units to ensure that the concept of operation for proposed beddown actions, aircraft realignments, or changes in

airspace is detailed enough to support the development of the operations data needed to model noise levels for NEPA analysis and update of the installation's AICUZ study.

2.14.3. Work with HQ AFIMSC, AFIMSC detachment engineers, and A5/8/9, when the MAJCOM is the Lead Command for a system (aircraft, munitions, weapons, support equipment, etc.) in acquisition or sustainment, to identify system specific installation-level environmental noise management requirements; include those requirements, as appropriate, in the system's Joint Capabilities Integration and Development System (JCIDS) documents; and advocate for the necessary funding in the MAJCOM's corporate budgeting process for the program office to meet those requirements.

2.15. The MAJCOM Director of Plans/Programs and Requirements (A5/8/9) will:

2.15.1. Work with AFIMSC detachment civil engineers to ensure future noise conditions are considered in the enterprise wide look for and site survey process for all potential basing actions.

2.15.2. Work with the MAJCOM or AFIMSC civil engineers and A3 when the MAJCOM is the Lead Command for a system (aircraft, munitions, weapons, support equipment, etc.) in acquisition or sustainment to identify system specific installation-level environmental noise management requirements; include those requirements, as appropriate, in the system's Joint Capabilities Integration and Development System (JCIDS) documents; and advocate for the necessary funding in the MAJCOM's corporate budgeting process for the program office to meet those requirements.

2.15.3. Work with MAJCOM A3 and installation operational units to ensure that the concept of operations for proposed beddown actions and aircraft realignments is detailed enough to support the development of the operations data needed to model noise levels for NEPA analysis and update of the installation's AICUZ study.

2.16. The MAJCOM Public Affairs Officer (PA) will:

2.16.1. Provide oversight and guidance to installations on any necessary communication strategies and plans for aircraft, weapons system operations and munition noise to ensure consistency.

2.16.2. Assist MAJCOM A3 to develop any strategic communications plans or other communication strategies/messages needed for noise issues in MAJCOM controlled or managed airspace and range environments and ensure content on metrics and methodologies is consistent with Air Force Noise Program guidance.

2.17. The AFIMSC Detachment Civil Engineers and AFRC A7 Engineers will:

2.17.1. Work with MAJCOM Basing Office (A8/9/5) to ensure anticipated future noise conditions are considered in the enterprise wide look for all potential basing actions (AFI 10-503, *Strategic Basing*).

2.17.2. Work with MAJCOM A3 and A5/8/9 when the MAJCOM is the Lead Command for a system (aircraft, munitions, weapons, support equipment, etc.) in acquisition or sustainment to identify system specific installation-level environmental noise management requirements; include those requirements, as appropriate, in the system's Joint Capabilities Integration and Development System (JCIDS) documents and advocate for the necessary funding in the MAJCOMS corporate budgeting process for the program office to meet those requirements.

2.17.3. Support AFCEC/CPP or 711 HPW/RHCB in the development and implementation of study plans needed to obtain field measurements for the noise model's acoustic measurement database, as needed.

2.18. The DRU Director of Operations (A3) will:

2.18.1. Work with DRU A7, DRU PA and AFCEC/CPP, as needed, to ensure the content on noise metrics or methodologies in any strategic communication plans or other communication strategies/messages needed for noise issues in DRU controlled and managed airspace and range environments consistent with Air Force Noise program guidance **(T-2)**.

2.18.2. Work with DRU A5/8/9 and installation operational units to ensure that the concept of operations for beddown actions, aircraft realignments, or changes in airspace, is detailed enough to support the development of the operations data needed to model noise levels for NEPA analysis any necessary update of the installation's AICUZ study or an airport's Part 150 study **(T-2)**.

2.18.3. Support DRU A7, AFCEC/CPP, 711 HPW/RHCB, and Commanders in the development and implementation of study plans needed to obtain field measurements for the noise model's acoustic measurement database, as needed **(T-2)**.

2.19. The DRU Director of Plans/Programs and Requirements (A5/8/9) will:

2.19.1. Work with DRU A7 to ensure future noise conditions are considered in the enterprise wide look for and site survey process for all potential basing actions **(T-2)**.

2.19.2. Work with DRU A3 to ensure that the concepts of operations for beddown actions or aircraft realignments, is detailed enough to support the development of the operations data needed to model noise levels for NEPA analysis and any necessary update of the installation's AICUZ study or an airport's Part 150 program study **(T-2)**.

2.20. The DRU Public Affairs Officer (PA) will: provide oversight and guidance to installations on any necessary communication strategies and plans for aircraft, weapons system operations and munitions noise and help ensure content related to noise metrics and methodologies is consistent with Air Force Noise Program guidance **(T-2)**.

2.21. The DRU A7 will:

2.21.1. Work with DRU Basing Office (A8/9/5) to ensure anticipated future noise conditions are considered in the enterprise wide look for all potential basing actions (AFI 10-503, *Strategic Basing*) **(T-2)**.

2.21.2. Work with DRU A3, A5/8/9, PA, and other organizations deemed necessary in developing strategic communication plans and other communication strategies for the Air Force Noise Program as needed **(T-2)**.

2.22. Installations. Roles and responsibilities of key installation personnel are listed below. Air Force units located on civilian airports will work cooperatively with the airport authority and the FAA on noise issues. At Air Force led Joint Bases, the Air Force implements the noise program.

2.22.1. **The Installation Commander will:**

2.22.1.1. Ensure implementation of the Air Force Noise Program **(T-1)**.

2.22.1.2. Engage external partners and stakeholders to include local jurisdictions, state legislatures, corporations and non-governmental organizations on noise-related issues when necessary **(T-2)**.

2.22.1.3. Ensure support of Installation Operations, Air Traffic Control, Radar Approach Control, Range Operating Authority, Airspace Managers, Flying Wings and Squadrons, Maintainers, and Civil Engineering when operational data is collected to for noise modeling efforts in accordance with DoDI 4165.57, Enclosure 3, Section 6c, and compliance with 32 CFR Part 989 **(T-0)**.

2.22.2. **The Operations Group/Squadron Commander will:**

2.22.2.1. Ensure all users of the SUA/ASU managed and scheduled by the installation are aware of noise avoidance areas, sensitive receptors, noise mitigation requirements, the effects their operations have on those receptors, and ways to minimize those effects **(T-2)**.

2.22.2.2. Ensure special operating procedures designed to minimize noise effects are documented as noise abatement procedures and published in local in-flight guides (if published) **(T-2)**. ANG and AF Reserve units at civil airports should work with the local airport authority to establish noise abatement procedures as necessary.

2.22.2.3. Ensures any operational mitigation to reduce noise associated with the installation's testing and training activities required as a result of compliance with or as a result of consultations with other federal agencies are adhered to and monitored for effectiveness in accordance with 32 CFR, Part 989.22 **(T-0)**.

2.22.2.4. Ensure flight patterns are designed to minimize noise exposure to the local communities so long as they do not result in unsafe operations of the aircraft or have a negative impact on the installation's ability to execute its mission **(T-2)**.

2.22.2.5. Assists Installation PA in responding to noise inquiries about aircraft activity in SUA/ASU or range environments **(T-1)**.

2.22.2.6. Ensure Air Traffic Control assists Installation PA in responding to noise inquiries about aircraft activity in the airfield vicinity **(T-2)**.

2.22.2.7. Review, validate, and certify the accuracy of the operations data in the Noise Model Operational Data Documentation (NMODD) biannually to ensure it reflects current mission activities **(T-1)**.

2.22.2.8. Support the development of operational data needed to prepare environmental analysis in accordance with 32 CFR § 989 and update AICUZ program noise zones in accordance with DODI 4165.57 **(T-0)**.

2.22.2.9. Ensures the environmental office is informed of any changes in the following operations in order to determine if environmental analysis or update of noise contours is needed **(T-1)**:

2.22.2.9.1. Mission change to include changes in aircraft types, major changes in number of flight operations, changes in flying tactics in SUA/ASU or at ranges.

2.22.2.9.2. Change in departure/arrival flight tracks or location of VFR/IFR traffic patterns.

2.22.2.9.3. Change of more than 500 feet in downwind altitudes on VFR/IFR traffic patterns.

2.22.2.9.4. Addition or deletion of run-up locations and /or suppression equipment.

2.22.2.9.5. Change in location or orientation of an unsuppressed engine runup or trim pad.

2.22.2.9.6. Change in types of aircraft/engines run at an unsuppressed location.

2.22.2.9.7. Change in runway usage, including offset thresholds of 500 feet or more.

2.22.2.9.8. Change in number of flight operations occurring between 10 p.m. and 7 a.m.

2.22.3. **The Range Operating Authority will:**

2.22.3.1. Coordinate with range users to define noise abatement procedures that would minimize noise impacts on lands adjacent to the range without impacting the ability to conduct mission activities **(T-2).**

2.22.3.2. Assist Installation PA in responding to noise inquiries received from range activities **(T-2)**.

2.22.3.3. Ensure that any mitigations to reduce the impacts of noise that are required as a result of compliance with 42 USC §§ 4321 et seq., or consultation with other federal agencies are adhered to and monitored for effectiveness in accordance with 32 CFR Part 989.22 **(T-0)**.

2.22.3.4. Ensure all users of air-to-ground and air-to-air ranges are aware of noise avoidance areas, sensitive receptors, noise mitigation requirements, the effects their operations have on those receptors, and ways to minimize those effects **(T-2)**.

2.22.3.5. Support the development of operational data needed to prepare noise contours for AICUZ studies and environmental analysis in accordance with 32 CFR § 989 **(T-1)**.

2.22.4. **Director of Plans, Training, Mobilization and Security Directorate or Chief of Range Control at Air Force led Joint Bases with an Army supported component will p**rovide range use information and an ammunition report from the Range Facility Management Support System (RFMSS) for use in modeling of noise from small and large caliber weapons training **(T-1)**.

2.22.5. **The Installation Civil Engineer will:**

2.22.5.1. Identify a lead for the Noise program to work in coordination with the AICUZ and environmental analysis program leads (if different) **(T-2)**.

2.22.5.2. Ensure any mitigation to reduce noise of Explosive Ordnance Disposal (EOD) proficiency training required as a result of compliance with 42 USC §4321 et seq., or as a

result of consultations with other federal agencies, are adhered to and monitored for effectiveness in accordance with 32 CFR 989.22 **(T-0)**.

2.22.6. **The Installation Noise Program Lead will:**

2.22.6.1. Obtain and retain NMODD for use in the biannual review and validation. Provide any updates to AFCEC/CPP for archiving in the Noise Repository **(T-1)**.

2.22.6.2. Ensure the information documented in the NMODD is reviewed, validated and updated biannually or as part of an environmental analysis effort to confirm it reflects current mission operations **(T-2)**.

2.22.6.3. Facilitate collection, review, and validation of operational data used for noise modeling **(T-2)**.

2.22.6.4. Obtain and retain (for a minimum of five years) noise complaint/inquiry data from Installation PA in electronic format and link to geospatial data layer in order to analyze locations of complaints/inquiries and identify patterns (i.e., day, night, seasons, training exercises, changes in operation tempo), weather conditions, flight tracks, flight patterns, types of aircraft, and/or weapon systems most associated with the complaints/inquiries **(T-2)**.

2.22.6.5. Analyze information in complaints/inquires to identify issues and potential impacts associated with future beddowns, realignments and support environmental analysis and noise management efforts **(T-3)**.

2.22.7. **The Installation Bioenvironmental Engineer will:**

2.22.7.1. Support other Air Force organizations in communicating various noise metrics to the public, as needed **(T-3)**.

2.22.7.2. Assist other Air Force offices with inquiries related to use of off-the-shelf noise meters **(T-3)**.

2.22.7.3. Provide guidance and support to Installation PA and the Installation Air Force Noise Program Lead regarding the use of noise meters by Air Force personnel, and in responding to public inquiries regarding the use of noise meters **(T-2)**.

2.22.8. **The Installation Staff Judge Advocate will:**

2.22.8.1. Provide legal advice concerning noise complaints, mission changes or other activities resulting in potential changes to noise impacts, implementation and monitoring of noise abatement or mitigation requirements or other noise related issues.

2.22.8.2. Approve payment of or deny claims for damages allegedly due to noise impacts in accordance with AFI 51-501, *Tort Claims*, and consistent with the Military Claims Act, Federal Tort Claims Act, or other applicable law **(T-0)**.

2.22.8.3. Coordinate with higher headquarters and appropriate offices within the Air Force Civil Law and Litigation Division (AFLOA/JAC) to ensure Air Force legal interests are protected and specialized expertise can be leveraged **(T-1)**.

2.22.9. **The Installation PA Officer will:**

2.22.9.1. Support communication efforts of noise-related information to the public as part of executing their community relations responsibilities under AFI 35-108, section 5 (T-2).

2.22.9.2. Assist the Installation Noise Program Lead, JA, Operations, Range Managers or other offices (as needed), develop key messages and frequently asked questions about installation noise sources as necessary **(T-3)**.

2.22.9.3. Provide communication training for installation personnel participating in public meetings where noise is a possible subject **(T-2)**.

2.22.9.4. Receive and respond to public noise-related inquiries including complaints, questions, and observations (See Attachment 4) **(T-2)**.

2.22.9.5. Provide the Air Force Noise Program Lead in the Installation Civil Engineer's office with noise complaint/inquiry documentation **(T-2)**.

2.22.10. **Commanders of Tenant Operational Units.**

2.22.10.1. Certifies the NMODD reflects current mission activities during the biannual review and validation cycle **(T-1)**.

2.22.10.2. Ensures any operational mitigation related to the testing and training operations of the flying unit required as a result of compliance with NEPA or as a result of consultations with other federal agencies are monitored and adhered to in accordance with 32 CFR 989.22 **(T-0)**.

CHAPTER 3

THE AIR FORCE NOISE PROGRAM

3.1. Purpose. The Air Force Noise Program will:

3.1.1. Ensure the availability of computer models to predict present and future noise environment, investigate specific noise concerns in support of Air Force planning and encroachment programs and support Congressional inquiries and questions from senior leadership.

3.1.2. Ensure appropriate management of aircraft/weapon system noise data, computer model operational data input files, and computer model output files to ensure they are available when needed and reflect current operations.

3.1.3. Establish the primary and supplemental metrics to be used in support of the AICUZ program and for analysis of noise impacts.

3.1.4. Standardize the methodology for identifying, analyzing, and describing impacts from military test and training generated noise and mitigation options.

3.1.5. Enhance installation personnel and Air Force leadership's understanding of the impacts associated with noise and vibration from military operations in order to better mitigate noise and facilitate public outreach and engagement.

3.1.6. Develop a comprehensive noise complaint/inquiry management methodology as a means to improve communication, dialogue and relationships with the surrounding communities and identify trends and issues with the potential to impact future beddowns and/or realignments.

3.1.7. Identify and advocate for noise related research/studies to support environmental analysis of noise impacts in compliance with 42 USC §4321 et seq. and Section 7 consultations under 16 USC §§ 1531 et seq and Section 106 under 36 CFR Part 800.

3.2. Computer Models. The Air Force and its contractors use the most current versions of the noise models described below for predicting noise in the various testing and training environments. More details about these models, their use and the type of operational data required for each model can be found in Attachment 2.

3.2.1. The DoD version of NOISEMAP suite of programs (BASEOPS/NOISEMAP, AAM, and NMPLOT) is used to predict noise for exposure from all flight activity, engine run operations from aircraft operations in the military airfield environment for the AICUZ program and environmental analysis in United States and its territories. The use of non-Air Force versions of these models requires prior approval from AFCEC/CPP. Overseas locations can use NOISEMAP for environmental analysis; however, the noise contours are for internal Air Force use only. AICUZ noise contours developed for overseas installations should be limited to the land area within the installation boundary. Before generating any noise contours for an overseas location, consult HQ PACAF and HQ USAFE for direction.

3.2.2. AFCEC/CPP, in coordination with 711 HPW/ RHCB, maintains and controls NOISEMAP, MR_NMAP3, and BOOMAP **(T-1)**. The National Aeronautics and Space Administration (NASA) maintains and controls the AAM model within the NOISEMAP

suite of models. The US Army Engineer Research and Development Center (EDRC)/CEERD-CN-N, Champaign, Illinois maintains and controls BNOISE and SARNAM.

3.2.3. AEDT or the most current FAA-approved noise model is used for preparing Noise Exposure Maps for airports that participate in the FAA's Part 150 program (14 CFR Part 150) and for environmental analysis of noise impacts for actions involving Air National Guard installations at civilian airports and for Air Reserve Stations located at civilian airports.

3.2.4. Military Operating Area and Range NOISEMAP (MR_NMAP) is used for predicting noise exposure from aircraft operations in Special Use Airspace and Airspace for Special Use, and air-to-ground ranges.

3.2.5. PCBOOM4 is used for predicting carpet and focus sonic boom footprints created by supersonic flight in Special Use Airspace and Airspace for Special Use.

3.2.6. BOOMAP is used for analysis of the cumulative sonic boom environment for air combat maneuvering that includes supersonic flight.

3.2.7. Air Gunnery model is used for predicting noise levels from airborne weapons use.

3.2.8. Blast Noise (BNOISE2) is used to predict noise generated by large caliber weapons (20 millimeter and above) and explosives.

3.2.9. Small Arms Range Noise Assessment Model (SARNAM) is used to predict noise levels generated from small arms (.50 caliber and below) ranges.

3.2.10. In cases where construction noise is analyzed, the 2006 Federal Highway Administration Construction Noise Handbook should be used as a guide.

3.3. Noise Model Data Management. The computer models require several types of data including weather data, terrain and elevation data, location specific operational data, and data (NOISEFILE) derived from aircraft overflight noise measurements, weapon systems, or explosive sound levels. The weather, terrain, and elevation data come from existing authoritative sources, while the location specific operational data for aircraft comes from pilot interviews, Air Traffic Control, and maintenance personnel. For Air Force led Joint Bases with an Army supported component, data for small arms range and other ranges comes from the Range Facility Management Support System (RFMSS). Operational data for Army helicopters comes from the airfield managers. See the Operational Data Collection Handbook in the Noise Toolbox on AFCEC/CPP's SharePointt® site for more detail. :**https://afcec-portal.lackland.af.mil/cp/cpp/em/SitePages/Home**. (Note: Must use email certificate to access the site.)

3.3.1. To ensure the installation always has a set of noise contours and associated operational data representing current flying, testing and training operations available for purposes of planning readiness, the following data management guidelines apply to the input data and the model output data files.

3.3.1.1. All final noise BASEOPS input and NMPLOT output files, including all supporting data (i.e., Geographic Information System (GIS) background data, digital elevation, topography, impedance, and operations calculation files) are sent to AFCEC/CPP for database entry and archiving.

3.3.1.2. All information used during the noise modeling process is included in the NMODD). This includes:

3.3.1.2.1. Detailed notes from operational data collection efforts.

3.3.1.2.2. Spreadsheets used for documenting and calculating daily activity with all cells visible. Hyperlinks should be avoided to ensure the data is clearly understood by the next user.

3.3.1.2.3. The operational data (e.g., aircraft configurations/flight paths/firing points/target locations/weapons use, amount of ammunition used) used by the respective noise model, and details of all assumptions made during the modeling process.

3.3.1.2.4. Flight profile maps for all permanently assigned aircraft and a flight profile operations summary as generated through the BASEOPS program.

3.3.1.3. The NMODD is retained by the installation noise program lead, and an electronic copy provided to AFCEC/CPP for archiving in accordance with paragraph 3.3.1.1. **(T-1)**.

3.3.2. The most current noise model data available from AFCEC/CPP or the FAA (for civilian airports) will be the basis for data review and revalidation or subsequent modeling.

3.3.3. The NMODD's are reviewed to ensure cumulative effects are accounted.

3.3.3.1. The NMODD used to generate installation Day Night Average Sound Level (DNL)/Community Noise Equivalent Level (CNEL) contours will be reviewed and validated biannually, with a complete collection of current operational data conducted every 5 years to ensure the NMODD and the noise contours reflect current mission operations. **(T-1)**. An environmental analysis for proposed changes to flight operations or testing and training activities scheduled to be done prior to the biannual review and validation, can serve as the biannual validation.

3.3.3.2. The operational data portion of the NMODD's will be certified as current by the Operations Squadron Commander, and commander of tenant units that conduct testing and training activities if appropriate. **(T-1)**. At Air Force led Joint Bases with an Army supported component, the Chief of the Range Control Office will validate Army range use and RFMSS data **(T-1)**.

3.3.3.3. NOISEFILE is the standard noise emissions database associated with each noise model. Changes to NOISEFILE data are controlled by 711 HPW/RHCB. Noise emission data for the NOISEFILE database for high performance military jet aircraft will be collected in accordance with the American National Standards Institute (ANSI) BSR/ASA S12.75-2012, *Methods for the Measurement of Noise Emissions from High Performance Military Jet Aircraft*. This standard describes the procedures for ground run-up and flyover tests for conventional take-offs and landings, and short/vertical take-off and landings. Noise measurement field studies to gather data for noise emissions from aircraft not covered by ANSI BSR/ASA S12.75-2012 will be done in coordination with 711 HPW/RHCB.

3.3.4. Changes to any NOISEFILE database associated with the NOISEMAP suite of programs, or MR_NMAP, will be approved by 711 HPW/RHCB prior to use for noise

modeling. All approved changes will be incorporated into the database controlled by AFCEC/CPP and provided with updated releases of NOISEMAP and MR_NMAP.

3.3.5. Changes to reference noise file databases for SARNAM and BNOISE (which is also used in the Air Gunnery model) are controlled by the US Army Engineer Research and Development Center (EDRC)/CEERD-CN-N, Champaign, Illinois.

3.3.6. When there is incomplete or unavailable noise data for a new or existing weapons system or munitions, use of surrogate/substitute data may be necessary. The use of surrogate or substitute data is approved only when actual noise data have not been and cannot be obtained for the weapons system or munition being modeled. When surrogate or substitute data is used due to lack of actual aircraft and weapon system noise data for environmental analysis, it will be handled as missing data as described in 40 CFR, Part 1502, Section 1502.22, Incomplete or Unavailable Data, and the text will include a discussion of the points in 40 CFR Part 1501, Section 1502.22(b) 1-4 in the environmental assessment or impact statement. In all cases, the use of surrogate/substitute aircraft will be approved by 711 HPW/RHCB **(T-1)** and its use fully documented. A list of pre-approved surrogate/substitute aircraft is available from AFCEC/CPP. Surrogate munitions must be reviewed and approved by Army Public Health Center (Provisional) Operational Noise Program in accordance with the SARNAM and BNOISE end users licensing agreement.

3.4. Metrics. The descriptors associated with noise level outputs from modeling testing and training activities are referred to as metrics. Metrics can be grouped into two types, primary and supplemental. Primary metrics are those used for determining environmental impacts from testing and training noise levels. The NOISEMAP primary metrics are used for determining land use compatibility for the AICUZ program. Supplemental metrics can be used in addition to the primary metrics to help local community leaders, general public or readers of environmental analysis documents to better understand how noise levels will change as a result of testing and training activities. The supplemental metrics used in an analysis of noise impacts will be determined in part by the issues raised during scoping or the context in which the action is occurring (e.g., if there are no schools in the region of influence then using TA based on school day hours is not necessary). Table 3.1 lists the primary and supplemental metrics produced by the computer noise models. More information can be found in the metric section of Attachment 2. Note: Before generating any metrics for Air Force overseas locations, consult with HQ PACAF and HQ USAFE regarding metrics.

Table 3.1. Computer Noise Models and Associated Noise Metrics.

Model	***Output/Metric***	
	Primary	**Supplemental**
NOISEMAP (including AAM)	DNL, CNEL	SEL, L_{max}, NA, TA, L_{eq}
AEDT	DNL/CNEL	SEL, L_{max}, NA, TA, L_{eq}
MR_NMAP	DNL_{mr}, $CNEL_{mr}$	SEL_r, $L_{max,}$ NA, TA
PCBOOM4	CDNL	L_{pk}, psf
BOOMAP	CDNL	L_{pk}, psf
Air Gunnery Model	CDNL	L_{pk}
BNOISE2	CDNL	CSEL, L_{pk}
SARNAM	DNL, SEL	CSEL, L_{pk}

3.5. Analyzing Noise Impacts. The identification of noise impacts is part of the environmental analysis process. When it is determined the proposed action or an alternative will produce sound levels that could have an impact on the acoustic environment and/or other aspects of the environment (i.e., biological, natural, social, economic, etc.), a description of the acoustic environment and analysis of the impacts is be prepared. Attachment 3 discusses concepts that are important to developing a good analysis of noise impacts and a synopsis of the typical issues included in analyzing impacts of noise from military testing or training operations.

3.6. Education and Communication. An effective noise program requires frequent communication and engagement with the public through a range of activities and programs including airmen training, responding to noise inquiries and complaints, development of outreach materials and educational tools that can be used not only in support of the noise program but also the AICUZ and environmental analysis programs. Effective communication involves understanding stakeholders, defining communication strategies, and educating the public, airmen and soldiers about noise and the effects that it has on the surrounding communities. Although PA is primarily responsible for communicating with the public, communicating effectively about noise requires a combined effort of all organizations on an installation since questions and comments regarding noise from military training are often directed to other installation personnel. More information on education and communication can be found in Attachment 4.

3.7. Comprehensive Noise Complaint Management Methodology. Noise inquiries/complaints from the public are opportunities to engage and inform members of the public as well as opportunities to obtain information that can be aggregated and analyzed to identify trends in public perception, opinions, or identify potential weaknesses in efforts to manage or communicate about testing and training noise. They can also be used to identify problems for future beddowns and realignments. Developing a comprehensive management methodology requires standardizing the information collected from complainants, linking the complaint and information to geospatial data (.i.e., location), weather conditions, temporal factors (time-of-day, day-of week, and month) and the noise event information. The noise complaint/inquiry section of Attachment 4 has more detail on the type of information to be collected.

3.8. Noise Research/Studies. The need for studies or research to better understand noise impacts can be identified by the Air Force, another Service or by other Federal or State agencies in their regulatory role or as a cooperating agency in compliance with 42 USC §§ 4321 et seq. Any study or research proposal agreed upon is to be designed so other Air Force installations or DoD Services can use the information when faced with impacts and mitigation requirements for similar actions in other locations. The following steps should be taken to ensure maximum returns on investment for any study or research related to the effects of aircraft and weapons noise to the human, structural, or biological environment.

3.8.1. To avoid unnecessary expense and duplication of effort, prior to committing to a study or research project during the consultation process, the proponent of the proposed action or the Air Force office involved in consultations should consult with the other Services to determine if they have had to address the same issue or have conducted a similar study but not published any findings. The 711 HPW/RHCB at the Air Force Research Lab, Wright Patterson AFB is available to help determine if research/studies done in the past can be used in support of the environmental analysis or consultations.

3.8.2. The 711 HPW/RHCB reviews all proposed studies or research designs to ensure the acoustical component is appropriately defined**.**

3.8.3. Coordinate any research or study design proposed as a result of consultations with federal or state agencies (e.g., Fish and Wildlife Service, NOAA Fisheries (for marine habitats) or state agencies such as the State Historic Preservation Office) to ensure all parties agree with the goals and objectives established for the study or research effort.

3.8.4. Upon completion of the study or research, submit a copy of the research report and results to 711 HPW/RHCB for review prior to final acceptance by the Air Force or use of findings in any Air Force environmental analysis.

3.8.5. Provide electronic copies of final studies and reports to AFCEC/CPP for archiving and future use.

JOHN B. COOPER
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Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

NOTE: The user of this instruction is responsible for verifying the currency of the cited documents.

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16 USC §§1531 *et seq.*, *Endangered Species Act of 1973*

54 USC §§300101 *et seq.*, *National Historic Preservation Act of 1966*

16 USC §31, Marine Mammal Protection Act (MMPA)

42 USC §§ 4901-4918, *Noise Control Act of 1972*

42 USC §§4321 *et seq.*, *National Environmental Policy Act of 1969*

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Abbreviations and Acronyms

%HA—Percent Highly Annoyed

AAD—Average Annual Day

AAM—Advanced Acoustic Model

AEDT−Aviation Environmental Design Tool

AEE—Office of Environment and Energy

AFCEC—Air Force Civil Engineer Center

AFCEC/CPP−Air Force Civil Engineer Center, Comprehensive Planning and Integration Division

AFEC/CPPR−Air Force Civil Engineer Center, Regional Planning Development Branch

AFCEC/CZN−Air Force Civil Engineer Center, National Environmental Policy Act Division

AFI—Air Force Instruction

AFLOA—Air Force Legal Operations Agency

AFRC—Air Force Reserve Command

AGL—Above Ground Level

AICUZ—Air Installations Compatible Use Zones

ANG—Air National Guard

ANSI—American National Standards Institute

ASU—Airspace for Special Use

CAL−Caliber

CATEX—Categorical Exclusion

CDNL—C-weighted Day-Night Average Sound Level

CEQ—Council on Environmental Quality

CFR—Code of Federal Regulations

CHABA−Committee on Hearing, Bioacoustics and Biomechanics

CNEL—Community Noise Equivalent Level

$CNEL_{mr}$—Onset-Rate Adjusted Community Noise Equivalent Level

CONUS—Continental United States

CSEL—C-weighted Sound Exposure Level

dB—Decibel

dBA—A-weighted decibel

DNL—Day-Night Average Sound Level

DNL_{mr}—Onset-Rate Adjusted Monthly Day-Night-Average Sound Level

DNWG—Defense Noise Working Group

DoD—Department of Defense

DoDI—Department of Defense Instruction

DRU−Direct Reporting Unit

EA—Environmental Assessment

EIAP—Environmental Impact Analysis Process

EIS—Environmental Impact Statement

EO—Executive Order

EOD—Explosive Ordnance Disposal

FAA—Federal Aviation Administration

FICAN−Federal Interagency Committee on Aviation Noise

FICON—Federal Interagency Committee on Noise

GIS−Geospatial Information System

HE−High Explosive

HEDP−High Explosive Dual Purpose

IFR—Instrument Flight Rules

ILLUM−Illumination

ICUZ−Installation Compatible Use Zones (ICUZ)

LAW−Light Anti-Armor Weapon

L_{Cdn}—Symbol for C-weighted Day-Night Average Sound Level

L_{Ceq}—Symbol for C-weighted Equivalent Sound Level

L_{dn}—Symbol for Day-Night Average Sound Level

L_{dnmr}—Symbol for Onset-Rate Adjusted Monthly Day-Night Average Sound Level

L_{eq}—Symbol for Equivalent Sound Level

L_{max}—Symbol for Maximum Sound Level

L_{pk}—Symbol for Peak Sound Level

MAJCOM—Major Command

MM−Millimeter

MR_NMAP—Military Operating Area and Range NOISEMAP

NAL—Number Above a Threshold Level

NEPA—National Environmental Policy Act

NM(nm)−Nautical Mile

NMFS−National Marine Fisheries Service

NMODD−Noise Model Operational Data Documentation

NOAA−National Oceanic and Atmospheric Administration

PA—Public Affairs

PAA—Primary Aerospace Vehicles Authorized

PK—Peak Sound Pressure Level

PK 15—Peak Pressure level exceeded by 15 percent of the events

PSF—Pounds per Square Foot

SARNAM—Small Arms Range Noise Assessment Model

SEL—Sound Exposure Level

SEL_r—Onset Rate-adjusted Sound Exposure Level

SM(sm)−statute mile

SPL—Sound Pressure Level

SUA—Special Use Airspace

TAL—Time Above a specified level

USC—United States Code

VFR—Visual Flight Rules

Terms

Acoustic Environment−The acoustic environment is the surroundings or conditions related to sound in which people, animals, and plants live or operate.

Acoustical Night−This is a term that may be used in documents to refer to the hours of 10:00 p.m. to 7:00 a.m., (those hours during which noise events have a 10 dB penalty applied when calculating DNL) to distinguish this period from the general use of the word "night." The term acoustical day may also be used to refer to the hours between 7 a.m. and 10.00 p.m. See also "environmental night."

Airfield Operation−Aircraft operations are counted by air traffic controllers for all aircraft operating in the airfield environment. One airfield operation is counted each time an aircraft passes the departure end of the runway and one airfield operation is counted each time an aircraft passes the approach end of the runway. When determining the number of aircraft operations occurring in the airfield environment, one aircraft sortie generates a minimum of two airfield operations, one for the initial departure and one for the final landing. When aircraft are practicing additional Instrument Flight Rules (IFR) or Visual Flight Rules (VFR) approaches (i.e., IFR Closed Patterns or VFR Closed Patterns), two aircraft operations are counted for each pattern, one when they approach the runway to land and one when they depart the runway. It is important to recognize that airfield operations used for air quality calculations are fewer than airfield operations used for noise as they are counted differently. For air quality, one operation is counted for a departure, one for an arrival, and one for a closed pattern.

Airspace for Special Use (ASU)−Used to collectively identify non-Special Use Airspace assets. ASU is airspace of defined dimensions wherein activities must be confined because of their nature, and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities.

Air Traffic Control−The organization responsible for controlling aircraft movement on the ground and in the air.

Ambient Noise−The total of all noise in the environment, other than the noise from the source of interest. This term is used interchangeably with background noise.

Annoyance−A summary measure of the general adverse reaction of people to noise that generates speech interference (i.e., being able to use the telephone or listen to television or radio without interruption), sleep disturbance, and desire for a tranquil environment.

A-weighted Sound Level−When measuring community response to noise, it is common to adjust the frequency content of the measured sound to approximate the response of the human ear. With A-weighting, low and high frequencies are de-emphasized because the ear does not respond equally to sounds of all frequencies, and is less efficient at low and high frequencies than it is at medium or speech range frequencies. A-weighting is appropriate for transportation noises such as aircraft overflight and small arms noise. See also "C-weighted Sound Level." (See ANSI S1.1 for scientifically agreed upon definition.)

Average Annual Day (AAD)−The AAD represents the average number of daily airfield operations that would occur during a 24-hour period based on 365 flying days per year. AAD is calculated by dividing the total annual airfield operations by 365 days.

C-weighted Day-Night Average Sound Level (CDNL [symbol-L_{Cdn}])−CDNL is used for low-frequency impulsive sounds, such as sonic booms, heavy weapons, and other explosions because they are perceived by humans not only by the ear, but also by the whole body as pressure or vibration. When experienced indoors, impulsive sounds can create secondary noise from rattling and vibrations of the building. See DNL for additional discussion. (See ANSI S1.1 for scientifically agreed upon definition.)

C-weighted Sound Level−C-weighting is applied to intense low-frequency noise that can cause vibrations, such as heavy bombs and sonic booms. C-weighting does not apply adjustments to noise signals over most of the audible frequencies, but does apply small adjustments to the very low and very high frequencies. C-weighting is appropriate for impulsive sounds, such as sonic booms and the deployment of heavy weapons. When experienced indoors, impulsive sounds can create secondary noise from rattling and vibrations of the building (see also CSEL and CDNL). (See ANSI S1.1 for scientifically agreed upon definition.)

C-weighted Sound Exposure Level (CSEL)−CSEL is a C-weighted single-event metric used to compare noise levels from individual events. CSEL is used for impulsive sounds, such as sonic booms and the deployment of heavy weapons (see also SEL). (See ANSI S1.1 for scientifically agreed upon definition.)

Community Noise Equivalent Level (CNEL [symbol-L_{den}])−This is one of several Day-Evening-Night metrics. This one is used for off-base land use planning and environmental analysis of noise for all installations and airspace in California. It is a twenty four hour average A-weighted sound level for a given day after the addition of a 5 dB penalty (sound levels or noise events during this period are equal to 3 daytime events, which creates an actual 4.78 dB penalty) to sound levels between the hours of 7:00 p.m. and 10:00 p.m., in addition to the 10 dB penalty to sound levels that occur between 10:00 p.m. until 7:00 a.m. Japan, Denmark and Finland also use the Day-Evening-Night Level metric, but evening hours are from 7:00 p.m. through 11:00 p.m., and each noise event that occurs during these hours is worth 3.162 daytime events, which results in a full 5 dB penalty. (See ANSI S1.1 for scientifically agreed upon definition.)

Day-Night Average Sound Level (DNL [symbol-L_{dn}])−A twenty four hour average A-weighted sound level for a given day after the addition of a 10 dB weighting is added to account for the increased sensitivity of humans to noise from such things as aircraft operations for sound levels that occur between the hours of 10 p.m. to 7 a.m. because ambient sound levels at night are typically lower than during the daytime hours. (See ANSI S1.1 for scientifically agreed upon definition.)

DNL/CNEL Contours−Lines of equal DNL/CNEL value.

Environmental Night−This is a term that may be used in documents to refer to the hours of 10:00 p.m. to 7:00 a.m. to distinguish this period from the general use of the word "nighttime." See also "acoustic night."

Equivalent Sound Level (symbol-L_{eq})−A twenty four hour L_{eq} is a cumulative noise metric that represents the average sound level over a specified period of time. L_{eq} does not include any penalty for evening or night time noise events. L_{eq} is the constant sound level that contains the same sound energy as the time-varying sound level over the same time period. (See ANSI S1.1 for scientifically agreed upon definition.)

Installation Complex−The land, facilities, airspace and ranges providing direct mission support to and/or are managed by the installation. This includes a combination of land and facilities comprised of a main installation and its noncontiguous properties (auxiliary airfields, annexes, and missile fields) that provide direct support to or are supported by that installation. Installation complexes may comprise two or more properties, e.g., a major installation, a minor installation, or a support site, each with its associated annex(es) or support property(ies).

Maximum A-weighted Sound Level (symbol-L_{max} or L_{AFmx})−This is the highest A-weighted sound level within a stated time interval. For DoD the time interval is typically the duration of the noise event. (See ANSI S1.1 for scientifically agreed upon definition.)

Mitigations−These are measures that can be done to reduce, avoid, or repair impacts. Mitigating the effects of aircraft noise on sensitive land uses such as schools, residential areas, and churches can take many forms, for example, modification to time of day or frequency of use, flight path

parameters (location, altitude, etc.), or changes to the listener's environment (building insulation).

NOISEFILE−A database that contains actual (or estimated) noise measurement data formatted for use by NOISEMAP and MR_NMAP. The database is used to generate the noise versus distance curves for specific aircraft configurations (engine power setting, airspeed) and atmospheric conditions (average temperature and relative humidity). For NOISEMAP, there are two NOISEFILEs, one containing aircraft flyover data (Flight01) for processing through OMEGA 10 and one containing engine run-up data (Static 01) for processing through OMEGA 11. For MR_NMAP there is one NOISEFILE for processing through OMEGA10r.

Noise Model Operational Data Documentation (NMODD)−A compilation of the aircraft operational data used in a noise model with the results released in public documents. It contains points of contacts for the providers of information, all assumptions, spreadsheets used to calculate daily operations, aircraft configurations (i.e., flight profiles) for aircraft operations in the airfield and SUA/ASU, as well as information on engine runs and munitions usage for ranges. For models using BASEOPS, this information can be generated from the report module. All spreadsheets are created in a manner that lends itself to use by others.

Noise Sensitive Area−An area where noise interferes with normal activities associated with its use. Normally, noise sensitive areas include residential, educational, health, and religious structures and sites, and parks, recreational areas (including areas with wilderness characteristics), wildlife refuges, and cultural and historical sites.

Number of Events Above (or at) a Specified Level (NAL)−Metric used to show the total number of noise events that meet or exceed the selected noise level threshold during a specified period of time (e.g., hour, school day, nighttime, etc.). Combined with the selected threshold level (L), the NA metric is symbolized as NAL. The threshold L can be defined in terms of either the SEL or L_{max} metric. A threshold level is selected that best meets the need for that situation. An L_{max} threshold is normally selected to analyze speech interference, whereas an SEL threshold is normally selected for analysis of sleep disturbance.

Onset Rate-Adjusted Monthly Day-Night Average Sound Level (DNL_{mr} [symbol-L_{dnmr}])−The metric used for quantifying noise in special use airspace because aircraft operate differently than in the airport environment, often flying in a more sporadic manner and at low altitudes with speeds greater than 425 miles per hour creating the potential to surprise the receiver. With DNL_{mr}, the conventional Day-Night Average Sound Level (DNL or L_{dn}) metric is adjusted to account for the "surprise" effect of the sudden onset of aircraft noise events. Each aircraft operating in SUA/ASU that exhibits a high onset rate have an adjustment or penalty ranging from 0 to 11 dB applied to the normal SEL. The DNL is then determined in the same manner as for conventional aircraft noise events and is designated as Onset-Rate Adjusted Day-Night Average Sound Level. The L_{dnmr} is calculated from month with the most operations (i.e. busiest month).

Onset Rate-adjusted Sound Exposure Level (symbol-SEL_r)−The A-weighted metric used in the SUA/ASU to compare noise levels from individual events. Military overflights in SUA/ASU

differ from airfield operations in that they are generally less frequent, can have a sudden onset, and do not create continuous noise environments. To represent these differences, the SEL metric is adjusted to account for the surprise of the aircraft noise onset, with an adjustment ranging from 0 up to 11 dB above the normal SEL. The adjusted SEL is referred to as the onset rate-adjusted SEL (SEL_r).

Operational Data−Data used to define operational parameters of the aircraft modeled in all noise programs. Data includes "where" (flight tracks and patterns, SUA/ASU), "how" (altitude, aircraft configuration, airspeed and power setting), and "when" aircraft fly day (0700—2200), night (2200-0700) for DNL and day (0700-1900), evening (1900-2200), and night (2200-0700) for CNEL.

Peak Sound Pressure (symbol-L_{pk})−Level of peak sound pressure with stated frequency weighting, within a stated time interval. The decibel version of the peak overpressure that is used as needed to describe a noise event such as a sonic boom or blast for the purposes of relating it to human and animal response**.** For impulsive sounds, it is the true instantaneous sound pressure (e.g., the peak pressure of the shock wave for sonic booms). This pressure is usually presented in physical units of pounds per square foot. DOD uses un-weighted peak, so make sure the weighting factor is denoted. (See ANSI S1.1 for scientifically agreed upon definition.)

Percent Highly Annoyed (%HA)−Percent highly annoyed is the basis for Federal policy on environmental noise. The December 2009 Defense Noise Working Group (DNWG) Technical Bulletin "*Community Annoyance Caused by Noise From Military Aircraft Operations*" (DNWG TB2009-1) describes %HA as "the primary effect of recurring aircraft noise on exposed communities is "long-term" annoyance" and acknowledges that "the scientific community has adopted the use of long-term annoyance as a primary indicator of community response because it attempts to account for all negative aspects of effects from noise, including sleep disturbance, speech interference and distraction from other human activities." The %HA is the most useful metric for assessing people's responses to noise. The %HA has become the basis for Federal policy on environmental noise. The %HA is not converted to the number of "highly annoyed" people in a specific population because many emotional and physical variables can influence the annoyance response of an individual.

Pounds Per Square Foot (psf)−This metric is used when analyzing effects on structures from supersonic flight and use of high explosives

Probability of Awakening−The Probability of Awakening is an estimation of the probability that some part of a population sleeping indoors will be awakened by an outdoor noise event based on the SEL. The Air Force uses the ANSI for predicting sleep awakenings from multiple noise events during a night-long period (i.e., 10:00 p.m. to 7:00 a.m.). The ANSI S12.9-2008 curve for determining Probability of Awakening from a single event is represented by the following equation:
Where $Z = -6.8884 + 0.04444L_{AE}$, and L_{AE} represents the indoor A-weighted SEL of an outdoor single noise event. SELs less than 50 dB shall be ignored; indoor SELs in excess of 100 dB should be used with caution because it is the practical extent of the underlying data and predictions may be underestimated (see also DNWG Technical Bulletin, *Sleep Disturbance*

From Aviation Noise,(DNWG TB2009-4). Probability of Awakening is not converted to the number of people in a specific population who would awaken from a noise event, because the Probability of Awakening relies on probability theory rather than direct field research/experimental data, and may vary depending on local physical variables. Probability of Awakening is not used where the sleeping populations would be expected to be outside.

$$P_{A,\text{sin }gle} = \frac{1}{1+e^{-Z}}$$

Sortie Operation−A sortie-operation is used to define aircraft operations in SUA/ASU. One sortie operation is counted each time a single aircraft enters an airspace unit, such as a Military Operations Area or Military Training Route for training.

Sound Exposure Level (SEL)−SEL is a composite metric that represents both the magnitude and duration of a time-varying noise event, such as an aircraft overflight. The SEL is determined using a single number to account for the event as if it occurred during one second; it does not directly represent the sound level heard at any given time. Rather, it accounts for the noise heard through an entire event, beginning when the noise source first becomes audible, rising up to the maximum level at its closest point to the receiver, and ending when the sound diminishes. To illustrate, the SEL is the result of taking all of the energy in the figure and squeezing it into the 1 second area, leading to a SEL that is typically higher than the maximum sound level. SEL is the building block for calculating DNL/CNEL and has proven to be a good number to compare the relative exposure of different transient sounds. (See ANSI S1.1 for scientifically agreed upon definition.)

Sound Power Level (PWL)−This is a logarithmic measure of the sound power in comparison to a specified reference level. Sound power is the acoustic energy radiated from a sound source over a unit of time and is measured in watts (W). PWL is also expressed in units of dB, but its reference value is 1 picoWatt (1 pW). To avoid confusion, sound power level is usually denoted as dB PWL, whereas sound pressure level is denoted as dB SPL. Unlike sound pressure, sound power is strictly a measure of the sound source strength and does not depend on location or distance. Sound power is the total power produced by the source in all directions. (See ANSI S1.1 for scientifically agreed upon definition.)

Sound Pressure Level (SPL)−SPL is a logarithmic measure of the effective acoustic pressure of a sound relative to a reference value and is measured in decibels (dB). The SPL is expressed in units of dB and is a ratio of a measured pressure compared to a reference pressure. The reference pressure for air is 20 microPascals (µPa) which is related to the threshold of human hearing. SPL is a measure of the sound magnitude at a particular location relative to the source. (See ANSI S1.1 for scientifically agreed upon definition.)

Special Use Airspace (SUA)−Airspace that is of a defined vertical and lateral dimension that alerts users to areas of unusual flight hazards and separates those activities from other airspace users to enhance safety. Certain limitations or restrictions may be placed on non-participating aircraft.

Stakeholder−A person or organization, either internal or external to the installation complex, with personal, financial, or other manifest interest in an issue or decision. Stakeholders include, among others: DoD Components; installation tenants; federal, state, regional and local governments and agencies; Tribal Councils; and individuals or groups outside of an installation or range, or beneath SUA/ASU.

Substitute Aircraft−An aircraft used to represent another aircraft whose noise data is not available in the NOISEFILE data base (see also surrogate aircraft).

Supplemental Metrics−Supplemental Metrics are used to help define the primary metrics, DNL and CNEL, when needed to help characterize the noise environment.

Surrogate Aircraft−An aircraft used to represent another aircraft whose noise data is not available in the NOISEFILE data base (see also substitute aircraft).

Time Above a Specified Level (TAL)−TAL is a measure (expressed in minutes) of the total time that the A-weighted aircraft noise level is at or above a defined sound level threshold over any time period of interest, provided there is operational data to define the time period of interest. Combined with the selected threshold level (L), the TA metric is symbolized as TAL and can be used to indicate that the sound level at identified locations exceed that noise level for a certain number of minutes per day.

Weapon System−A combination of one or more weapons with all related equipment, materials, services, personnel, and means of delivery and deployment (if applicable) required for self-sufficiency. For the purposes of this AFI, a weapon system includes aircraft, weapons, and munitions.

Weighted Sound Levels−A and C-weighting are frequency filters applied to sounds that attempt to account for the human perception of loudness. They are used in noise assessments because weighted sound levels have been shown to correlate moderately well with the human response to noise. When A-weighting is applied to noise levels, very high and very low sound frequencies that are outside the range of human hearing are screened out, thereby weighting the sound to reflect what people actually hear. A-weighting is typically used to assess environmental sounds, specifically for the noise generated by transportation sources and small arms use. C-weighting is applied to intense low-frequency noise that can cause vibrations, such as heavy bombs and sonic booms. C-weighting does not apply adjustments to noise signals over most of the audible frequencies, but does apply small adjustments to the very low and very high frequencies. C-weighting is typically used to assess large-amplitude impulsive noises generated when aircraft fly at supersonic speeds and when heavy weapons and large bombs are used. (See ANSI S1.1 for scientifically agreed upon definition.)

Training Exercise−The short-term increase in the normal day-to-day operations-tempo of any training area.

Attachment 2

COMPUTER MODELING, DATA, AND METRICS

A2.1. General. This attachment provides additional details regarding the computer models, data required for each model and the metrics the Air Force uses for noise contours in support of the AICUZ program and environmental analysis of the noise impacts from testing and training activities. The discussions on models and data are organized by the type of operational environment in which they are used, e.g. military airfield, civilian airfield, SUA/ASU, air to ground ranges, ground ranges and explosive ordnance disposal proficiency training ranges. At the end of this section, Figure A2-1 summarizes the noise models used for predicting noise levels in each type of operational environment. Table A2- 1 lists the computer models and the rules related to each model.

A2.2. Computer Modeling for Military Airfield Environment. The NOISEMAP suite of programs (NOISEFILE, BASEOPS, NMPLOT, AAM) is used to predict noise exposure from all flight activity, engine run operations, and the effects of the topography and ground impedance on noise exposure from aircraft operations in the military airfield environment. Only the most recent DoD version of NOISEMAP (identified on the AFCEC/CPP's SharePoint® site is to be used when preparing noise contours for environmental analysis or the AICUZ program.

A2.2.1. BASEOPS is the program used for all data input and execution of the NOISEMAP suite of programs (NOISEMAP, RNM, AAM, NMPLOT). It is the only program authorized for data input, model execution, and data output. The BASEOPS report functions are used to generate the installation NMODD. Document such things as aircraft groupings and/or other unusual or non-standard ways of doing things in BASEOPS.

A2.2.2. Use NMPLOT to convert grid files resulting from the NOISEMAP suite of programs into noise contours and for generating and exporting noise contours into shape files so they can be input into a GIS. NMPLOT contains analytical features that can be used to investigate noise complaints, research noise mitigation techniques, or when in need of information regarding single event or cumulative noise levels at any location by providing the top 20 ranked aircraft contributors to the noise environment. When NMPLOT produces unexplainable abnormalities in noise contours, change the grid spacing in NOISEMAP and/or NMPLOT to refine the contours. Noise contours produced by NMPLOT are not to be modified using GIS without full justification, documentation and written permission of AFCEC/CPP. This is to ensure that anyone trying to validate the results of the noise modeling can reproduce the output from NMPLOT.

A2.3. Computer Modeling for Civilian Airfield Environment. The overall responsibility for aircraft noise in the civilian airport environment lies with the local airport authority. The most current FAA-approved noise model is AEDT and is designed specifically for modeling aircraft noise at civilian airfields. AEDT is used to predict noise exposure in support of 14 CFR Part 150, *Airport Noise Compatibility Program* and for analyzing noise impacts in the preparation of EAs and EISs in accordance with FAA Order 1050.1F, *Policies and Procedures for Considering Environmental Impacts.*

A2.3.1. When requested by the airport authority, the USAF provides copies of the input and output files from the most recent USAF noise analysis (AEDT or NOISEMAP) to the airport authority for their use in updating their noise exposure maps.

A2.3.2. When the Air Force has a proposed action that will take place at a civilian airport and the noise from the military aircraft dominate the airport's acoustic environment and/or the AEDT standard flight profiles do not reflect local operating conditions, or are unavailable, approval shall be requested from the FAA to use NOISEMAP to model military aircraft in accordance with FAA Order 1050.1F, *Policies & Procedures for Considering Environmental Impacts*, paragraph B-1.2, Appendix B. AEDT is used to model civilian aircraft operations and NOISEMAP used to model military aircraft operations, and the results from each modeling run are combined through NMPLOT to produce a single set of DNL/CNEL contours.

A2.3.3. When military aircraft have been modeled using AEDT in a publically released Noise Exposure Map as part of the airport's Part 150 program, AEDT may be used to model both civilian and military aircraft for environmental analysis providing accurate military aircraft flight profile data is available in the AEDT noise database.

A2.3.4. If the airport is not participating in the FAA's Part 150 program nor have an active noise management and AEDT files do not exist, civilian aircraft may be modeled in NOISEMAP for environmental analysis purposes.

A2.3.5. In all situations, the produce the affected environment noise contours and proposed action noise contours using the same noise model.

A2.4. Computer Models for SUA/ASU. Noise associated with SUA/ASU is handled somewhat differently than the airfield environment because it involves more random flight activity where low altitudes and high airspeeds can produce high on-set rates and supersonic flights can produce sonic booms. The following models are used to predict noise in SUA/ASU. **Note**: The FAA has approved specific noise models for modeling impacts from proposed actions involving SUA/ASU. The use of models other than the ones approved by the FAA requires pre-approval by the FAA. Use FAA Order 1050.1F, Appendix A, Section 14 for assistance in determining whether a noise analysis is warranted and if so, what type of analysis should be conducted.

A2.4.1. The most recent version of MR_NMAP (as identified in the Noise Toolbox on the CPP SharePoint® site) is used for predicting the noise exposure from aircraft operating at subsonic airspeeds within SUAA/ASU. The FAA's Office of Environment and Energy has approved the use of MR_NMAP for use and analysis of SUA/SUA (FAA Order 1050.1F).

A2.4.2. Use BASEOPS to generate MR_NMAP input files. The BASEOPS report functions will be used to generate input into the installation NMODD. NMPLOT is used to display input and output from MR_NMAP in graphical form.

A2.4.3. Use PCBOOM4 when needed to predict the sonic boom footprint of individual supersonic flight operations. Its use requires knowledge of supersonic flight parameters and sonic booms. It is designed to analyze sonic booms from single sorties, with emphasis on identifying the specific pattern and amplitude of the footprint. Use of PCBOOM during the EIAP in which the FAA is a cooperating agency requires written approval from the FAA's Office of Environment and Energy in accordance with FAA Order 1050.1F.

A2.4.4. Use BOOMAP when predicting the cumulative sonic boom environment for air combat maneuvering operations where speeds exceed Mach 1 and sonic boom events tend to be brief, but occur often enough that cumulative effects are of concern. BOOMAP does not

accurately predict sonic booms from aircraft with super-cruise capability, such as the F-22. Contact AFCEC/CPP for guidance in calculating sonic boom noise levels for aircraft with super-cruise capability. The FAA's Office of Environment and Energy has approved the use of BOOMAP for use and analysis of SUA/ASU (FAA Order 1050.1F).

A2.5. Computer Models for Air-to-Ground Ranges. Noise associated with air-to-ground Ranges is dependent on the use of the range. It is based on two factors, the aircraft overflight and the munitions used for training.

A2.5.1. Use MR_NMAP to predict noise from subsonic aircraft overflight where inert munitions are used as described under SUA/ASU.

A2.5.2. Noise modeling is not required for use of inert munitions, i.e., Bomb Dummy Units. The noise associated with the aircraft would dominate the noise environment.

A2.5.3. Use Air Gunnery Model to develop noise levels from Air-to-ground firing. It is designed to predict elevated weapon noise and is used for predicting noise from muzzle blast, rocket propulsion, and sonic booms resulting from the use of supersonic projectiles (i.e., bullets and rockets). It should be noted that for HE bombs, the explosion on the ground is handled by BNOISE.

A2.6. Computer Models for Ground Training Ranges and EOD Proficiency Training Ranges. Because noise from ground sources have different characteristics than aircraft noise and the propagation path of ground based weapons is different from aircraft different computer models are used.

A2.6.1. SARNAM is used for predicting noise levels for small arms (≤.50 caliber or less. SARNAM is designed for ranges with fixed firing points and targets and its use for other training tactics will be limited. The Army Public Health Center (Provisional) Operational Noise Program must validate all SARNAM input files prior to release in a public document as required by the End User License Agreement for the U.S. Army Engineer Research and Development Center noise modeling software "SARNAM" and "BNOISE" family of computer programs.

A2.6.2. Noise level predictions for Ranges for large caliber weapons (≥ 20 millimeter) and EOD proficiency training ranges is done using the most current version of BNOISE. BNOISE files require validation by the Army Public Health Center (Provisional) Operational Noise Program prior to release in a public document. BNOISE2 version control is the responsibility of the U.S. Army Engineer Research and Development Center/CEERD-CN-N, Champaign, Illinois.

Figure A2.1. Noise Model Usage.

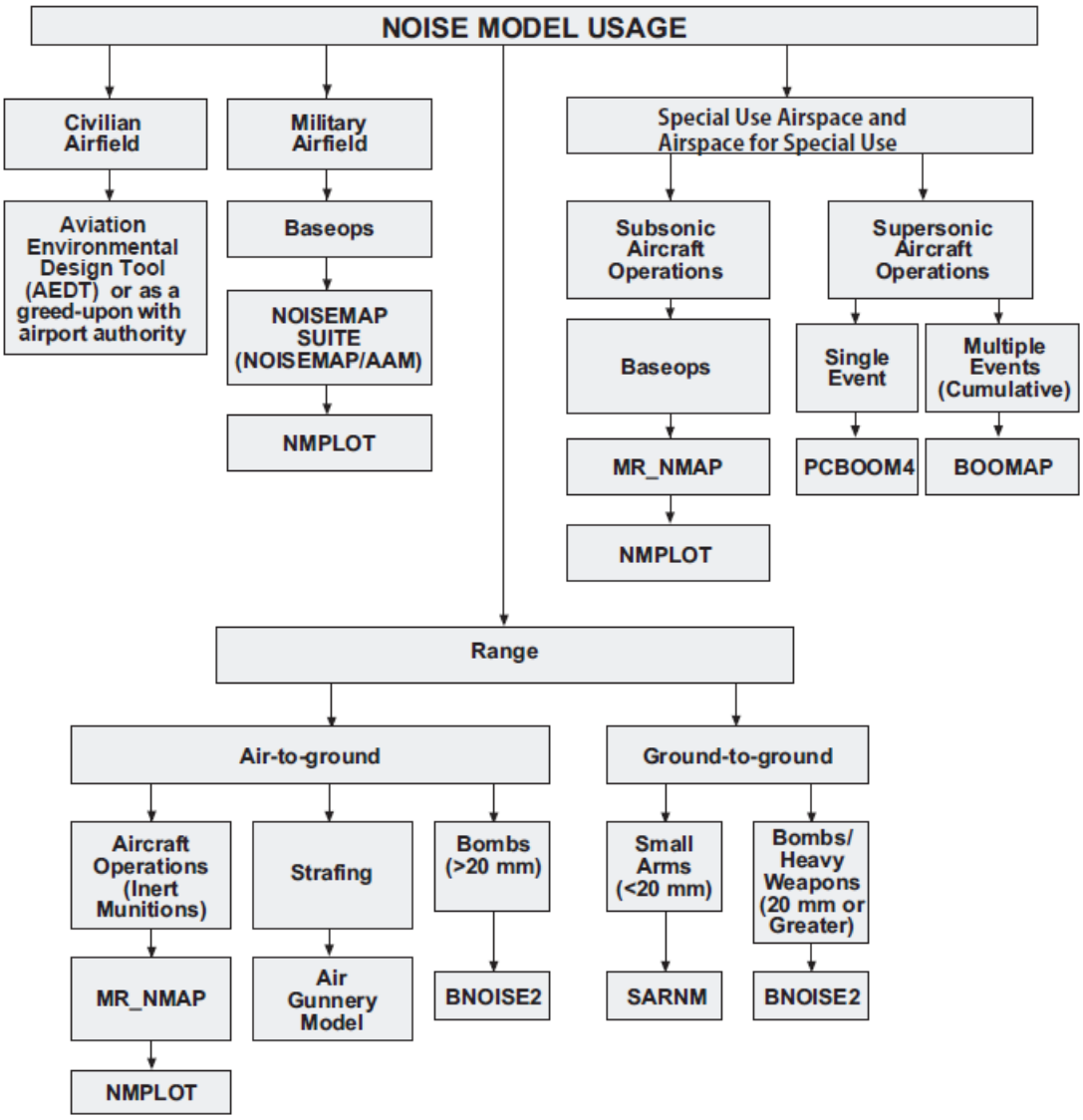

Table A2.1. Noise Models Usage Guidelines.

Model	Guidelines
NOISEMAP Suite of Programs (BASEOPS, NOISEMAP, AAM, and NMPLOT)	Used for noise prediction and analysis for all military airfield environments in the United States and its territories. [Use for overseas installations not required if host nation agreements require use of other models]. All input is to be done using the BASEOPS input program. Used for single event estimation at sensitive receptors in the airfield vicinity Used to analyze activity interference on such speech interference and sleep estimation in the airfield vicinity Used to analyze activity interference on such speech interference and sleep estimation in the airfield vicinity For installations outside the Continental United States installations, noise model output is to be used for on-base planning purposes only and will be provided to the host nation only if requested. No public release of these contours without prior permission from numbered Air Force.
AEDT	In 2015, The FAA formally replaced the Integrated Noise Model (INM) with AEDT or noise analysis. Use at civilian airports in support of the Federal Aviation Regulations 14 CFR Part 150 noise exposure maps and environmental analysis. Request exemptions as necessary for military aircraft.
Military Operating Area and Range Noise Model (MR_NMAP)	Used for predicting noise exposure from aircraft operations in SUA/ASU and air-to-ground ranges. Analytical capability using supplemental single event metrics at sensitive receptors used for environmental analysis.
PCBOOM	Used for predicting both carpet and focus boom footprints created by supersonic flight in SUA Airspace for environmental analysis. Use requires FAA approval for proposed actions in which the FAA is the final approving agency.
BOOMAP	Used for analysis of the cumulative sonic boom environment for air combat maneuvering that include supersonic flight.

Model	Guidelines
	Use for predicting sonic booms from aircraft with super-cruise capability not supported, contact AFCEC/CPP for direction.
Air Gunnery Model	Used for predicting the noise levels from airborne weapons usage.
Blast Noise (BNOISE2)	Used to predict noise generated by large caliber weapons and high explosives (20 millimeters and larger) for environmental analysis and AICUZ studies for Air Force led Joint Bases with an Army supported component. Input files require validation by the Army Public Health Center (Provisional Operational Noise Program prior to release in a public document.
Small Arms Range Noise Assessment Model (SARNAM)	Used to predict noise generated from small arms ranges (.50 caliber and smaller) for environmental analysis AICUZ studies for Air Force led Joint Bases with an Army supported component Input files require validation by the. Army Public Health Center (Provisional) Operational Noise Program prior to release in a public document

A2.7. Data Needed for Noise Level Predictions. Each model has its own operational data requirements and methods for obtaining that data. Tables A2-2 and A2-3 contain examples of operational data used by several of the computer models.

A2.7.1. **Airfield Environment Operational Data.** Use proven interview techniques for obtaining the operational data to be used in the noise models. The Air Force Operational Data Collection Handbook found at: **https://afcec-portal.lackland.af.mil/cp/cpp/em/SitePages/Home.aspx** should be used as the guide for obtaining operational data to be used with the NOISEMAP suite of programs. Currently there is no approved automated data collection method. Using radar data or other Air Traffic Control data requires the pre-approval of AFCEC/CPP. BASEOPS is used to input all operational data into NOISEMAP (see paragraph A2.2.1).

A2.7.1.1. Aircraft operational and engine run-up data for based aircraft is specific to each installation and is be obtained from and validated by the operators and maintainers, and certified by each squadron commander.

A2.7.1.2. Yearly traffic counts provided by air traffic control should be used only to validate the operational numbers used to generate noise contours.

A2.7.1.3. Use of standard flight profiles contained within BASEOPS is limited to transient aircraft not using the airfield on a daily basis or where base-specific operational profiles are unobtainable through pilot interviews. Standard profile data will be adjusted as necessary to accurately reflect local flying rules and noise abatement procedures. When there are multiple types of transient aircraft with very few daily operations (less than 0.50), aircraft may be grouped with similar aircraft in an appropriate category for

noise modeling purposes. In all cases, document aircraft groupings in BASEOPS for future reference.

A2.7.1.4. Topography and elevation files is to be used, and all non-water areas is to be modeled as "soft" ground (~200 kPa-s/m^2). Open water and areas designated as wetlands that are inundated more than 50 percent of the year, are considered as hard ground, otherwise use soft ground. All noise contours used for the "affected environment" developed for the acoustical environment section in environmental analysis documents, that were not originally developed using topography and elevation files will need to be revised using those files. This may result in noise contours that do not match those previously released in a public document. In these instances, a statement that the baseline noise contours have been updated to include the effects of topography and elevation resulting in changes in the noise environment will be included. Once AAM and legacy aircraft spheres are approved for use, National Land Cover Data impedance values will be used.

A2.7.2. **Special Use Airspace (SUA)/Airspace for Special Use (ASU) and Ranges.** Defining the affected (i.e. baseline) acoustical environment used in environmental impact analysis documents for the SUA/ASU, air-to-ground ranges, small arms and ground ranges requires current operational data. Existing records can be used if they have been reviewed and validated by the appropriate airspace manager or range operating authority as being representative of current operations in accordance with AFI 13-201, *Airspace Management*, AFI 13-212, *Range Planning and Operations*, and AFI 36-226, *Combat Arms Program*. For Army ground ranges and small arms ranges at an Air Force lead Joint Base with an Army supported component the operational data should be reviewed and validated by the Director of Plans, Training, Mobilization and Security Directorate or Chief of Range Control. All operational data for the proposed action and alternatives should be provided by the proponent of the action in coordination with the appropriate airspace manager/range operating authority or Chief of Range Control for Army ranges.

A2.7.2.1. High-speed aircraft, engine power settings, and airspeed are to be restricted to the settings in the NOISEFILE associated with MR_NMAP.

A2.7.2.2. The minimum data points needed for MR_NMAP model input are found in Table A2-2. Data should be provided for each dissimilar mission.

A2.7.2.3. The minimum data points needed for SARNAM and BNOISE are found in Table A2-3 Data should be provided for each range training area.

Table A2.2. Sample MR_NMAP Data Requirements.

Mission Name		
Aircraft Type	F-22	F-16
Airspace Unit	R-2301	R-2301
Number of sorties per year	5,000	2,000
Number Daytime Operations (0700-2200 (or 1900 for CA)	4,000	1,500
Number of Evening Operations 1900-2200 [CA only]	0	0
Number of Night Operations (2200-0700)	1,000	500
Average time (in minutes) in airspace per	60	60
Average Power Setting	90% ETR[1]	90%RPM[2]
Average Indicated Airspeed (in knots)	450	425
Percent time by altitude block (in Above Ground Level (AGL)) (Each column should add to 100%)		
100 – 300 feet	0	0
300-500 feet	0	0
500 - 1,000 feet	5	5
1,000- 2,000 feet	20	20
2,000 - 3,000 feet	15	15
3,000-5,000 feet[3]	10	10
5,000 - 10,000 feet	25	25
10,000 + feet	25	25

Notes: 1. Engine Thrust Request)
2. Revolutions Per Minute
3. Required to support Air Quality Analysis

Table A2.3. Sample SARNAM or BNOISE Data Requirements.

Description	Weapon Type	Ammunition Type	Day 0700-2200	Night 2200-0700	Annual Total Ordnance/ Ammunition Estimated Expenditure
Combat Pistol Range	Pistol	9 mm	1,000	5,000	6,000
		.45 cal	23,000	5,000	28,000
	Shotgun	12 gauge	6,240	1,560	7,800
Multi-Purpose Range	Rifle	5.56 mm	6,100	0	6,100
		7.62 mm	15,600	0	15,600
		.50 cal	4,800	1,200	6,000
Live Hand Grenade Range	Hand Grenade	HE Fragmentation	50	0	50
Field Artillery Indirect Fire Range	Artillery	155 mm HE	800	20	8020
		155 mm Illum	0	100	100
		155 mm Smoke	400	0	400
	Mortar	120 mm HE	320	80	400
		120 mm Illum	0	100	100
		120 mm Smoke	100	0	100
Light Anti-Armor Weapon Live Range	Rocket (Personnel)	LAW	100	0	100
		84 mm	181	45	226
Light Anti-Armor Weapon Live Range	Grenade Launcher	40 mm HEDP	500	0	500
Multi-Purpose Training Range	Machine Gun	.50 cal	4,000	1,000	5,000

Notes: mm = millimeter; cal = caliber, HE = High Explosive, HEDP = High Explosive Dual Purpose, Illum = Illumination, LAW = Light Anti-Tank Weapon.

A2.8. Noise Metrics. The computer models can produce noise levels using several descriptors or metrics. Table A2-4 at the end of this section summarizes which metrics are produced by which computer models.

A2.8.1. Depending on the source of the noise, noise levels used in the USAF are either A-weighted or C weighted. Human hearing is less sensitive at very low and very high frequencies, so weighting applies frequency filters to sounds to account for the human perception of loudness. A-weighted noise levels are not to be combined with C-weighted (nor will the contours be joined).

A2.8.1.1. Aweighting de-emphasizes those frequencies that humans don't hear very well so that emphasis is placed on the mid-frequency sounds that are more closely related to human hearing. When assessing noise effects related to subsonic aircraft operations and small arms (less than 20 millimeters) use A-weighting. When the majority or all noise levels in a document are A-weighted, it is acceptable to drop the "A- weighted" and use "dB" as long as the use of A-weighting is understood.

A2.8.1.2. C-weighting slightly emphasizes the lower frequencies but does not emphasize other frequencies that are treated as un-weighted sounds. When assessing the potential noise effects on humans, terrestrial wildlife and marine life from supersonic aircraft operations, large weapons (equal to or greater than 20 millimeters) and blast noise sources, noise is C-weighted.

A2.8.2. **Primary Metrics**

A2.8.2.1. Day-Night Average Sound Level (DNL). DNL is the primary metric used by Federal Agencies for analyzing noise effects around airfields. It does not represent the actual sound level heard at any one point in time. DNL is an average that takes into account the sound exposure levels of all individual events that occur during a 24-hour period, penalizes night operations to account for an increased sensitivity to noise during sleeping hours, and then divides the sum by the total number of seconds in a day (Federal Interagency Committee on Noise, *Federal Agency Review of Selected Airport Noise Analysis Issues*, August, 1992). DNL is the best single system of noise measurement that can be uniformly applied in communities around airports for compatible land use planning and for which there is a relationship between projected noise and surveyed reaction of people to the noise (Schultz Curve 1978 and Finegold *et al.* 1994). DNL is the primary noise metric used for describing long-term noise impacts for sub-sonic aircraft operations and small weapons noise, and is the primary metric used to describe the noise environment in the airfield vicinity for programs such as AICUZ and EIAP.

A2.8.2.1.1. DNL is the Federal standard for determining impacts to the human environment and is used to describe and predict long-term noise impacts for sub-sonic aircraft operation.

A2.8.2.1.2. Daily operations for noise modeling are calculated using the Average Annual Day (AAD) method (yearly operations divided by 365 days per year). The number of AAD operations are to be rounded to the nearest hundredth (i.e., two decimal places), and the number of arrivals and departures should always be equal.

A2.8.2.1.3. DNL contours developed for environmental analysis are presented in 5 dB increments from 65 to 85 dB. DNL is used for describing the existing noise environment and for analyzing noise effects in the airfield.

A2.8.2.1.4. To ensure that the reader of any NEPA document or AICUZ study understands that noise levels do not abruptly stop at the 65 dB noise contour, or the other contour lines, the presentation of noise levels on maps includes both the solid contour lines along with color bands that gradually transition from red at the upper noise levels to yellow, to green to purple at the lower noise levels (whenever feasible from a presentation standpoint). The use of translucent colors allows features on the installation maps to be seen by the reader. This technique communicates the actual noise exposure. Because the colors reflect noise levels lower than 65, it does not mean that additional contour lines should be shown, nor does it indicate there is any significance attached to the noise 65 dB or higher noise contours has changed.

A2.8.2.2. Community Noise Equivalent Level (CNEL) contours are used in AICUZ studies and for analyzing noise impacts in NEPA documents for installations, ranges and

airspace in California. AICUZ studies will include a separate DNL contour map for on-base planning.

A2.8.2.3. When necessary for environmental analysis or public outreach, operations for short-term military training exercises may be calculated based on the duration of the event and presented as short-term DNL/CNEL contours to supplement the traditional DNL contour. All presentation materials are to be clearly marked as "Training Exercise Noise Contours—Not for Land Use Planning Purposes." When using this method, emphasis is to be placed on the Name of the Exercise and Number of Days per year the exercise is expected to occur. Short-term noise contours do not replace the AAD noise contours presented in AICUZ study or other land use planning documents.

A2.8.2.4. Onset rate-adjusted monthly day-night average sound level (DNL_{mr} or L_{dnmr}). This metric is used for quantifying noise impacts in SUA/ASU and when predicting noise exposure resulting from subsonic aircraft operations using SUA/ASU and air-to-ground ranges.

A2.8.2.4.1. Noise contours may be developed for SUA/ASU associated with air-to-ground ranges where the DNL_{mr} of 65 dB extends outside of the range boundaries.

A2.8.2.4.2. DNL_{mr} levels are documented in table format for all other SUA/ASU.

A2.8.2.5. C-weighted Day-Night Average Sound Level (CDNL or L_{Cdn}). This metric is used for large weapons (20 millimeter and greater) and other blast noise sources when predicting noise exposure on military ranges. It does not represent the actual sound level heard at any one point in time**.**

A2.8.2.5.1. C-weighting is appropriate for low-frequency impulsive sounds, such as sonic booms, heavy weapons, and other blast noise sources.

A2.8.2.5.2. For Air Force led Joint Bases with an Army supported Component, C weighted DNL contours are to be plotted in 5 dB increments from 62 dB to 80 dB.

A2.8.2.5.3. Sonic booms CDNL contours are plotted in 5 dB increments.

A2.8.2.5.5. When discussing C-weighted metrics, it should be disclosed that when experienced indoors, impulsive sounds can create secondary noise from rattling and vibrations of the building.

A2.8.2.6. Peak Sound Pressure Level (Lpk) is the primary metric for small caliber weapons (.50 caliber or less) and for small arms range noise modeled with SARNM.

A2.8.2.7. Other countries may use other noise metrics for aircraft noise. Some countries have dedicated offices that generate official aircraft noise metrics. Check with HQ PACAF and HQ USAFE Civil Engineering detachments before generating any AICUZ noise contours or preparing analysis of noise impacts for environmental reviews at Air Force installations overseas.

A2.8.3. **Supplemental Metrics.** DNL/CNEL can be supplemented by other metrics to characterize specific effects on a case-by-case basis, and to help the reader understand what they might experience from changes to the noise environment. These metrics are not be used instead of DNL for determining significance of aircraft noise at bases in CONUS and US Territories.

A2.8.3.1. Supplemental metrics are intended enhance the understanding of pertinent facts surrounding the change in the noise environment. These may include the use of metrics such as Equivalent Sound Level (L_{eq}) or single event metrics such as SEL and L_{max}, or descriptions of the noise environment in terms of the number of times or minutes of exposure at a specific location during an average day. Uses for each supplemental metric are listed below. Additional discussion can be found in Defense Noise Working Group's (DNWG) *Technical Bulletin for Using Supplemental Noise Metrics and Analysis Tools* (DNWG TB2009-2), DNWG *Guide to Using Supplemental Metrics: Improving Aviation Noise Planning, Analysis and Public Communications with Supplemental Metrics*, (DNWG TB2009-3); and DoD's *Planning in the Noise Environment, AFM 19-10* (1978) (located in the Noise Toolbox on AFCEC/CPP's SharePoint® site: **https://afcec-portal.lackland.af.mil/cp/cpp/em/SitePages/Home**).

A2.8.3.2. Equivalent Sound Level (L_{eq}) is a useful metric for describing the total aircraft noise exposure over an extended or limited period of time without any penalties applied. The specified time can be an hour, a school day, daytime, nighttime, a full 24 hours or even a weekend. L_{eq} values for a less than 24-hour day can be useful for determining impacts to sensitive locations.

A2.8.3.2.1. For example, an 8-hour L_{eq} can be calculated for the time of day that a school is in session and used to determine classroom impacts providing that operational data is available for that time period. L_{eq} may also be used when predicting habituation to aircraft overflights by domestic animals and wildlife.

A2.8.3.2.2. When used, L_{eq} is shown in tabular format for discrete locations of interest. L_{eq} contours are used for calculating the number of people that may have increased risk of hearing loss (see Attachment 5, Table 5.7-3) but should not be published in public documents in order to avoid them being confused with DNL contours.

A2.8.3.3. Sound Exposure Level (SEL) is an A-weighted decibels metric used when analyzing the probability of awakening from aircraft operations, noise effects to domestic animals and wildlife, and when comparing sound levels from different types of aircraft and different aircraft operations.

A2.8.3.4. C-weighted Sound Exposure Level (CSEL) is used to describe the individual noise resulting from single impulsive sounds, such as sonic booms and the deployment of heavy weapons.

A2.8.3.5. Onset Rate-adjusted Sound Exposure Level (SEL_r) is an A-weighted metric used in the SUA/ASU to compare noise levels from individual events (see also SEL).

A2.8.3.6. Maximum A-weighted Sound Level (L_{max}) is an A-weighted metric used in the assessment of speech intelligibility and interference. Additionally, it may be used independently or together with SEL to compare noise levels from different aircraft and different aircraft configurations, and for noise effects to domestic animals and wildlife. L_{max} is not be used to measure the overall intrusiveness of an event.

A2.8.3.7. Un-weighted Peak Sound Pressure (L_{pk}) may be used when referencing noise from sonic boom, small arms, large weapons, and blast noise to human responses. Peak levels also correlate well with airborne vibration and structural response.

A2.8.3.7.1. BNOISE can produce any peak level, however Peak 15 and Peak 50 are typically the primary peak metrics used because they show the influence of weather conditions: Peak 15 represents adverse conditions, and Peak 50 represents neutral weather conditions. If operations were to take place under all conditions, the Peak 15 would be the single event peak level exceeded by 15 percent of events, (i.e. 85% of the events will fall within the Peak 15 band). Only under extreme propagation conditions (i.e., low clouds or temperature inversion) will peak noise levels be louder than the predicted Peak 15. Peak 50 is the single event peak level exceeded by 50 percent of events, and represents neutral conditions. Be aware that peak levels can also be significantly lower than predicted PK15 and PK50 levels under favorable conditions.

A2.8.3.7.2. The contour generated by SARNAM when the Peak metric is selected, is actually Peak 15 vs an average peak (i.e., Peak 50).

A2.8.3.8. Pounds Per Square Foot (psf) is used when analyzing effects of structures from supersonic activity and high explosive events.

A2.8.3.9. Number-of-Events Above (NAL**)** has a distinct advantage in communicating current and projected noise exposure in a way not available through the use of other metrics or tools. It is the only supplemental metric that combines single event noise levels with the number of aircraft operations. It answers the questions of how many aircraft would be expected to fly over a given location or area at or above a certain threshold level. NAL has proven useful as an indicator of the effects that aircraft noise will have on certain human activities, specifically, the number of times a day (or other time period) that a person's activities could be interfered with, or the number of nighttime noise events that may cause some level of sleep disturbance. NAL should not be reported as an absolute number and when used in the airfield environment should include an explanation of runway usage and a normalized flying schedule that contains typical times of day of mission departures and arrivals. Similarly, when used in SUA/ASU or Range environments, supporting explanations of flight training procedures should be provided. When used, NAL is shown in tabular format.

A2.8.3.10. Time Above (TA) is useful for describing the noise environment in schools, particularly when comparing different operational scenarios. TA analysis can be conducted along with NA analysis so the results show not only how many events occur above the selected threshold(s), but also the total duration of those events above those levels for the selected time period. When used, TA can be portrayed for single or multiple locations and is to be shown in tabular format.

Table A2.4. Computer Noise Models and Associated Noise Metrics.

Model	***Output/Metric***	
	Primary	**Supplemental**
NOISEMAP (NMAP)	DNL, CNEL, $L_{eq,}$ $L_{eq(c)}$	SEL, SEL_c, L_{max}, NA, TA, L_{eq} SPL SPL_A, SPL_c,
AEDT	DNL/CNEL	SEL, L_{max}, NA, TA, L_{eq}
MR_NMAP	DNL_{mr}, $CNEL_{mr}$	SEL_r, $L_{max,}$ NA, TA
PCBOOM4	CDNL	L_{pk}, psf
BOOMAP	CDNL	L_{pk}, psf
Air Gunnery Model	CDNL	L_{pk}
BNOISE2	CDNL	CSEL, L_{pk}
SARNAM	DNL, SEL	CSEL, L_{pk}

Attachment 3

ANALYZING NOISE IMPACTS

A3.1. Overview. The National Environmental Policy Act of 1969 (NEPA) [42 U.S. Code (U.S.C.) §4321] and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA require Federal agencies to ensure the potential impact of proposed actions are considered early and throughout the decision-making process. This attachment provides an overview of both short and long- term impacts of noise from military aircraft and weapon systems.

A3.1.1. There are a number of proposed actions that may require an analysis of noise impacts if they are part of a proposed action. Aircraft related actions include: beddown or realignment of existing or new aircraft, shifting operations to a different runway, major change in operational tempo or in number of nighttime flight operations, changing departure/arrival pattern flight tracks, establishing new testing or training activities or changes to existing ones, conducting supersonic flight operations below 30,000 ft. AGL or development of new or changes to existing SUA/ASU. Ground training actions include beddown or realignment of new weapon systems; establishing or modifying new training areas or ranges, (air-to-ground, EOD proficiency training or artillery ranges/maneuvering areas). Screening guidelines to help determine whether detailed analysis for aircraft noise is necessary is located in the Noise Toolbox on AFCEC/CPP's SharePoint® site: **https://afcec-portal.lackland.af.mil/cp/cpp/em/SitePages/Home.**

A3.1.2. Noise from tanks and ground vehicles being driven along roads and for maneuvers are typically only an issue if they are going to be operating in areas located close to the base boundary and there are residences nearby. Artillery or gunfire from these vehicles may extend beyond the base boundary depending on the proximity to the boundary. Short-term noise impacts typically includes noise generated by construction activities, e.g. jack hammers, large truck, bulldozer, generators, etc. Analysis of this type of noise is especially important if there is residential or other noise sensitive land uses nearby.

A3.2. Coordinating with Other Agencies. The Air Force is often required to coordinate with other agencies on proposals that have a potential to change the existing noise environment. The following is information on those agencies in which noise is typically the driver behind the requirement to consult.

A3.2.1. Federal Aviation Administration (FAA). The FAA is responsible for compliance with the most current version of FAA Order 1050.1, *Environmental Impact: Policies and Procedures*, for all public airports and all navigable airspace in the United States.

A3.2.1.1. Airports**.** When using NOISEMAP for Air Force projects, FAA Memorandum, July 28, 2009, Subject: *AEE and Airports Coordination Policy for Non-Standard Modeling Procedures and Methodology* applies.

A3.2.1.2. Special Use Airspace (SUA) and Airspace for Special Use (ASU). Some proposed Air Force actions involving SUA/ASU may require the FAA to make a decision. To minimize unnecessary duplication of effort, for all actions for which the FAA must make a decision (i.e. triggers formal rule making), complete the noise modeling and subsequent environmental analysis to support the FAA's decision.

A3.2.2. National Park Service. Coordination occurs with the National Park Service when a National Park is located within an area of frequent military aircraft activity. When there is the potential for elevated noise levels to affect National Park resources or the potential for structural damage, consult with the National Park that could be impacted early in the environmental analysis process.

A3.2.3. U.S. Fish and Wildlife Service. Under Section 7 of the Endangered Species Act, federal agencies must consult with the United States Fish and Wildlife Service when any action the agency carries out, funds, or authorizes has the potential to affect a listed endangered or threatened species. If there are potential impacts to federally listed species, consultation with the United States Fish and Wildlife Service is required and mitigation measures may be developed through the consultation process.

A3.2.4. State Historic Preservation Offices/Tribal Historic Preservation Offices. AFI 32-7065 requires consideration of historic properties by federal agencies. Noise (audible) intrusions and damage to historic properties are recognized as examples of adverse effects under 36 CFR 800.5(a)(2). If the Air Force determines the action has the potential to adversely affect historic properties, or properties to which federally recognized Indian tribes may attach religious and cultural significance, coordinate early in the process to identify sensitive sites and areas and conduct consultation is essential.

A3.3. Defining the Concept of Operations. It is important to develop a thorough description of the noise generating testing/ training operations as early as possible in the proposal planning process. This information is used to determine the type of the noise the proposed action will generate, i.e. subsonic aircraft noise, sonic booms, small-arms range noise, blast noise from artillery/mortars or EOD proficiency training, the types of operational data required, and the models and metrics to be used for predicting noise levels. It also makes it easier to provide a more thorough a detailed description the proposed action to the public.

A3.4. Acoustic Conditions of the No-Action Alternative. The No-Action Alternative represents the future condition of the acoustic environment at the base, range or under the airspace that will exist if the proposed action (or an alternative is not implemented). It represents the conditions from against which the impacts of the proposed action and alternatives are evaluated. For noise analysis purposes, the No-Action Alternative noise levels include noise from proposed aircraft operations that were previously analyzed but the decision has not yet been fully implemented.

A3.5. The Acoustic Environment. When it is determined that the proposed action or an alternative could produce noise levels that may potentially have a significant impact, noise impacts need to be evaluated in detail using the appropriate computer model, operational data, and metrics to predict the noise levels from the proposed action and alternatives. Noise is a by-product from operating military aircraft or weapon systems; it is not a "resource." For the purposes of the environmental analysis, the aspect of the environment that could be impacted by the operation of aircraft or weapon systems is existing "acoustic environment." The discussion would focus on how the acoustic environment will change as a result of the proposed operations of the aircraft or weapon systems. For purposes of this AFI and environmental analysis of noise impacts, the definition of the acoustic environment is the acoustical conditions in which people, animals, and plants live or operate.

A3.5.1. The concept of operations for the action alternatives determines the geographical area for the extent of the acoustic environment that needs to be evaluated. For aircraft operations generally this will be either the area near the installation, range or under the SUA/ASU or all three areas. For ground based proposed actions, it will generally be near the installation or the installations training areas.

A3.5.1.1. The airfield or installation acoustic environment is typically defined as the area within the 65+ DNL/CNEL or 62 CDNL contours for all alternatives. However, this region can be influenced by the surrounding community and sensitive land uses within the community. If noise sensitive land uses exist near the edge of the 65 dB DNL/CNEL or 62 CDNL zone the region for evaluating impacts may need to extend into areas immediately outside the zone. For the installation environment, AFCEC/CPP should have the most recent set of environmental analysis or AICUZ noise modeling output noise contours and associated NMODD. However, this output may not include the changes to noise resulting from any categorically excluded actions subsequent to the date of the most recent noise modeling.

A3.5.1.2. The geographic extent of the acoustic environment for SUA/ASU is typically the entire area underlying each respective alternative.

A3.5.1.3. The geographic extent of the acoustic environment for either air-to-ground ranges or ground ranges is determined by the extent of the DNL, CDNL or, Peak 15 contours.

A3.6. Calculating Acreage and Population. Identify the number of acres of land affected by the noise from the military activity, and human population (both on and off base) exposed to high noise levels. For the airfield environment, use geospatial data and GIS software in combination with the DNL contour map to calculate changes to number of acres within in each DNL noise zone for both the affected environment noise conditions and the environmental consequences.

A3.6.1. The most current U.S. Census block data (or lowest level available) is used to define the exposed populations residing off-base. Information to determine on-base populations exposed to noise, the base housing office can provide data for on-base residents and the installation finance office can provide data on the number of people working on base. When on-base housing data is used, it is important to ensure that on base populations are not included in the Census data to avoid double counting.

A3.6.2. Generally it is assumed that the population is distributed equally through each census block in urban areas unless it is clear from local land use data that the entire census block is residential. In these situations, additional research using local resources may be necessary to calculate the population exposed to noise. In rural areas, population distributions are variable based on the location of population centers within each block. There are times when using the equal distribution assumption is not reasonable because there are large areas within the census block that do not contain residences. In this situation, aerial imagery or ground survey should be used to assist in determining more realistic population distribution.

A3.7. Noise and Land Use Compatibility. For the airfield environment, this section analyzes the change in the number of acres of various land uses within the noise zone that would be

incompatible with the noise from military operations. The compatibility evaluation is based on Air Force land use compatibility tables in the AICUZ Instruction AFI 32-7063. A comparison of number of acres considered incompatible in both the before and after conditions is typically presented in a table, along with a land use or zoning map with noise contours.

A3.7.2. For the SUA/ASU environment, the long term noise levels are rarely high enough that there would be incompatible land uses. However, special management areas such as National Parks, Wildlife Refuges, etc., may require additional analysis.

A3.7.3. Any special management areas such as around airfields or under the SUA/ASU are considered noise sensitive and may require more detailed analysis and use of supplemental metrics that indicate how often military noise would be noticeable.

A3.8. Effects of Noise-Induced Vibration on Structures. The potential for damage to structures from noise-induced vibration is often a concern raised by the public. Noise from explosive detonations, sonic booms, and large arms firing can cause buildings to vibrate, which the occupants experience as shaking of the structure and rattling of the windows. Residents typically believe the vibrations can cause structural damage. The probability of this shaking causing structural damage is minimal.

A3.8.1. Although vibration can travel from a source to the receiver both through the ground (ground-borne) and air (airborne), the distance that ground-borne vibration travels is limited and what residents perceive is overwhelmingly airborne vibration. Airborne vibration is the dominant cause of structural vibration off the installation. Most studies of airborne vibration and the damage guidelines derived from these studies used sonic booms as the source. These same guidelines can be applied to vibration from artillery and tank main-gun firing. The threshold of human perception of vibration is far below the threshold of structural damage.

A3.8.2. Measuring vibration levels can be an involved undertaking requiring very specialized equipment and expertise. Therefore, often a simplified means to evaluate damage potential is by using the un-weighted Peak Sound Pressure Level (dBP). Multiple studies have shown that the Peak level correlates directly with vibration. The Peak level is easier to measure and can also be predicted through the DoD's blast noise model.

A3.8.3. Subsonic overflight noise. Based on experimental data and models, noise and vibrations from subsonic aircraft overflights are unlikely to damage architectural resources, including adobe buildings.

A3.8.4. Sonic Boom/Blast Noise. Conventional structures (i.e., residences, churches, schools) typically do not suffer extensive damage from sonic booms and blast noise from ground testing or training range activity. However, there have been very rare incidences where damage may occur to structures in poor condition.

A3.8.4.1. There have been several instances where military fighter jets flying supersonic have caused windows to break. The window is generally the weakest part of a conventional structure. Although there are a number of investigators have attempted to characterize the probability distribution of the pressure at which glass panes fail, there is a lack of consensus. For example, at 1 pound per square foot (psf), the probability of a window breaking ranges from one in a billion (Sutherland 1990) to one in a million (Hershey and Higgins 1976). These damage rates are associated with a combination of boom load and glass condition. For example, laboratory tests of glass (White 1972) have

shown that properly installed window glass will not break at overpressures below 10 psf, even when subjected to repeated booms. However, another study (Haber and Nakaki 1989) found that regular failures of good glass would occur with psf in the 4-10 range and above 10 psf from sonic booms from the same direction.

A3.8.4.2. After window breakage, the most common form of structural damage from vibration caused by sonic booms and artillery and tank main gun firing consists of cracks in interior wall/ceiling surfaces. A number of guidelines have been developed for the identification and quantification of damage due to these sources. The maximum safe predicted levels (U.S. Air Force 1990) for representative building materials on interior walls and ceilings are listed in Table A3.1. The maximum safe level has a 99.99 percent confidence that damage will not occur. In general, it requires overpressures of 10 psf or above for sonic booms artillery and tank main gun firing to cause structural damage to newer or structures in very good condition. Structural damage to structures that are older or in poor condition can occur at overpressures below 10 psf.

Table A3.1. Maximum Safe Predicted Levels for Representative Building Materials on Interior Walls and Ceilings.

Material	Peak Pressure (lbs per sq ft) for		Peak Sound Level (dBP) for	
	Minor Damage*	Major Damage**	Minor Damage*	Major Damage**
Plaster on wood lath	3.3	5.6	138.0	142.6
Plaster on Gyplath	7.5	16.0	145.1	151.7
Plaster on Expanded metal Lath	16.0	16.0	151.7	151.7
Plaster on Concrete Block	16.0	16.0	151.7	151.7
Gypsum Board (new)	16.0	16.0	151.7	151.7
Gypsum Board (old)	4.5	16.0	140.7	151.7
Nail Popping (new)	5.4	16.0	142.2	151.7
Bathroom Tile (old)	4.5	8.5	140.7	146.2
Damage Suspended Ceiling (new)	4.0	16.0	139.6	151.7
Stucco (new)	5.0	16.0	141.6	151.7

* Minor damage includes small (less than 3 inches) hairline crack extensions and pre-damaged paint chipping.
** Major damage includes falling plaster and tile.

A3.9. Effects of Noise on People.

A3.9.1. **Annoyance.** The concept of long-term annoyance is used to account for all negative aspects of noise, including activity interference, including speech interference and sleep disturbance, and is the basis for determining impacts due to aircraft noise associated with military and civilian airfields. The best available source of empirical dosage effect information for predicting community response to transportation noise is the updated Schultz

Curve (Air Force Curve). The Schultz curve was validated by the by the Federal Interagency Committee on Noise (FICON) in 1992 based on the additional data points collected by the Air Force, for use by Federal agencies in aircraft noise-related environmental impact analysis and by the American National Standards Institute (ANSI) as a standard on community responses to environmental noise.

A3.9.1.1. Since research studies to date have not produced a process to accurately attribute annoyance responses to acoustic and non-acoustic factors, it is not possible to accurately predict annoyance responses to aircraft noise exposure in any specific community (DNWG TB2009-1)). Percent Highly Annoyed (%HA) is not designed to be used to calculate an exact number of people in an ROI and therefore, annoyance is reported as the change in the percent of population expected to be highly annoyed (%HA). The metric DNL or DNLmr is used along with the Air Force Curve to determine the %HA.

A3.9.1.2. Correlation between CDNL and annoyance has been established, based on community reaction to impulsive sounds (Committee on Hearing, Bioacoustics and Biomechanics 1981). Table A3-2 shows the relation between annoyance, DNL, and CDNL.

Table A3.2. Relationship Between Annoyance, DNL and CDNL.

DNL	*% Highly Annoyed*	*CDNL*
35	0.20	32
40	0.41	37
45	0.83	42
50	1.66	46
55	3.31	51
60	6.48	56
65	12.29	60
70	22.10	65
75	36.47	69
80	53.74	74

A3.9.2. **Speech Interference**. Speech or interference with listening due to aircraft noise can occur in homes, classrooms and workplace and is a primary contributor to long term community annoyance. Frustration and irritation is often the result of aircraft noise disrupting routine activities such as listening to radio, television or music, talking on the phone or having a simple conversation. The quality of speech communication is important in the classroom due to potential adverse effects on children's learning ability. There are two aspects to speech comprehension: word intelligibility and sentence intelligibility. Word intelligibility is the more important of the two when it comes children's learning. Include a general discussion on speech interference as a contributor to annoyance in the environmental consequences section, with additional attention later in the document addressing the potential impacts of noise and speech interference on children's ability to learn. There is a more

detailed discussion on speech interference in classrooms in sections A3.9.5.1 through A3.9.5.2.

A3.9.3. **Sleep Disturbance.** When aircraft operations are to occur during environmental night (10 p.m. to 7 a.m.), the potential for sleep disturbance should be considered when housing areas are located within an area where the SEL could reach 90 dB. In 2009, DNWG endorsed the use of the July 2008 the ANSI Standard *ANSI S12.9-2008, Quantities and Procedures for Description and Measurement of Environmental Sound — Part 6: Methods for Estimation of Awakenings Associated with Outdoor Noise Events Heard in Homes***.** The ANSI S12.9-2008 methodology predicts sleep disturbance in terms of percent awakenings or numbers of people awakened associated with noise levels in terms of indoor A-weighted SEL. Sleep disturbance is based on an outdoor SEL of 90 dB, which corresponds to an indoor SEL approximately 25 dB lower (65 dB) with doors and windows closed and approximately 15 dB lower (75 dB) with doors or windows open (see DNWG 2009-4). The noise level reduction provided by buildings varies with the climate. The values of 15 dB and 25 dB are the ones typically used in the United States and are based on average residential construction techniques for the average United States climate (USEPA 1974). Instructions for preparing detailed analysis can be found in Appendix 1 of DNWG TB-2009-4.

A3.9.4. **Health Effects.** The discussion of human health effects associated with noise from military operations includes both auditory health effects and non-auditory health effects.

A3.9.4.1. Auditory Effects. The United States Environmental Protection Agency's *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With An Adequate Margin of Safety, (USEPA 1974)* established an 8 hour L_{eq} of 75 dB and a 24 hour $L_{eq.\ of}$ 70 dB at the ear exposure as levels that would produce a hearing loss of less than 5 dB at 4000 Hertz for 96 percent of the population over 40 years. The National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) identified 75 dB as the level at which hearing loss may occur (CHABA 1977).

A3.9.4.1.1. Noise-related hearing loss due to long-term exposure (many years) to continuous noise in the work place has been studied extensively, but there has been little research on the potential for noise induced hearing loss on members of the community from exposure from aircraft and weapon system noise. Unlike workplace noise, community exposure to military noise sources is not continuous, but consists of individual events where the sound level exceeds the background level for a limited time period. There is limited data on the effect of aircraft noise on hearing. The scientific community has concluded there is little likelihood that the noise exposure from aircraft noise from civilian airports could result in either a temporary or a permanent hearing loss (Newman and Beattie 1985). The EPA criterion (L_{eq24}=70 dB) can be exceeded in some areas (outside) near airports. Inside buildings, where people are likely to spend most of their time, the average noise level will be much less than 70 dB. Certain types of military aircraft (primarily fighter type aircraft) are in general much noisier that civilian aircraft, but the available data, while sometimes contradictory, appears to indicate a similar lack of significant effects of noise on hearing.

A3.9.4.1.2. There are only a few studies that look specifically at the impacts of military jet noise on noise-induced hearing loss. These included several studies looking at noise levels typically produced by low-flying aircraft along MTRs or within SUA/ASU, and one looked at whether children who grew up on Royal Air Force (RAF) bases in England had experienced noise induced hearing loss. The studies and their findings are summarized in the Defense Noise Working Group Technical Bulletin *"Noise-Induced Hearing Impairment*, (DNWG TB2013-2) located in the Noise Toolbox on the AFCEC/CPP SharePoint® website.

A3.9.4.1.3. According to the US EPA's Report 550/9-74-004, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, (USEPA 1974) and U S. Environmental Protection Agency (USEPA) Report No. 550/9-82-105, *Guidelines for Noise Impact Analysis* (USEPA 1982), populations exposed to noise greater than 80 dB DNL as being at the greatest risk of potential hearing loss. The 80 dB DNL contour is used to identify populations at the most risk of potential hearing loss. While this does not preclude populations at lower exposure levels from being at some degree of risk of hearing loss, the estimate will be restricted to populations within a DNL of 80 dB and higher, including residents of on-base housing. The exposure of DoD employees in the area already defined as the hazardous noise area are not be included in this analysis because they fall under the occupational noise regulations and are to be evaluated using the appropriate DoD component regulations for occupational noise exposure.

A3.9.4.1.4. For the purposes of predicting the potential for hearing loss (PHL) due to aircraft noise outside the workplace environment (i.e. off-base and in residential areas on base) in a NEPA document Potential for hearing loss (PHL) should be assessed using the methodology from the *US Guidelines for noise Impact Analysis* (USEPA 1982). This methodology quantifies hearing loss risk in terms of Noise-Induced Permanent Threshold Shift (NIPTS), a quantity that defines the permanent change in the threshold level below which a sound cannot be heard. Note that this is not the methodology used by OSHA or the DoD for hearing protection in the work place. DoD guidance for hearing conservation, audiogram monitoring and hearing protection is in DoDI 6055.12, *Hearing Conservation Program (HCP).*

A3.9.4.1.4.1. NIPTS is stated in terms of the average threshold shift at several frequencies that can be expected from daily exposure to noise over a normal working lifetime of 40 years, with exposure lasting 8 hours per day for 5 days per week. The EPA Guidelines includes two methods to quantify the impact, hearing-weighted population (HWP) and potential hearing loss (PHL). Because potential hearing loss is a more easily understood indicator, that is the indicator used to quantify the impact in DoD environmental analysis. DNWG TB2013-2 describes the procedure for calculating PHL. This calculation is not used in AICUZ studies as the land use compatibility guidelines states that people performing outdoor activities in the 80+ noise zone should be wearing hearing protection.

A3.9.4.1.4.2. The actual value of NIPTS for any given person depends on that individual's physical sensitivity to noise. Over a 40-year working lifetime, some people will experience more loss of hearing than others. The actual noise exposure for any person living in an area subject to 80 dB DNL or greater is

determined by the length of time that a person is outdoors and directly exposed to the noise. For example, noise exposure within an 80 dB DNL contour near an airfield would be affected by whether a person was at home during the daytime hours when most flying occurs. Many people would be inside their homes and therefore would be exposed to lower noise levels due to noise attenuation provided by the house structure.

A3.9.4.2. **Non-Auditory Health Effects**. Current research regarding the potential for non-auditory health effects should be acknowledged in NEPA documents. As noted in DNWG TB-2013-3, and The Airport Cooperative Research Project (ACRP) Synthesis Report #9, "*Effects of Aircraft Noise: Research Update on Selected Topics*" (ACRP 2008), and much of the current research concludes that is not yet possible to determine causal or consistent relationship between health disorders and aircraft noise exposure.

A3.9.5. **Aircraft Noise Effects and Children.** Discussions about the impact of aircraft noise on children generally include discussions related to children's learning and may include a discussion on physiological effects.

A3.9.5.1. Classroom Speech Interference. There have been a number of studies about the effects of noise (road traffic and aircraft noise) on learning. A major European Union study, the Ranch study, investigated the relationship between aircraft and road traffic noise exposure at schools and learning in multiple countries. The study found a linear relationship between exposures to aircraft noise and impaired reading comprehension, while road noise did not in this particular study effort. Although this study represents an improvement on previous studies due to the large number of participants and schools across several countries, the study did acknowledge that the study did have limitations. Speech interference due to noise can also impact a student's ability to comprehend lessons. In classrooms, speech communication between teacher and student is the primary activity sensitive to noise intrusion from aircraft. In order for students to understand unfamiliar words and concepts, it is essential for students to hear clearly every word spoken by the teacher. Children are not as familiar with language as adults and therefore may miss some of the verbal cues and redundancies, which aid adults in communication. For this reason, background noise levels should be lower for children to achieve the same level of speech comprehension as adults. Details on evaluating the potential for speech interference in classrooms can be found in DNWG TB2013-4 located in the Noise Toolbox on AFCEC/CPP's SharePoint® site: **https://afcec-portal.lackland.af.mil/cp/cpp/em/SitePages/Home.**

A3.9.5.2. Physiological Effects. There has been some limited investigation on the potential physiological and auditory effects of aircraft noise on children. A review of the literature found that studies 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. Some studies have shown that children who were chronically exposed to aircraft noise experienced increases in blood pressure, significant increases in stress hormones, and a decline in quality of life (Evans *et al.* 1998). Others studies have shown that children attending noisy schools had statistically significant higher average systolic and diastolic blood pressure ($p<0.03$) (Cohen *et al.* 1980). Studies investigating hormonal levels between groups of children exposed to aircraft noise compared to those in a control group demonstrated that were no

differences between the children exposed to aircraft-noise and the control groups (Haines *et al.* 2001b and 2001c). Other studies have reported hearing losses from exposure to aircraft noise (Chen *et al.* 1997, Chen and Chen 1993). The one study to look at noise induced hearing loss in children due to military aircraft noise is summarized in DNWG TB-2013-2. There is additional information on studies looking at noise induced hearing loss and children in paragraph A3.9.4.1.2.

A3.10. Noise Effects on Animals. Amphibians, reptiles, birds and mammals are the terrestrial wildlife species that are evaluated for impacts, with a focus on the species of greatest concern or interest. Among these are Special-Status Species, which are defined as: 1) federally listed animal species that are protected under the Endangered Species Act (Public Law 93-205); and 2) other special-status species, including state- listed species that are not federally listed, and other species of special concern identified by state and federal agencies. Game species may also be species of interest if hunting is a major economic activity or there are populations that hunt as their major source of food (e.g. subsistence lifestyle).

A3.10.1. The effects of aviation noise on animals (both wild and domesticated) have been studies extensively over the last 25 or so years, with much of the early work being conducted by Air Force sponsored researchers. The studies revealed that the effects are highly species dependent and the degree of the effect may vary widely. Responses of animals to aircraft noise vary from almost no reaction to virtually no tolerance of sound therefore it is difficult to generalize animal responses to military jet overflight and sonic boom noise disturbances or to draw inferences across species. Analysis of potential impacts to terrestrial species requires an investigation of available literature on the species in question, nature of the proposed action, and coordination with affected governmental agencies having jurisdiction and expertise in this area.

A3.10.2. Quantitative criteria for animal health have not been established by the Air Force. Determining whether the proposed action is compatible with a particular animal requires investigating available literature on the species in question and coordination with affected governmental agencies having jurisdiction and expertise in this area. The Air Force has conducted studies to determine the effects of military aircraft noise on many species; the results of those studies should be used to the extent practicable to define effects on animals. Whenever there is a potential to affect a special status species, consultation with either the USFWS or NMFS is required.

A3.10.3. The effects of noise from aircraft overflights are difficult to assess because a number of adaptive responses may be involved, making the overt behavioral or physiological changes in response to noise highly variable. These responses include the acoustic startle, the orienting response, and other species typical and individual strategies for coping with novelty, species-typical defensive behaviors, and responses conditioned by previous exposures to noise. In addition, 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).

A3.11. Effects on Cultural and Historic Resources. Cultural and historic sites include archaeological sites, structures and buildings, historic districts, and cultural landscapes protected under various laws and regulations. Potential impacts to cultural and historic resources from noise include audible intrusions affecting the setting of cultural and historic resources and

damage from noise-induced vibrations from sonic booms. Noise measurements for assessing noise impacts to historic sites include both A-weighted and C-weighted noise metrics such as DNL (or L_{dnmr}) for subsonic flight operations and CDNL for the sonic booms generated by supersonic flight operations.

A3.11.1. The standard DNL metrics can be supplemented with discussions on the from current activities and proposed conditions as well as the increases in the frequencies of overflights with noise measured in SEL (SEL_r) and the frequency of sonic booms are used to assess impacts associated with noise intrusions. Generally noise intrusions only apply to those situations where the historic setting or context is a character-defining feature of the significance of the site or where quiet is an essential component of a traditional cultural property.

A3.11.2. Historic sites include both archaeological sites that date to the period after European contact as well as buildings and structures. Noise generated by low altitude, high-speed aircraft does not affect archaeological sites or structures except under specific instances such as where the noise affects the historic or traditional setting or where sonic booms occur in areas with historic structures in poor condition.

A3.11.3. In general, prehistoric and historic archaeological sites lacking standing structures are generally ground surface or even subsurface deposits that would not be affected by noise induced vibrations or noise intrusions. Some prehistoric archaeological sites could contain natural structures such as rock shelters or caves, which may contain petroglyphs or pictographs etched or painted onto the rock surfaces. However, studies have found that these types of natural formations are not affected any more by noise vibrations form sources such as from sonic booms, than by natural erosion, wind, or seismic activity (Battis 1983). In situations where these sites are considered traditional use areas or sacred areas and are visited for ceremonies, then impacts due to noise intrusions may occur.

A3.11.4. Culturally sensitive areas and sites refer to traditional or sacred areas or other areas where setting and context is a critical part of the importance of the site or is a character defining feature of its eligibility for listing in the National Register of Historic Places (e.g., Little Bighorn Battlefield). For sites, districts, or landscapes where the historic setting is important, the introduction of a noise source not currently occurring in the area may have an adverse effect. Noise impacts to American Indian traditional cultural resources may be related to interference with ceremonies and other traditional activities at sacred sites. Undisturbed habitats, resources, and settings are considered to be critical to religious practices (NPS 1994). Potential impacts can be identified only through consultation with the affected groups.

A3.12. Socio-Economic Effects of Noise. Socioeconomic impacts are assessed in terms of direct effects on the local economy and population and related indirect effects on other socioeconomic resources within the ROI. Changes in noise due to a proposed action could also potentially affect property values. However, many factors (e.g., economic opportunities, ready access to the airport, and status of the neighborhood) affect property values. The majority of studies on property values and noise have looked at changes in property values in the vicinity of commercial airports not military installations. Existing property value studies should be reviewed to identify their limitations and assess whether there is a need for a study in the area around the base in question.

A3.13. Reducing the Noise Effects. Modifying the noise source, the path the noise travels, or the receiving location of the noise can reduce noise levels and associated effects. This section briefly reviews the options for reducing noise. More information on these strategies can be found in the Noise Toolbox on AFCEC/CPP's SharePoint® site: **https://afcec-portal.lackland.af.mil/cp/cpp/em/SitePages/Home.**

A3.13.1. Modifying the receiving location can require facility engineering solutions or relocating the people. Unlike the FAA's Part 150 program which is funded through passenger fees, the Air Force is funded through Congressional authorizations and appropriations and does not have the authority to spend appropriated funds to sound attenuate or modify buildings that the Air Force does not own or control. The Air Force can add sound attenuation to buildings on the base. The relocation of people in high noise zones is a last resort because of the cost and the disruption to people's lives and the community. The Air Force AICUZ program encourages communities to avoid locating future residential development in high noise zones; however, it is not designed to address situations in which changes to Air Force operations change the noise levels for areas that were previously compatible.

A3.13.2. Modifying the path that the noise travels is most applicable for ground based noise sources. Some examples of reduction strategies include the use of barriers, roadway configuration, the use of enclosures for point sources of noise, and attenuation through distance or acoustic site design. The only path modification that is appropriate for addressing aircraft noise is moving the flight tracks, or in some cases increasing the altitude, however increasing the altitude may have unintended consequences. While increasing the altitude of an aircraft may slightly decrease the noise level underneath the plane it may actually increase the area on the ground exposed to the aircraft noise. Never assume increased altitude will reduce the noise impact. Always consult with an acoustician or confirm through modeling the proposed operational changes before making any changes.

A3.13.3. The most common method for reducing noise is to modify the source because this is within Air Force control. There are two primary ways to reduce noise at the source: 1) technology changes such as design modifications, which actually reduces the "amount" of noise emanating from a source, e.g. quieter engines, new types of aircraft, and 2) changing how the aircraft or weapon system is used. The second method does not necessarily reduce the absolute level of noise generated by the aircraft or weapon system but can reduce the level of noise at a receiving location. Table A3.6 provides an overview of methods for reducing noise at the source that are within the Air Force's control.

A3.13.4. . Identification and implementation of noise reduction techniques that involve changing how aircraft and weapon systems are operated requires a comprehensive planning and evaluation, and involvement of the proponent of the action, pilots, airspace managers, testing and training personnel if necessary. Modifications should always consider and minimize any negative impacts to training or other mission activities. Additionally, when reducing noise by modifying the source or path, it is important to recognize that the proposed technique may result in the noise simply shifting from one area to another. Changes to flight operations can result in new impacts that will need analysis in the NEPA document, and the changes may result in a new alternative that needs to be fully evaluated.

A3.13.5. Mitigations based on changes to operations committed to in a Record of Decision, or are the basis of a Finding of No Significant Impact, a mitigation and monitoring plan is required. When the term monitoring is used in relationship to noise impacts analyzed in a NEPA document it is not referring to noise monitors or meters, it is referring to verifying that the whether the aircraft is being operated consistent with how the Air Force described and modeled its operations. For aircraft this type of monitoring involves verifying that the operations conducted once the action is implemented is consistent with the information used in the modeling to predict of noise levels. Validate flight tracks, flight profiles, and types of flight operations using the NMODD developed for the noise analysis in the NEPA document and checking it against how the aircraft are actually being operated to see if there are any differences. If there are, additional modeling may be necessary to determine whether the DNL levels are noticeably different (in the range of 3 dB DNL or more) than originally predicted. If this is the case, a supplemental NEPA analysis may be needed.

A3.13.6. The strategies used to reduce impacts to animals will depend on the type of animal and the environment in which it is found as well as the intensity and frequency of the noise. If there is a potential for noise to affect federally listed species, measures to reduce those the effects will be developed through consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service (NMFS). During consultations on reducing impacts to species of interest, minimizing impacts to the Air Force mission remains a priority. Mitigation of noise impacts on animals is typically be done through the creation of seasonal or temporal avoidances that minimize or eliminate noise during the breeding and/or nesting season; scheduling training and other noise-generating activities to minimize noise exposure during the most active time of day/night for a particular species of concern or during migration or wintering periods. Another method is to create physical avoidance areas or "bubbles" around areas where animals are known to live. This can typically be done by lateral offsets or increase in flight altitudes for aircraft.

A3.13.7. The strategies to reduce noise impacts to cultural or historic properties will depend on the type and location of the resource or type of property affected (i.e., structure, sacred sites, etc.). Noise (audible) intrusions and damage to historic properties are recognized as examples of adverse effects under the law that governs the Protection of Historic Properties (36 CFR 800.5(a)(2)). If the Air Force determines that noise generated by their activities has the potential to adversely affect historic properties, then consultation with the State Historic Preservation Officer and/or Tribal Historic Preservation Officer is required. During consultations on reducing impacts to cultural or historic properties, minimizing impacts to the Air Force mission remains a priority.

Table A3.3. Methods for Reducing Weapon System Noise.

Noise Source	*Methods to Reduce Noise Impacts*
Aircraft Maintenance	Locate high-power engine runs away from noise sensitive areas. Increase buffer areas. Maximize use of hush-houses and test cells. Limit engine runs between the hours of 10 p.m. (2200) and 7 a.m. (0700). Limit engine run times when atmospheric conditions will likely cause increase noise complaints.
Aircraft Flight Activity	Change flight paths to avoid noise sensitive areas. Designate a preferential runway during calm winds that minimizes overflight of noise sensitive areas. Create permanent, seasonal or event-related avoidance areas. Maximize use of reduced-thrust take-offs. Adjust altitude profiles. Minimize flights between the hours of 10 p.m. (2200) and 7 a.m. (0700). Build sound attenuation into new construction.
Supersonic Aircraft Activity (Sonic Booms) [Note that the sonic boom is formed in front of the aircraft]	Change flight patterns. Limit activity to higher altitudes. Avoid supersonic airspeeds when approaching or directly overflying noise sensitive and populated areas. Avoid sharp turns before structures and near towns. If a turn must be executed do so either after passing or at the very edge of any town.
Artillery and Bombs	Change the orientation of weapons release (bombs). Change locations of firing points (artillery). Increase buffer areas.(both) Minimize training between the hours of 10 p.m. (2200) and 7 a.m. (0700). (both) Limit training when atmospheric conditions will likely increase noise complaints. (both)

Attachment 4

THE ROLE OF COMMUNICATION AND COMPLAINT MANAGEMENT

A4.1. Public Outreach and Communication Open communication with the public about an installation's noise sources is a critical component of a successful noise program. By maintaining a dialog with the public through publications and electronic news media, the installation can help improve the public's understanding of the sound generated from military activities and what the installation is doing to minimize it. Often, when a community believes the installation is acting as a 'good neighbor,' the annoyance level of the public decreases which often means that complaints are reduced. These lines of communication also provide a mechanism for the pubic to educate the installation personnel about their noise concerns. It is important to understand that given the subjective nature of noise i.e. unwanted sound, that even the most robust communication strategies may not always change the public's opinion about the noise, however without any communications, the public's opinion may become more negative.

A4.1.1. Communicating with the Public. The installation PA typically takes the lead in these when it comes to communicating with the public, but other members of the installation staff maybe needed to assist in developing the messages and have a role in delivering these messages. It is vitally critical that all messages about noise generating activities be developed in coordination with the Installation Public Affairs (PA) Office(r) as detailed in Air Force Instruction (AFI) 35-101, *Public Affairs Policies and Procedures* and AFI 35-108, *Environmental Public Affairs*.

A4.1.2. Managing Public Expectations. People who live near military installations typically become familiar with routine military operations and sounds in their surrounding environment and have expectations as to what levels of noise they will hear and when they will hear it. A change to noise generating activities often creates uncertainty in people's minds and often results in an increase in inquiries or complaints. Notifying the public through press releases or other outreach methods in advance of any changes to normal operations (i.e., training exercises, air shows) resets the public's expectations (i.e. establishes a new "norm") of what they will hear and when. Experience has proven that advance notification typically minimizes the inquiries and complaints. This requires open communication across installation organizations to ensure all appropriate offices associated with the activities and with noise related responsibilities are working with the Public Affairs office.

A4.1.3. Tools. The use of brochures or fact sheets providing general background on the installation, its mission, major noise sources, and contact information can be helpful outreach tools. These brochures can be provided to a variety of stakeholders and can be an effective public awareness tool for local engagement activities, such as civic or local government meetings, news coverage, or base tours. Social media provides an additional communication tool. Examples of brochures and fact sheets and other communication tools are in the Noise Toolbox on AFCEC/CPP's SharePoint® site: **https://afcec-portal.lackland.af.mil/cp/cpp/em/SitePages/Home**.

A4.2. Education of Installation Personnel. Before engaging the public, installation personnel should ensure they understand local noise concerns and are ready to respond to them if necessary. Training of installation personnel should include information on communicating

about noise focusing on establishing trust and credibility with the public based on primary messaging that is open and honest and conveys empathy. Facts and figures such as Day-Night Average Sound Level (DNL) contours, noise levels of individual noise events (i.e., Maximum Sound Level (L_{max}) or Sound Exposure Level (SEL)), number of people exposed may be difficult for the general public to understand and should be considered as secondary messaging. AFCEC/CPP can provide noise focused specific risk communication training for talking to the public about noise.

A4.3. Handheld Sound Level Meters. Easy-to-use, publicly available technology such as low-cost sound level meters and sound meter application software developed for downloading onto any smart phone present an increasing challenge when members of the public begins to collect measurements and dispute documentation published by the Air Force.

A4.3.1. Handheld sound level meters are not designed to discriminate between sources of noise and often report results in metrics other than those being disputed (i.e., disputing a noise level present on a DNL contour map with a L_{max} reading). Note that DNL contours cannot be validated using handheld sound level meters. Installation personnel should be able to explain the difference between noise metrics used by the Air Force and measurements from the sound level meters.

A4.3.2. When the public raises an issue based on the use of handheld sound level meters, or if the complainant appears to be experienced in the acoustic environment, installation personnel should consult with personnel who have an in depth understanding of noise metrics and sound level meters for assistance. These include the installation Bioenvironmental Engineer, or AFCEC/CPP.

A4.4. Noise Inquiries and Complaints. Not all phone calls or emails about military noise are complaints. Many times people will call or email with an inquiry about a noise event (e,g, questions about an unusual noise event and what caused it). Complaints may be non-specific, and result when there is an accumulation of issues that have finally risen to a level that an individual feels they need to make their concerns known to the installation, or they may be about a specific noise event. There are typically two types of callers/writers: 1) those individuals that call routinely let the installation know that they are not happy with about the noise or other activities, and 2) those that call occasionally, typically when there have been changes to operations, or about a specific type of activity that is generating noise. It is important to distinguish between inquiries, and complaints and the type of callers/writers in order to take advantage of any information that the caller or writer may be able to provide.

A4.4.1. **Documenting Noise Inquiries and Complaints.** Documenting all noise inquiries and complaints makes it easier to inform the Commander of public concerns. It is important for the installation commander to be briefed on noise complaints and inquiries so responses can be prepared and possible mitigations explored and implemented if necessary. Many installations have a phone number or hotline dedicated to noise inquiries and complaints. Installation personnel should treat all callers with respect and integrity and assure the individual that a detailed log of their complaint is being recorded and will be reported to the installation commander. It may not always be possible to answer all calls in real time. Calls received but not answered directly by installation personnel (i.e., after hours) should be addressed within 24 hours. When documenting noise inquiries/complaints gather as much information from the caller about an event or issue as possible because it will make it easier

for installation staff to identify trends and patterns, see paragraph A4.4.2.4 for more information. Some bases have their own protocols for the information collected from callers, but for those that don't, Table A4.1 provides the minimum data that should be collected.

Table A4.1. Noise Inquiry and Complaint Log Information.

Identifying Information	**Questions to Ask Caller**
Name of Installation Personnel Recording Complaint:	1)How did the noise affect the caller (e.g., startled, interfered with conversation, interfered with ability to hear television or radio, vibrations)?
Date:	2)Was there any damage as a result of the event?
Caller Name, Address, Phone Number:	3)How many times did the disturbance occur and has it occurred in the past?
Location (physical address) of the caller and/or location at time of incident:	4)How long did the disturbance last?
Date and time the incident occurred:	5)Is there any other information about the noise disturbance?
Source of the Noise (e.g., aircraft, explosion, sonic boom, vehicle)	6)What were the weather conditions during the time of the incident (e.g., temperature, wind conditions, rainy or dry, hot, humid)?

A4.4.2. **Responding to Inquiries and Complaints.** The installation's public affairs office has the lead for handling these inquiries and complaints; however, input from other installation organizations is often required. No matter who is responding to the inquiries/complaints, the responses should be as consistent as possible. The installation and community relationship is based on the public's understanding that the Air Force takes all noise complaints seriously and works to adjust operations whenever possible as long as it doesn't create negative impacts on testing and training activities.

A4.4.2.1. After the noise inquiry or complaint is logged, the incident should be investigated with the appropriate Air Force agency. Wing Operations should review all complaints, and when appropriate, the responsible flight or range squadron notified and any deviations from standard procedures identified.

A4.4.2.2. In order to promote "good neighbor" practices, installation personnel may choose to meet with the complainant or invite them to visit the installation to improve community relations. Effective complaint management and response requires installation personnel to be courteous and interested in the complainant's noise concern. In some circumstances, there may already be accurate information concerning the noise event that has occurred; if so, installation personnel should provide a brief explanation to the complainant.

A4.4.2.3. Installation personnel should always follow-up with the complainant after the installation commander has reviewed the information and the responsible flight or range squadron has been contacted to determine the source of the noise. Personnel may provide supplementary information and an explanation of the noise event, if necessary. If changes were implemented because of the noise inquiry or complaint, installation PA should follow-up with the complainant to determine if the issue of concern has been resolved.

A4.4.3. **Identifying Patterns and Trends.** Data from noise inquiries or complaints provides for can be used to identify patterns/trends, problem areas, or planning future mitigation of noise concerns. The noise program manager should retain records a minimum of five years. Maintaining records over a period of years allows the installation to maintain accountability and monitor flight patterns and weapon system use which result in considerable public inquiry or complaints.

A4.4.3.1. By evaluating and understanding these patterns, installation personnel may be able to identify strategies to mitigate noise in areas in the surrounding community or sensitive locations. With the use of technologies such as GIS, the installation can map noise inquiries or complaints with existing noise contours that extend outside the installation and more easily relate location of complaints/inquiries and flight tracks (departures, arrivals, pattern work), and identify possible changes in flight operations that might mitigate the public concerns.

A4.4.3.2. Data from complaints can also be used to conduct additional analysis on the type flight operations to determine if the operational data used to create the existing noise contours should be re-evaluated to determine if a change in aircraft operations has occurred resulting in a large number of complaints.