VIRGINIA ARMY NATIONAL GUARD STATEWIDE OPERATIONAL NOISE MANAGEMENT PLAN

JULY 2005

Prepared By:
Operational Noise Program
Directorate of Environmental Health Engineering
U.S. Army Center for Health Promotion
And Preventive Medicine
5158 Blackhawk Road
Aberdeen Proving Ground
Maryland 21010-5403

This page left intentionally blank

EXECUTIVE SUMMARY

OVERVIEW

This Statewide Operational Noise Management Plan (SONMP) provides the Virginia Army National Guard (VaARNG) with a strategy for noise management. It is developed with guidance from the Department of Defense in response to the Noise Control Act of 1972, the Quite Communities Act of 1978, and the National Environmental Policy Act (NEPA) of 1969. Elements of this SONMP include discussions of noise and vibration, mitigation techniques, noise abatement procedures, encroachment/training issues, recommendations for working with local communities, and noise modeling

The SONMP provides a methodology for analyzing exposure to noise and safety hazards associated with military operations and presents land use guidelines for achieving compatibility between the Army and surrounding communities. The Army has an obligation to U.S. citizens to recommend uses of land around its installations which will (a) protect citizens from noise and other hazards and (b) protect the public's investment in these training facilities.

The noise impact on the community may be translated into noise zones and this SONMP defines and illustrates three noise zones and one buffer zone: Noise Zone I (NZ I) is compatible for most noise-sensitive land uses, Zone II (NZ II) is normally incompatible for noise-sensitive land uses, Zone III (NZ III) is incompatible for noise-sensitive land uses and the land use-planning buffer zone (LUPZ) consists of a portion of NZ I.

Maximum noise levels are also discussed in this report as there are areas that do not fall within a Zone II or Zone III noise contour, but still may at times be impacted by noise generated from training operations. While noise contours are useful as a planning tool, an occasional loud event can also cause an individual citizen to complain. For this reason, maximum noise levels, as well as noise zones, should be taken into consideration when creating land use plans and buffer zones, and also when dealing with individual complaints.

Additionally, this report also addresses the issues of aviation safety and accident potential zones (APZs).

CONCLUSIONS

The VaARNG supports a wide range of operations so it follows that issues regarding the noise generated are diverse. The following is a brief description of the findings for each major training area:

- Fort Pickett–Maneuver Training Center (FPMTC): Though training noise off of the Installation may be evident at times, it appears not to be at a level that is intolerable to the public. Fort Pickett receives very few noise complaints and has in the past made adjustments, were practical, to accommodate concerns of the community. The addition of Stryker training will increase the amount of noise that travels off of the

base, but not likely to a degree that will lead to a higher rate of complaints. Development pressures around the base are increasing slowly and should be monitored closely.

- Camp Pendleton State Military Reservation: Camp Pendleton's primary feature from a noise standpoint is the existing M-16 range. There is residential housing located very close to this range, but it generates few complaints as the small arms noise tends to pale in comparison to the aircraft noise from nearby Naval Air Station Oceana. Completing the proposed encapsulation of this range should eliminate any remaining noise issues and increase the acceptable hours of operation.

- Richmond International Airport (Byrd Field) Army Aviation Support Facility (AASF): The relatively infrequent noise generated by the AASF flights are indistinguishable from the overall noise environment created by the surrounding civilian airport operations.

The VaARNG will continue with its SONMP program to reduce the potential of incompatible land uses around its facilities, will distribute this plan to local governments, and work in tandem with local officials in an attempt to limit incompatible uses around the installation and thus limit lost training days.

RECOMMENDATIONS

The findings of this plan indicate that, as with most installations nationally, development pressures around VaARNG installations will continue to increase as is for the foreseeable future, albeit at a measured pace. Accordingly, the VaARNG and the surrounding local governments must communicate and coordinate efforts (when necessary) to ensure that development around the installations is compatible with the noise environment

It is recommended that this document be released to communities surrounding the VaARNG installations so that it may become part of the public record.

It is recommended that USACHPPM's "Noise Management–A Primer on Facilitating Community Involvement and Communicating with the Public" be reviewed. The primer can be downloaded at:

http://chppm-www.apgea.army.mil/dehe/morenoise/noisemanagementprimerpage.aspx

TABLE OF CONTENTS

SECTION **Page**

1 INTRODUCTION
1.1 General 1
1.1.1 History of Noise Management in the Army 1
1.1.2 The Threat to Military Installations 2
1.1.3 Contending with the Threat 3
1.1.4 Army's Statewide Operational Noise Management Plan 3
1.2 Purposes 4
1.3 Objectives 4
1.4 Content 4

2 NOISE MANAGEMENT
2.1 Introduction 5
2.2 Noise Complaint Management 5
2.2.1 Noise Complaint Management Program 5
2.2.2 Noise Complaint Procedures 7
2.3 Training Activities with Noise Generating Potential 9
2.4 Noise Assessment 9
2.4.1 Noise Zones 10
2.4.2 Land Use Guidelines 11
2.4.3 Impulse Weapons (Weapons >20MM) 11
2.4.4 Small Arms Range Noise (Weapons <20MM) 15
2.4.5 Simulated Weapons Noise 16
2.4.6 Aircraft Noise 16
2.5 Aviation Safety 17
2.5.1 Mitigation of Safety Hazards 18
2.6 Noise Mitigation 19
2.6.1 Role of Personal and Situational Variables in Understanding Noise Annoyance 21
2.6.2 Other Considerations 22
2.7 Summary 23

3 FORT PICKETT
3.1 Location of Fort Pickett 25
3.2 History of Fort Pickett 25
3.3 Civilian Community 27
3.4 Fort Pickett Mission and Training 28
3.4.1 Fort Pickett Use 33
3.4.2 Future Training at Fort Pickett 33
3.5 Noise Environment 34
3.5.1 Large Arms Ranges and Demolitions 34
3.5.2 Peak Levels Blast Noise Contours 37

SECTION **Page**

3.5.3 Small Arms Ranges 40
3.5.4 Aircraft Training 40
3.5.3.1 Aircraft Training Noise Specifics 42
3.6 Zoning around Fort Pickett 42
3.7 Summary 45

4 CAMP PENDLETON STATE MILITARY RESERVATION
4.1 Camp Pendleton State Military Reservation (SMR) Location 47
4.2 History 47
4.3 Civilian Community 47
4.4 Camp Pendleton SMR Mission and Training 49
4.5 Noise Environment 49
4.5.1 Small Arms Noise Zones 49
4.5.2 Aircraft Training 54
4.5.3 Vehicle Noise 54
4.6 Summary 54

5 RICHMOND INTERNATIONAL AIRPORT (BRYD FIELD) ARMY AVIATION SUPPORT FACILITY (AASF)
5.1 Location 55
5.2 History 55
5.3 Civilian Community 55
5.4 Richmond AASF Mission and Training 57
5.5 Noise Environment 59
5.6 Summary 59

6 FEDERAL, STATE, AND LOCAL LAND USE POLICY AND CONTROL
6.1 General 60
6.2 Federal 60
6.3 State 60
6.4 Local 60
6.5 Land Use Planning Determinants 60
6.6 Land Use Compatibility 61
6.6.1 The Joint Land Use Study (JLUS) 62
6.7 Environmental Justice 62
6.8 Summary 63

APPENDICES **Page**

A DESCRIPTION OF THE NOISE ENVIRONMENT, NOISE EVALUATORS, AND NOISE CONTOURING PROCEDURES
A.1 Introduction 65
A.2 History of Noise Evaluators 66

APPENDICES **Page**

A.3 LEQ/DNL Noise Evaluators 67
A.4 Noise Contours 68
A.4.1 Impulsive Noise 68
A.4.2 Aircraft Noise 68
A.4.3 Small Arms Noise 69
A.4.4 Single Events 69
A.5 Conclusion 70

B NOISE CONTOUR OPERATIONAL DATA
B.1 Introduction 71
B.2 Fort Pickett Large Arms/Demolition Data 71
B.3 Camp Pendleton/SMR Small Arms Data 75

C GUIDELINES FOR COMPATIBLE USE
C.1 DoD Compatible Land Use Guidelines for Clear Zones and Accident Potential Zones 77
C.2 Guidelines for Considering Noise in Land Use Planning and Control 81

D GLOSSARY OF TERMS, ACRONYMS, AND ABREVIATIONS
D.1 Glossary of Terms 87
D.2 Glossary of Acronyms and Abbreviations 92

E REFERENCES AND SOURCES 97

FIGURES **Page**

2-1 VaARNG Noise Complaint Form 8
3-1 Fort Pickett Location and Vicinity 26
3-2 Direct Fire Ranges at Fort Pickett 30
3-3 Indirect Fire Ranges at Fort Pickett 31
3-4 Fort Pickett's Training and Maneuver Areas 32
3-5 Fort Pickett C-Weighted Day-Night Level Contours 36
3-6 Fort Pickett Peak Decibel Level Contours 38
3-7 Fort Pickett Peak Decibel Contours with Stryker Training 39
3-8 Blackstone Army Airfield/Allen C. Perkinson Municipal Airport Vicinity 41
3-9 Fort Pickett Adjacent Zoning 44
4-1 Camp Pendleton SMR Location 48
4-2 Camp Pendleton SMR Existing Small Arms Range 50
4-3 Camp Pendleton SMR Existing Small Arms Range Tower 50
4-4 Camp Pendleton Existing Small Arms Range Backstop and Berm 51
4-5 Camp Pendleton SMR Small Arms Peak Contours 53
5-1 VaARNG Army Aviation Support Facility Vicinity Map 56
5-2 Example of a UH-60 Black Hawk Helicopter 58
5-3 Example of an OH-58 Kiowa Warrior Helicopter 58

TABLES **Page**

2-1 Land Use Planning Guidelines 11
2-2 Impulse Noise Guidelines 12
2-3 Predicted Levels for 120 mm Tank Gun Firing 13
2-4 Predicted Levels for 155 mm Howitzer Firing 13
2-5 Predicted Levels for 155 mm Howitzer Round Detonation 13
2-6 University of Utah Criteria for "Good" and "Bad" Firing Conditions 14
2-7 Percentage of Population Highly Annoyed by Small Arms Range Noise 15
2-8 Predicted L_{Amaxf} for M-16 (5.56 mm) Rifle 17
2-9 Predicted L_{Amaxf} for M2 (.50-CAL) Machine Gun 17
2-10 Maximum Sound Levels of Aircraft By Slant Distance 20
2-11 Percentage of Population Highly Annoyed by Particular Levels of Aircraft Noise 20
3-1 Population Surrounding Fort Pickett 27
3-2 Existing Ranges at Fort Pickett-MTC 28
3-3 Fort Pickett's Drop Zones and Their Training Capabilities 33
3-4 Fort Pickett Baseline Annual Data for Blast Noise Contours 35
3-5 Fort Pickett Baseline Annual Data for Small Arms Contours 40
3-6 Aircraft SEL Values at Fort Pickett 43
4-1 Population Surrounding Camp Pendleton SMR 49
4-2 Camp Pendleton SMR Predicted Peak Decibels for M-16 Live Fire 50
5-1 Population Surrounding the VaARNG Army Aviation Support Facility at Richmond International Airport…… 57
B-1 Data Used to Create Fort Pickett Annual BNOISE Contours 70
B-2 Data Used to Calculate Future BNOISE Contours with the Addition of Stryker Training 74
B-3 Data Used to Calculate Fort Pickett's Peak BNOISE Contours 74
B-4 Data Used to Calculate for Pickett's Future Peak BNOISE Contours with the Addition of Stryker Training 75

SECTION ONE

INTRODUCTION

1.1 GENERAL

One of the goals of the Department of the Army (DA) is to plan, initiate, and carry out actions and programs designed to minimize the Army's adverse impacts upon the quality of the human environment without impairing continued success in the Army's mission. In keeping with this goal, the Army established an Operational Noise Management Program as the framework for the control of noise produced by Army activities since noise has been determined by the United States Congress, as recorded in the Noise Control Act of 1972, to "present a danger to the health and welfare of this Nation's population" (PL 92-574 1972). The primary tool for noise management is the Statewide Operational Noise Management Plan (SONMP).

Note: The Statewide Operational Noise Management Plan (SONMP) was referred to as the **Environmental** Noise Management Plan (**E**NMP) until 2004 when the name was changed in order to better describe the nature of the plan.

1.1.1 HISTORY OF NOISE MANAGEMENT IN THE ARMY

The advent of jet aircraft in the 1950's resulted in significantly greater noise levels around commercial airports that led to an intense outcry from the public. This backlash caused Congress to revise the Federal Aid to Airports Act to make Federal aid contingent upon implementation of programs to resolve noise problems with surrounding neighborhoods. Subsequently, Congress passed the Noise Control Act of 1972 and the Quiet Communities Act of 1978. Under these laws, airports carried out noise control measures such as outright purchase of adjoining land; work with local communities to ensure zoning which would permit only compatible uses; development of procedures to include noise information in the consumer disclosure documents provided when real estate is sold; altering run-up procedures and locations; and changing approach and takeoff patterns. At the present time, the Federal Aviation Administration (FAA) has specific requirements for community involvement in all airport planning and accomplishes noise planning through a regulation known as Part 150.

The Federal Aid to Airports Act exempted military aircraft, as did portions of the Noise Control Act of 1972. However, the Noise Control Act and the Quiet Communities Act did contain language outlining the responsibilities of Federal agencies in protecting the public from unreasonable noise impacts. Specifically these laws state that:

> *"Federal agencies shall, to the fullest extent consistent with their authority under federal laws administered by them, carry out the programs within their control in such a manner as to .... promote an environment for all Americans free from noise that jeopardizes their health and welfare."*

To comply with the intent of Congress, the Department of Defense (DoD) provided guidance to the military departments regarding the compatible use of public and private lands in the vicinity of military airfields. The DoD guidance (DODI 1977):

- Defined restrictions on the uses and heights of natural and man-made objects in the vicinity of air installations

- Defined restrictions on land use in the vicinity of air installations to assure compatibility with the characteristics, including noise of military operations

- Provided policy as to the extent of the U.S. Government's interest in retaining or acquiring real property to protect the operational capability of active military airfields

As a matter of general policy, the military departments were instructed to work toward achieving compatibility between air installations and the neighboring civilian communities through a compatible land use planning and control process conducted by the local civilian community.

Based upon the DoD guidance, the DA developed its Operational Noise Management Program (ONMP) that considers noise from all sources of military activities, not just military airfields. The Army's program is designed to (U.S. Army 1997):

- Control environmental noise to protect the health and welfare of military personnel and their dependents, Army civilian employees, and members of the public on lands adjacent to Army, Army Reserve, and Army National Guard installations.

- Reduce community annoyance from environmental noise, to the extent feasible, consistent with Army, Army Reserve, and Army National Guard training and materiel testing activities.

1.1.2 THE THREAT TO MILITARY INSTALLATIONS

It is an established fact that military installations tend to attract activity from the civilian sector. Sizeable new communities often grow near an installation or existing communities may expand toward or around an installation's boundaries. This growth process can place severe limitations upon the ability of a military installation to support training and for assigned units to maintain an adequate level of readiness. Herein lies the threat: as noise impacts from military activities increase upon the civilian communities, both litigation and/or political pressures which could result in degradation of the installation's mission also increase. Not only does the number of complaints to installation commanders increase dramatically, but so does the number of complaints to members of Congress.

As the consequence of adverse public reaction to military operations, some military installations have closed and others have had limitations placed upon the conduct of operations.

One of the best examples of the degradation of mission performance due to encroachment occurred at the Naval Air Station (NAS) in Los Alamitos, CA. When originally established during World War II, this NAS was in a rural area. With the postwar expansion of southern California, NAS Los

Alamitos was eventually surrounded with homes and the Navy could no longer routinely fly jet aircraft into this property. Today, the airfield serves the needs of the California Army National Guard (ARNG) and the U.S. Army Reserve which, compared to the Navy, operates relatively few noisy flights. Although in the past, the Navy's noise issues have generally involved aircraft, a highly politicized controversy over the noise and pollution of gunfire on Vieques Island (Puerto Rico) threatened Navy readiness in late 1999. This controversy ultimately led to the Navy's complete with drawl from that island.

In the Army's case, as an example, the size of the explosives which were used in Combat Engineer field training at Fort Belvoir, VA, was so severely restricted by encroachment that it became necessary to move a portion of the training to a less urbanized area at Fort A.P. Hill, VA. Eventually that entire engineer training school was forced to move to Fort Leonard Wood, MO. In another case, limitations were placed upon the types of weapons which could be fired at Fort Dix, NJ, as well as the times the weapons could be fired. In both of these cases, the limitations upon operational activities degraded the installations' capability to support essential training and the training missions of these installations were moved to other installations. A study published by the Army Environmental Policy Institute found that noise was the second most important threat (behind endangered species) to Army Range Operations (AEPI, 1999)

1.1.3 CONTENDING WITH THE THREAT

The consequences of ignoring the conflicts between the noise generated on military installations and the desires of the civilian community regarding use of the land surrounding these installations can be grave. If the military fails to respond to the concerns of the civilian community, the ill will produced by such an approach is quite likely to result in a general unwillingness within the civilian community to work with the military to regulate land use. The community ill will can also result in political pressure or lawsuits that force unilateral concessions on the part of the military without any reciprocal concessions from the community.

In order to prevent the conflicts between military operations and civilian land use from reaching significant proportions, it is necessary for the Army to work with the local communities to prevent incompatible land use from occurring and to take reasonable steps on the installation to protect the community from noise. Since the regulation of land use on adjoining land is the authority of local communities, the military cannot solve these problems unilaterally. Rather, the military must work with local communities to establish the controls that will prevent noise problems from growing even larger.

1.1.4 ARMY'S STATEWIDE OPERATIONAL NOISE MANAGEMENT PLAN (SONMP)

The primary strategies for protecting the mission of military installations from the problems of noise incompatibility are community supported long-range land use planning for adjacent lands and being a responsible neighbor to our surrounding communities. The Statewide Operational Noise Management Plan (SONMP) addresses these issues in a proactive manner. The SONMP assesses, through the use of computer-generated noise contour maps, the compatibility of the noise environment with the land uses.

Other elements of the SONMP include education of the military and civilian community, management of noise complaints, mitigation of the noise and vibration, the "Fly Neighborly" program, and noise abatement procedures. The goal is to be a responsible neighbor to the communities surrounding military installations.

1.2 PURPOSES

The SONMP has two purposes: 1) to serve as a mission guide for the VaARNG Operational Noise Management Program, and 2) to serve as a reference document on noise for both installation personnel and regional land use planners. The plan provides the necessary information to allow regional land use planners to make responsible decisions regarding requested changes in zoning classification for noise impacted lands. More specifically, the SONMP is a compendium of information regarding noise propagation, effects on people, public affairs measures that can mitigate noise impacts on the surrounding population, and land use compatibility associated with Guard training noise. Also, suggested methods for working with the public are included in this plan.

The SONMP will be distributed to regional land use planners and, while not intended for wholesale distribution to private citizens and landowners, will also be made available to interested individuals.

1.3 OBJECTIVES

The objectives of the SONMP are to:

- Educate the military and civilian communities and improve communication between the two
- Instruct on the management of noise complaints to reduce the potential for conflict between VaARNG installations and the surrounding communities
- Assess the compatibility of the noise environment with the existing and proposed land uses
- Assist in the mitigation of the noise and vibration environments, where feasible, to increase land use compatibility
- Promote the use of noise abatement procedures

1.4 CONTENT

This report consists of a discussion and analysis of the VaARNG, the surrounding communities, and the relationships between them. Furthermore, the report describes the legal basis for Federal, State, and local noise management in Virginia, and presents the SONMP concept, policies, and methodologies as well as a specific description of the VaARNG's noise. Lastly, the report lists the responsibilities of the Army and the communities, provides recommendations for both the Army and the communities, and provides a generic discussion of community involvement for the benefit of VaARNG installation planners.

SECTION TWO

NOISE MANAGEMENT

2.1 INTRODUCTION

At many installations, the land use around the facility is not compatible with the noise environment; at others, there is the potential for future incompatible development. To reduce the potential for conflict between the installation and surrounding communities, the Army developed SONMP. In addition to a noise assessment, the plan includes education of both installation personnel and surrounding residents, management of noise complaints, mitigation of the noise and vibration, and noise abatement procedures.

The principal source of noise at VaARNG sites is the live firing of small and large caliber weapons. Noise also results from the following: tracked vehicle training, rotary-wing and fixed-wing aircraft, demolitions, and daily operations at the installation.

An important element of the SONMP is education. This includes the education of both the noise producers and the noise receivers. The noise producers must be aware of all VaARNG policies and regulations dealing with environmental noise. These include the locations of no-fly areas, noise-sensitive areas, and range safety procedures. The education of the noise producers will include the potential for adverse consequences to the VaARNG's ability to perform and maintain its mission due to violations of the policies and regulations.

2.2 NOISE COMPLAINT MANAGEMENT

The purpose of the Noise Complaint Management Program is to educate persons lodging noise complaints so that they are aware that the VaARNG cares about their concerns. In most cases, the courteous and honest treatment of the complainant will reduce the formation of community action groups and lower the potential for future calls and letters to local, state and federal government officials.

2.2.1 NOISE COMPLAINT MANAGEMENT PROGRAM

The two keys to a successful complaint management program are ***integrity*** and ***sensitivity***.

The program must have integrity so that when installation officials tell the community something, the community will believe and trust them; once the installation tells the community something, they consider the information as policy. For example, if the installation tells the public that no explosive charges will be detonated before 9:00 a.m. then this must be strictly adhered to for the credibility of the installation, Army, and entire government is at stake. If it is necessary to change this procedure, then the installation should explain to the community why the procedure is being altered **before the change takes place.**

The program must also be sensitive to the community's concerns. Empathizing with the public's concerns creates and environment where information is exchanged more freely, ideas come forth more fluidly, and parties are more likely to make concessions in order to solve problems.

A successful noise complaint management program will assist the installation in avoiding community action against its activities. Like the other elements of the SONMP, these procedures must be proactive to effectively reduce the potential of noise complaints. The following are the tools used to successfully attack the problem of noise complaints:

Listen

The installation should listen to the community and find out what is annoying them. Sometimes there is a trouble-free solution to the problem once the cause of the concern is discovered. The installation also needs to be responsive to the community by providing information such as the reason the VaARNG must perform a particular operation. It must always be remembered that the public's ***perception*** of the installation is their ***reality***.

Inform

How does an installation keep the public informed? By providing the news media with press releases when unusual operations are scheduled or when normal operations are scheduled to resume after a period of inactivity. The press release should include a telephone number that the community can use to receive additional information or complain about the noise. And for their part, the news media must be monitored to make sure the information is indeed being released to the community in a timely manner.

Respond

The installation should also respond to all complaints in a timely and polite fashion to help lower the intensity of the situation. When the public is aware that each complaint is responded to quickly and courteously the potential of the complainants organizing into citizen action groups (that complain to higher levels of command and government) is reduced.

Again, one of the installation's primary goals is to maintain control of noise complaints so that they do not become political issues. When the situation becomes political, the installation's mission can be impaired by unnecessary operational restrictions and resources spent reacting to political pressures, both local and congressional.

2.2.2 NOISE COMPLAINT PROCEDURES

A noise complaint procedure is required by Army Regulation (AR) 200-1 (U.S. Army Feb 1997) to log and investigate all complaints. But an effective procedure also enables the VaARNG to maintain a good relationship with the surrounding communities. The National Guard Bureau (NGB) Document, Public Affairs Guidance on the National Guard Bureau Environmental Program, advises how noise complaints should be handled. This guidance states that, as a minimum, states should:

(1) Maintain a log of all noise complaints.

(2) Investigate complaints without delay.

(3) Ensure the complainant is aware of the installation's mission and that every effort will be made to correct the problem, mission permitting.

(4) Route complainants to the office responsible for the type of activity that resulted in the noise complaint. The Public Affairs Office (PAO) will require a response for the purpose of providing information to the complainant.

(5) Complete a follow-up by identifying the cause of the noise and any action taken to correct the deficiency. A copy of the follow-up will be provided to the Noise Committee.

The VaARNG follows the guidance of the NGB and has designated the state-wide PAO as the official Noise Complaint Point of Contact (POC). The VaARNG as a whole gets few complaints, though, and just about all of them go directly to Range Control at Fort Pickett where they are usually handled directly. However, if necessary, the PAO then investigates by contacting the noise producing proponent (Fort Pickett, SMR/Pendleton, etc.) and the results of the investigation are then reported back to the complainant. Figure 2.1 shows the VaARNG complaint form.

A noise complaint phone number for noise complaints will be established and published periodically in the local news media. This phone number will be included in all press releases announcing training exercises at the facility. During non-duty hours, the Staff Duty Officer (SDO) will receive the call, take caller information, and tell the caller that they will be called back during regular duty hours.

A general outline of the complaint procedure is as follows:

1) Complaints are received by the POC (PAO, Range Control, or AASF). The POC fills out the noise complaint questionnaire. If follow-up is needed, the POC informs the caller that complaint will be investigated and they will be contacted when the investigation is completed.

2) POC forwards complaint to Proponent (noise producer).

3) Proponent conducts investigation, determines cause and corrects activities as appropriate and sends results back to noise POC.
4) POC calls complainant and informs them of results, then forwards final report to Environmental Office.

5) Environmental Office maintains log of all complaints. If damage is claimed, complainant is referred to JAG claims office.

XXXX National Guard
Environmental Noise Management Program
Complaint Investigation Report Form

Complainant: _____ Date: _____
Address: _____
Phone (home): _____ (work): _____

Reason for Complaint: _____
_____
_____
History of Problem: _____
_____
_____
Damage Claimed: Yes No _____

Is this the first time you have been annoyed by this noise: Yes No _____

Investigation/Coordination
Training Site or Facility: _____Unit: _____
Weather Conditions: _____
Results of Investigation: _____
_____
_____
_____
Action to Correct or Alleviate Noise Problem: _____
_____
_____
_____
Additional Information: _____
_____
_____
_____

Response to Complainant: _____
_____
Complainant Satisfied: Yes No _____
_____

Follow Up: _____
_____

Received By: _____Time: _____

Remarks: _____
_____

FIGURE 2-1 VaARNG Noise Complaint Form

2.3 TRAINING ACTIVITIES WITH NOISE GENERATING POTENTIAL

VaARNG training sites and Army Aviation Support Facilities (AASFs) will notify the Public Affairs Office (PAO) when unusual training that has the potential to impact neighbors is scheduled. The PAO can then determine the best means to disseminate this information to the public and use the Office's expertise to ensure that enough information is given out to notify neighbors about potential noise effects, while at the same time ensuring that there are no security risks posed by the information released.

Informing the PAO about upcoming training will also give the PAO the needed information to respond to people if they do call during the exercise with a complaint or inquiry.

2.4 NOISE ASSESSMENT

The Army Operational Noise Management Program (ONMP) provides a method for evaluating the effect of noise and the hazards associated with training operations that stem from activities at military installations. The purpose of the program is to identify land areas that are exposed to generally unacceptable noise levels. This information is then used to recommend uses for the land lying within these areas that are compatible with the needs of the civilian community and the Army.

Army installation commanders establish and maintain active programs to achieve the maximum feasible compatibility between the noise environment and noise-sensitive land uses, both off and on the installation. The program requires that all appropriate governmental bodies and citizens be fully informed whenever ONMP or other planning matters affecting the installation are under consideration. This includes a positive and continuous effort designed to:

- Provide information, criteria, and guidelines to federal, state, regional, and local planning bodies, civic associations, and similar groups.
- Inform such groups of the requirements of the operational activity and noise exposure.
- Describe the noise reduction measures which are being, or could be, used.
- Ensure that all reasonable, economical, and practical measures are taken to reduce or control the impact of noise-producing or hazardous activities so as to minimize the exposure of populated areas. This must be done without jeopardizing the safety or effectiveness of military operations.

The ONMP considers the land areas, with noise-sensitive land uses, that are exposed to generally unacceptable noise levels. There are three noise zones, Noise Zones III (NZ III), II (NZ II) and I (NZ I). The zones are developed using computer models. The operational data used as input to these computer models is shown in Appendix B. Noise-sensitive land uses include, but are not limited to, residences, schools, medical facilities, and churches.

2.4.1 NOISE ZONES

Regarding noise, the SONMP is partitioned into three sub-zones based on what noise-sensitive land uses should be permitted given the common noise levels found there. As particular land uses like schools, residences, medical facilities, and churches are more sensitive to noise than other more industrial uses, the Noise Zones factor in variables (such as use and building construction) to create these lists of compatible uses for each sub-zone.

The noise sub-zones are labeled with Roman numerals as Noise Zone I (NZ I), II (NZ II), and III (NZ III) and are projected using computer models (for detailed information please see Appendix A).

The extent of the noise emanating from VaARNG weapons firing, aircraft and other military activities at specific sites will be depicted graphically later in this section. Note: During the examination of the environmental noise attributable to Guard operations, the day-night level (DNL) will always refer to the C-weighted DNL (CDNL) to describe large caliber weapon firing or blast noise and to A-weighted DNL (ADNL) to describe small arms weapons firing, aircraft, vehicle, etc. A more detailed description of the noise environment and the methodology used in noise evaluation is provided in the Appendices.

Noise Zone I (NZ I)

NZ I include all areas around a noise source in which the day-night sound level (DNL) is less than 65 dBA (A-weighted for aircraft, vehicle, small arms range, etc.) or less than 62 dBC (C-weighted for weapons systems larger than 20mm). This area is usually suitable for all types of land use activities and is generally located furthest away from the noise source. NZ I includes all areas which are outside of the NZ II and NZ III contours.

Noise Zone II (NZ II)

NZ II consists of an area where the DNL is between 65 and 75 dBA or between 62 and 70 dBC. Exposure to noise within this area is considered significant and use of land within NZ II should normally be limited to activities such as industrial, manufacturing, transportation and resource production. However, if the community determines that land in NZ II areas must be used for residential purposes, then noise level reduction (NLR) features should be incorporated into the design and construction of the buildings. Details of NLR features are included in Appendices B and C.

Noise Zone III (NZ III)

NZ III consists of the area around the source of the noise in which the DNL is greater than 75 dBA or greater than 70 dBC. The noise level within NZ III is considered so severe that noise-sensitive land uses should not be considered therein.

2.4.2 LAND USE GUIDELINES

The Federal Interagency Committee on Urban Noise (FICUN) (FICUN 1980) has developed land use guidelines for areas on and/or near noise producing activities, such as highways, airports, and firing ranges. The Operational Noise Management Program (ONMP) uses these guidelines. By projecting these zones onto an area map, land use guidelines can be used to help planners develop compatible land uses (Appendix C). Table 2-1 summarizes the noise zones used in the land use planning guidelines.

Noise Zone	Percent Population Highly Annoyed	Noise Limit Transportation and Small Arms ADNL in A-weighted dB	Noise Limit Impulsive CDNL in C-weighted dB
Land Use Planning Zone (LUPZ)	9 – 15	60 - 65	57 - 62
Zone I	<15	<65	<62
Zone II	15 – 39	65 - 75	62 - 70
Zone III	>39	>75	>70

Table 2-1 Land Use Planning Guidelines

2.4.3 IMPULSE NOISE (WEAPONS > 20MM)

There are times when noise complaints are received from outside of the noise zones. The noise zones are an annual average noise exposure and are useful for planning purposes, but an infrequent loud event can lead to complaints even if the average noise levels are “compatible”. Therefore, it is useful to also look at individual peak noise levels when evaluating the impact of infrequent loud events.

When contemplating noise limit criteria for impulse noise, one finds very little objective guidance available. Factors to be considered include the possibilities of structural damage to buildings and physiological damage to humans, and the likelihood of receiving noise complaints.

Studies (Siskind, 1989) have shown that homeowners become concerned about structural rattling and possible damage when the level exceeds 120 decibels peak (dBP). It appears that the first structural damage to occur as impulse sound intensity increases is window breakage and threshold to crack a poorly mounted window pane is approximately 150 dBP. The threshold for actual physiological damage is, on the other hand, approximately 140 dBP. The threshold for annoyance, while lower than 140 dBP, varies greatly among individuals.

To evaluate the complaint potential from impulsive noise, USACHPPM uses a set of guidelines (Pater, 1976) developed by the Naval Surface Warfare Center in Dalhgren, Virginia. These guidelines for delaying tests at Dahlgren (shown in table 2-2) are based on over 10 years of experience using meteorological forecasts. These levels resulted from the best compromise between cost, efficiency of range operations, and good community relations.

For comparison, the ranges of noise levels expected from detonating a 155 mm high explosive round and the firing of the 120 mm tank gun (U.S. Army 1986a) are listed in Tables 2-3 through 2-5. In these tables, the degrees at the top of the columns show the azimuth in reference to the direction of the gun. An azimuth of 180 degrees means that the listener is behind the gun, and an azimuth of 90 degrees meant that the listener is to the side of the gun. The standard deviation refers to variability around the "normal curve." For example, at one kilometer behind the 120 mm tank, the expected level is 126.8 dBP—half of the measurements would be above and half below 126.8 dBP, and 84% would be expected to be within 5 dBP. In other words, 84% of the firings would fall within the range of 121.8 to 131.8 dBP.

Predicted Peak Sound Level (dBP)	**Risk of Complaints**	**Action**
<115	Low risk of complaints	Fire all programs
115-130	Moderate risk of complaints	Fire important tests; postpone non-critical tests, if feasible
130-140	High risk of noise complaints, possibility of damage	Fire only extremely important tests
>140	Threshold for permanent physiological damage to unprotected human ears; high risk of physiological and structural damage claims	Postpone all explosive operations
Note: For rapid fire test programs and/or programs that involve many repetitions of impulse noise, reduce allowed sound levels by 15 dBP.		

Table 2-2 Impulse Noise Guidelines

Distance (meters)	Predicted Level (dBP)					Standard Deviation (dB)
	0°	45°	90°	135°	180°	
500	143.2	143.1	142.4	138.8	137.8	±5.0
1,000	132.2	132.1	131.4	127.8	126.8	±5.0
2,000	121.2	121.1	120.4	116.8	115.8	±5.9
3,000	114.8	114.7	114.0	110.4	109.4	±6.5
4,000	110.2	110.1	109.4	105.8	104.8	±6.9
5,000	106.7	106.6	105.9	102.3	101.3	±7.2

Table 2-3 Predicted Levels for 120 mm Tank Gun Firing

Distance (meters)	Predicted Level (dBP)					Standard Deviation (dB)
	0°	45°	90°	135°	180°	
500	141	137.4	135.9	128.4	127.0	±5.0
1,000	130.1	126.5	125.0	117.5	116.1	±5.0
2,000	119.1	115.5	114.0	106.5	105.1	±5.9
3,000	112.6	109.0	107.5	100.0	98.6	±6.5
4,000	108.1	104.5	103.0	95.5	94.1	±6.9
5,000	104.5	100.9	99.4	91.9	90.5	±7.2

Table 2-4 Predicted Levels for 155 mm Howitzer Firing

Distance (meters)	Predicted Level (dBP)	Standard Deviation (dB)
500	145.7	±5.0
1,000	134.7	±5.0
2,000	123.7	±5.9
3,000	117.3	±6.5
4,000	112.7	±6.9
5,000	109.2	±7.2

Table 2-5 Predicted Levels for 155 mm Howitzer Round Detonation

The large range of levels listed in Tables 2-3, 2-4, and 2-5 are caused by the dependence of impulsive noise propagation on meteorological variables. Studies have found that variation of temperature and wind velocity with altitude can cause a noise event to be inaudible at one time and highly annoying at another time. This phenomenon is referred to as **atmospheric refraction**.

Atmospheric refraction is the bending of sound rays caused by the variation with altitude of the speed of sound. This variation is a function of temperature and wind velocity and this bending of the sound rays can concentrate acoustic energy, causing sound levels to be significantly greater. Conversely, the sound rays can also be bent upward so that the acoustic energy of the event is dissipated by the atmosphere, resulting in a lower sound level on the ground. Please see Section 5 for more information on atmospheric conditions and sound mitigation.

A simplified technique has been developed by the Explosives Research Group (ERG) (University of Utah 1958) to predict atmospheric refraction conditions. The ERG technique summarizes the results of this research into a series of "good" and "bad" firing times. These results are listed in Table 2-6. This technique provides a good first approximation of the effects of the existing weather conditions on noise propagation. The VaARNG could use this technique to reduce the possibility of complaints if demolitions operations are resumed.

"Good" Conditions	"Bad" Conditions
CLEAR SKIES WITH BILLOWY CLOUD FORMATIONS, ESPECIALLY DURING WARM PERIODS OF THE YEAR A RISING BAROMETER IMMEDIATELY FOLLOWING A STORM	DAYS OF STEADY WINDS OF 5-10 MPH WITH GUSTS OF GREATER VELOCITIES (ABOVE 20 MPH) IN THE DIRECTION OF RESIDENCES CLOSE BY. CLEAR DAYS ON WHICH "LAYERING" OF SMOKE OR FOG ARE OBSERVED. COLD HAZY OR FOGGY MORNINGS. DAYS FOLLOWING A DAY WHEN LARGE EXTREMES OF TEMPERATURE (ABOUT 68 DEGREES F) BETWEEN DAY AND NIGHT ARE NOTED. GENERALLY HIGH BAROMETER READINGS WITH LOW TEMPERATURES

Table 2-6 University of Utah Criteria for "Good" and "Bad" Firing Conditions

2.4.4 SMALL ARMS RANGE NOISE (WEAPONS < 20 MM)

The Small Arms Range Noise Assessment Model (SARNAM) is used to assess small arms noise levels, and characterizes noise levels using the ADNL metric. SARNAM incorporates the latest available information on weapons noise source models (including directivity and spectrum), sound propagation, effects of noise mitigation, and safety structures such as walls, berms and ricochet barriers (Pater 1999).

As with impulsive noise, small arms noise can also be assessed by two means. The Noise Zones will depict areas that are incompatible with noise-sensitive land uses, but noise can also be evaluated by looking at peak noise levels. Hede and Bullen (1982) interviewed Australians living near a civilian small arms range and found that none were seriously affected when the linear peak level was below 85 dBP. Shooting at this range was confined almost exclusively to weekends, mainly in the afternoons, with approximately 150,000 shots fired annually. Hede and Bullen concluded, "it would appear then, that a mean unweighted peak sound pressure level around 85 dB would be a reasonable criterion for land-use planning. At this level approximately 10% of a residential population would be expected to be seriously affected." In a later study at a more active military range in Williamstown, Hede and Bullen confirmed this limit with a caveat. Their research group wrote: "it should be assumed that the 85 dBP criterion will only be valid for Williamstown up to 1,000,000 rounds per year. For other rifle ranges, the criterion should hold provided that there are no substantial, and particularly sudden, increases over the long-term average activity for a given range (O'Loughlin et al., 1986)."

The unweighted peaks for the M-16 rifle at several azimuths and distances are shown in Tables 2-3. The zero degree azimuth is the direction of fire, while the 180° azimuth is directly behind the weapon.

Distance, meters	**Predicted Level, dBP Azimuth**		
	0°	**90°**	**180°**
50	135-150	112-127	102-117
100	113-128	106-121	95-110
200	106-121	99-114	89-104
400	93-108	86-101	78-93
800	85-100	77-92	69-84
1600	75-90	67-82	59-74

Table 2-7 Predicted Peak Decibels for M-16 (5.56 mm) Rifle

The range of levels shown in the tables is caused by changes in the sound propagation conditions between the source and receiver. The primary cause of the range in levels is the wind direction. The lower numbers approximate the levels expected when the receiver is upwind of the source, and the higher numbers when the receiver is downwind. The levels listed in the tables do not include any reduction in the noise caused by natural or man-made terrain between the source and receiver, such as hills or berms.

The tables are useful in conveying two pieces if information: Firstly, the direction of fire will have a large impact on the noise level. Secondly, the impact of small arms noise is relatively localized and thus, under most weather conditions, once you are 1,000 meters from the range, levels should not be high enough to annoy people.

2.4.5 SIMULATED WEAPONS NOISE

As part of training, simulation devices, such as the Hoffman Device, are used. The device provides a loud bang at the crew position during simulated firing exercises. It has a low explosive force compared to the firing of the tank main gun. Measurement studies have shown that a typical simulator to be 121 dBP at 100 meters and 113 dBP at 250 meters. Therefore, as long as the simulator is used at least 250 meters from the residences, complaints are unlikely.

2.4.6 AIRCRAFT NOISE

Aircraft noise can be assessed by several means including noise zones that depict where noise-sensitive land uses would be incompatible with aircraft operations. Generally the level aircraft activity at VaARNG sites tend not to be high enough to generate Zone II or Zone III noise contours that extend beyond the airfield properties. But, as with impulsive noise events, an infrequent helicopter overflight may cause annoyance and possibly lead to complaints.

In reference to aircraft complaints, there is no evidence that the Scandinavian Studies (Rylander, 1974 and Rylander, 1988) would be applicable to the operations at airfields, flight tracks, and nap-of-the-earth runs (NOEs) with fewer than 50 operations per day, it is a tool in providing some indication of the percent of people who might be annoyed.

The Scandinavian Studies have found that a good predictor of annoyance at airfields with 50 to 200 operations per day is the maximum level of the three noisiest events. The maximum noise levels for U.S. Army aircraft are listed in Table 2-8. These maximum levels are then compared with the levels listed in Table 2-9 to determine the percent of the population that would consider itself highly annoyed in a given situation.

Slant Distance (Feet)	Maximum Sound Level by Aircraft Type (dBA) (speed at 100 knots)						
	C-17	AH-64	CH-47D	OH-58D	UH-1	UH-60	F-16
200	101.0	91.8	97.5	89	91	91	105
500	91.4	83.4	89.3	80.5	82.8	82.5	96.4
1,000	83.3	76.8	83	73.8	76.4	75.9	89.6
2,000	74.4	69.8	76.5	66.7	69.8	68.7	82.3
5,000	62.1	59.1	67.1	56.1	60.2	57.8	71.1
10,000	51.8	49.6	59.1	47.1	52.1	48	61.2

Table 2-8 Maximum Sound Levels of Aircraft by Slant Distance

Maximum Level (dBA)	Percentage Highly Annoyed
70	5
75	13
80	20
85	28
90	35

Table 2-9 Percentage of Population Highly Annoyed by Particular Levels of Aircraft Noise

2.5 AVIATION SAFETY

In addition to noise, two other land use determinants are of concern to the planning community: accident potential and hazards to air navigation.

Hazards to air navigation include such things as the erection of structures that protrude into the airspace and the release of substances into the air or that can impair visibility. Officials in the civilian communities around VaARNG installations should be concerned with issues like the heights of potential obstructions and it is essential that civilian officials regulate the use of off-post land to provide for the safety of both military and civilian aircraft.

Accident potential, as discussed here, is in terms of the zones where most accidents at military airfields have occurred in the past (U.S. Army, 1981). The results of this approach do not produce accident probability statistics since the question of probability involves too many variables for an accurate prediction model to be developed. Rather, the analysis of military aircraft accident history focused on determining where, within the airfield environs, an accident was likely to take place and how large an impact area was likely to result from any single accident. To this end, an expanded Clear Zone and two Accident Potential Zones have been designated at both ends of military runways.

2.5.1 MITIGATION OF AVIATION SAFETY HAZARDS

As stated above, the two major areas of concern to aviation safety vis-à-vis land use planning are the areas directly around a runway and the regulations governing the construction of things that could obstruct the flight of the aircraft or impair its pilot.

The following are descriptions of the areas around runways where the accident potential and danger to the public is the greatest:

Clear Zone (CZ)

The Clear Zone is an area 1,000 feet wide by 3,000 feet long (for a Class A runway), located at the immediate end of the runway. The accident potential in this area is so high that no building is allowed. For safety reasons, the Army is authorized to purchase the land for these areas if not already part of the installation. The runway at Butts Army Airfield is Class A.

Accident Potential Zone I (APZ I)

The accident potential in APZ I is less critical than in the Clear Zone but it still possesses significant risk. This 1,000 feet wide by 2,500 feet long area, located just beyond the CZ, has land use compatibility guidelines which allow a wide variety of industrial, manufacturing, transportation, communication, utilities, wholesale trade, open space, and agricultural uses. However, uses that concentrate people in small areas are not acceptable.

Accident Potential Zone II (APZ II)

APZ II is less critical still than APZ I but also retains a measurable risk. APZ II is also 1,000 feet wide and extends 2,500 feet beyond APZ I (for a Class A runway). Compatible land uses include those of APZ I, as well as low density single family residential, small scale personal and business services, and low-intensity commercial/retail trade uses. High density uses such as multistory buildings, places of assembly (e.g., theaters, schools, churches and restaurants), and high-density office uses are not considered compatible.

Insufficient regulation of development on the ground can also lead to dangerous conditions for the aircraft as it is in flight. Construction of towers within the Guard training areas directly affects aircraft procedures and indirectly impacts upon the local community. Improper location of tower sites may result in change of flight procedures such as rerouting air corridors and routes, alteration of departure/landing directions and traffic patterns, or closure of remote landing sites—alterations that could result in an increased noise impact upon the local community.

Apart from towers, other hazards to in-flight aircraft that should be regulated through prudent land use planning are:

- Activities that release substances into the air (such as steam, dust or smoke) which can impair the visibility of aircrew members. Some examples of such activities are industrial plants, refineries, quarries, and sand or gravel pits.

- Objects that produce light emissions, either direct or indirect (reflective), which could interfere with the vision of aircrew members. Some examples are high intensity strobe lights, extensive areas of glass such as those found in many modern office buildings, and highly reflective artificial surfaces.

- Activities which produce emissions capable of interfering with aircraft communications or navigational systems.

- Activities which tend to attract birds or waterfowl, particularly in large numbers. Such activities include the operation of sanitary land fills, the maintenance of feeding stations, and growing certain types of vegetation (e.g., grain and corn fields).

2.6 NOISE MITIGATION

Public attitude surveys have shown that noise is considered an "enemy" in urban, suburban, and even rural areas. It is often rated worse than crime, litter, and abandoned buildings since it seems to infiltrate homes and minds incessantly. As the public, in general, has become less tolerant of noise, the noise from military-specific sources—artillery, low-level jet operations, helicopters, and small arms firing—has increased both in intensity and frequency. Even though the military departments have made concerted efforts to reduce the noise from training and operations, weapons platforms and systems have become larger and louder.

The weapons, munitions, and aircraft used at Fort Pickett are no exception in this larger and/or louder scenario. Whereas the noise from horse-drawn artillery and small airplanes was once confined to the military reservation, with little if any impact upon the civilian communities, today's training involves artillery pieces, projectiles, rockets and aircraft that create noise extending beyond the installation boundary.

In its efforts to be a good neighbor, the VaARNG has adopted the following noise mitigation measures:

- No fly areas have been established around known noise-sensitive areas.

- Flight routes have been delineated such that overflying of populated areas is avoided.

- All ranges are sited with directions of fire away from the reservation boundaries, resulting in generated noise projected away from the boundary.

- Noise is considered in all National Environmental Policy Act (NEPA) documents.

As stated in the previous paragraph, the VaARNG has specific noise complaint procedures in place, but the following are general rules and guidelines that may be used by any installation interested in the handling and reduction of noise complaints:

Identification of Noise Complaints

A noise complaint procedure has been established to receive and record complaints about noise. While not used as the sole criterion for judging the severity of operational noise impacts, citizen complaints may be indicators of situations where noise control measures are necessary or established policies are being violated. Such complaints are logged and investigated, and corrective action is applied where applicable. In many instances, such problems can be resolved to the mutual satisfaction of the Guard and the civilian element involved.

Complaint Procedures

All complaints which appear to be substantiated (and which contain sufficient information), particularly those complaints that may have been caused by violations of established procedures, are forwarded to the responsible unit or activity for action. Upon receipt of such a complaint, the appropriate officials conduct an inquiry to determine:

- The identity of the unit involved
- The validity of the complaint
- Whether appropriate regulations and guidelines were followed
- The corrective action, if appropriate, that was taken. For instance, whether procedural adjustments to routes and corridors are necessary and/or possible in view of safety, training, and noise impacts.
- How to avoid similar complaints

Control Procedures

The adverse impact of the noise from some operations and training at VaARNG installations can be reduced by mitigation methods. In its continuing effort to be a good neighbor, the VaARNG will continue to consider implementing the following mitigation strategies when warranted:

- Using operational controls, where feasible, to reduce the noise environment in sensitive areas. These controls include shifting training so that quieter weapons are used in these areas.
- Minimizing the firing of large caliber weapons between the hours of 2300 (11:00 PM) and 0600 (6:00 AM).
- Implementing and controlling procedures for aircraft that are designed to avoid or reduce noise. These include:

- ♦ Using established traffic patterns, corridors and routes, and designated altitudes
- ♦ Avoiding residences, buildings, and farm-related facilities by at least 500 feet slant range while maintaining the appropriate altitude
- ♦ Avoiding towns, cities and villages, except when operating in approved corridors
- ♦ Avoiding livestock and recreational areas

- Designating noise-sensitive areas where selected noise complaints result in the creation of a noise-sensitive area that will be inclusive of a 2000 foot radius whereby no overflights shall be made below 1,000 feet above ground level (AGL).

Other Considerations

Feasible noise mitigation is also investigated during the National Environmental Policy Act (NEPA) process for new operations and proposed changes in existing operations. Computer modeling of new training sites offers the prospect of predicting whether the proposed action will be compatible with adjacent land use. This is a proactive technique in that it offers the opportunity to eliminate sites from consideration before the undesirable effects of noise ever become a factor. It also allows the installation to minimize the noise impact when designing sites.

2.6.1 ROLE OF PERSONAL AND SITUATIONAL VARIABLES IN UNDERSTANDING NOISE ANNOYANCE

The amount of annoyance a sound elicits in an individual depends on many factors including the time of day the noise takes place, the background noise environment, and whether the person is indoors or outdoors at the time. The annoyance and complaint potential from single events, such as firing a 120 mm tank gun, is highly subjective and data are limited in this area.

The usual complaint pattern is that economic activity unrelated to the installation stimulates increased population and development in the vicinity. Some segments of the new population are not economically dependent on the installation and tend to be annoyed by the noise or other aspects of the government presence so the noise from the ranges then provides a specific and undeniable object about which to complain. As time goes on, the people reporting complaints become more articulate and eventually address their grievances to higher levels of command and government. When the situation becomes political, the installation's mission can be jeopardized.

Individual response of community members to noise depends on many factors. Some of these factors are the characteristics of the noise itself including the intensity and spectral qualities, duration, repetitions, abruptness of onset or cessation, and the noise climate or background noise against which a particular noise event occurs.

However, social surveys show that the following are also factors related to annoyance that are not about the characteristics of the noise itself:

- The degree of interference of the noise with activity
- The previous experience of the community with the particular noise
- The time of day during which the intruding noise occurs
- Fear of personal danger associated with the activities of the noise sources
- Socioeconomic status and educational level of the community
- The extent to which people believe that the noise output could be controlled
- Beliefs about the importance of the noise source
- General Noise sensitivity
- The amount of insulation in the home

An understanding of these factors is key to getting to the root of why someone is irritated and thus key to resolving the complaint.

2.6.2 OTHER CONSIDERATIONS

Other areas of Operational Noise Management are:

- Reviewing Environmental Assessments (EA) and Environmental Impact Statements (EIS) to ensure that the noise impacts of the proposed action are addressed and are consistent with the SONMP.
- Physical monitoring of the noise environment (as opposed to computer modeling) when the noise environment is controversial, when noise zone III exists in a noise-sensitive area, and when the noise source is unique and cannot be modeled.
- Incorporating noise contours as a layer on the facility's Geographic Information System (GIS). This layer can be overlaid with other layers (for example, land uses) and used in citing future facilities.

2.7 SUMMARY

This section provided a discussion of the Statewide Operational Noise Management Plan (SONMP). The purpose of the SONMP is to assist the VaARNG in managing its noise environment, with a minimal impact on its mission, while at the same time being a good neighbor. The SONMP includes information on noise assessment, education, complaint management, noise mitigation, and vibration. The environmental impacts of activities at VaARNG sites may at times extend beyond the military reservation boundary. Therefore, officials at the VaARNG depend upon the goodwill and cooperation of the civilian sector to promote public support for and understanding of the installation's mission requirements.

This page left intentionally blank

SECTION THREE

FORT PICKETT

3.1 LOCATION OF FORT PICKETT

Fort Pickett–Maneuver Training Center (FPMTC) is located in Virginia's piedmont physiographic province and consists of 35,000 acres of diverse terrain with few environmental constraints (42,273 acres total). The Installation is located just east of the city of Blackstone and stretches into or closely borders four counties: Nottoway, Dinwiddie, Lunenburg, and Brunswick (Figure 3.1)

3.2 HISTORY OF FORT PICKETT

Fort Pickett was established in late 1941 as the threat of war on home shores began to weigh on the minds of the United States. Once the U.S entered WW II, Fort Pickett experienced development that is amazing in both its swiftness and breadth; by the end of 1942, more than 1,400 buildings were completed and in use across the post. For the remainder of WW II, Fort Pickett served as a training center, a 2,000 bed convalescence hospital, and a POW camp for approximately 6,000 German captives. But by the end of 1946, with the war over and the demand for military operations declining, the post was cleared of most personnel and idled until the next time it would be needs.

That next time happened to come just two years later in 1948 when tensions with the Soviet Union over the Berlin Crisis led the Army to reorganize the 17th Airborne Division making Fort Pickett (then Camp Pickett) its home station. The Berlin Crisis ended peacefully but the Korean War followed closely behind and once again, the hospital complex was revamped and Fort Pickett became a clearing house for training, housing POWs, and treating infirmed soldiers. However, the end of fighting in Korea again brought closure to most facilities at Fort Pickett (1953) and while guard and reserve units still came for annual training in the summer, the base was virtually empty the rest of the year.

Although the threat of permanent closure loomed, the demands of the Cold War and the need to train division-sized Reserve Component units in the mid-Atlantic region brought back an important and redefined role for the post. By 1960, portions were being revamped to house battalions coming for a week or two each year to conduct specialized training. This included not only Guard/Reserve commands, but also Navy and Marine Corps personnel–components that still use Pickett's facilities today under Virginia National Guard control.

The 70's and 80's brought signs of long-term commitment to Pickett through the construction of new barracks and support structures (large enough to house and entire brigade), a doubling of the telephone system capacity, and the renovation of Blackstone Army Airfield's runways to support C-130 and C-17 transport planes.

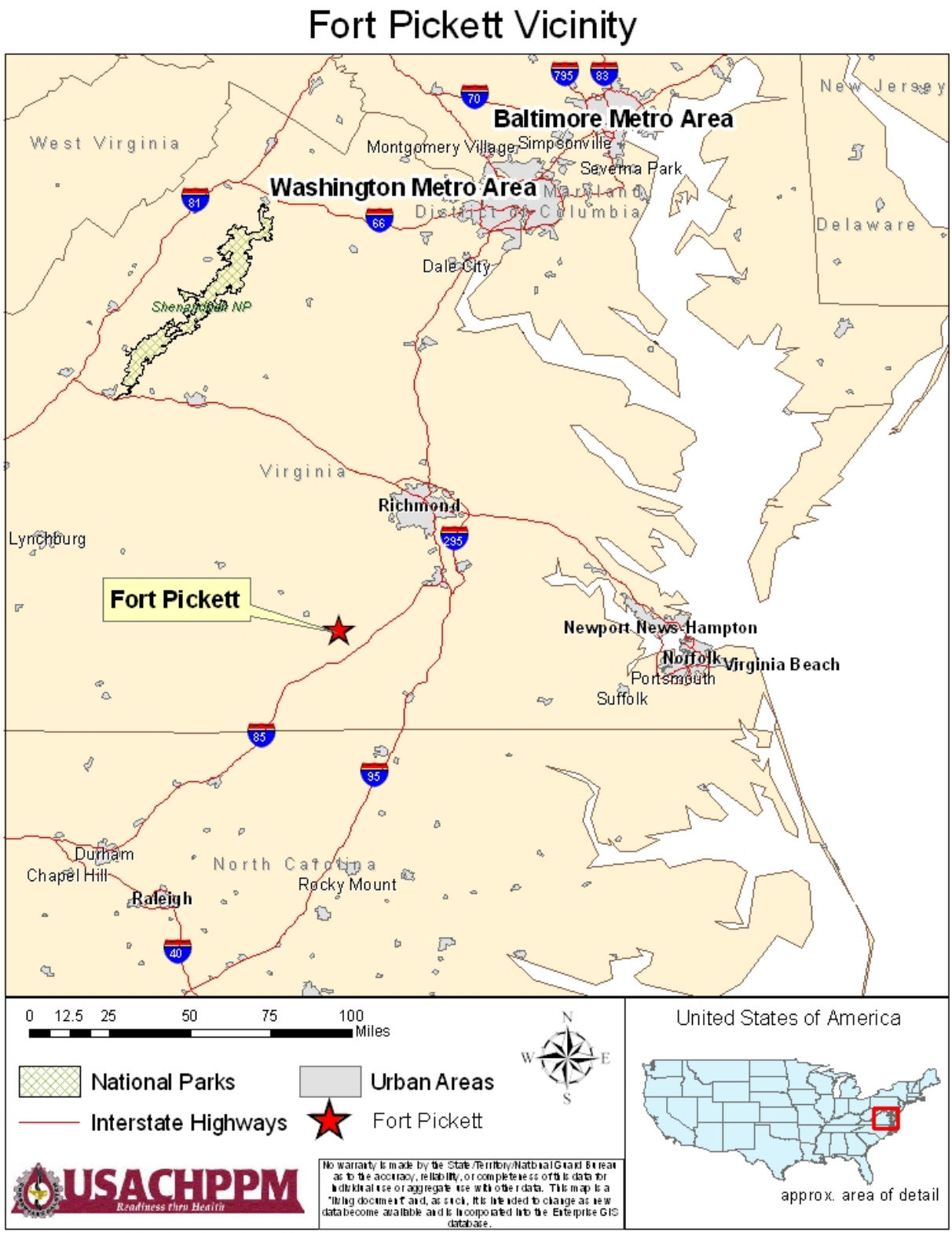


Figure 3-1 Fort Pickett Location and Vicinity

Most recently, the decision to inactivate the regular Army garrison and turn over operations of the post to the Virginia National Guard was finalized in 1995 and enacted in 1997. Furthermore, in the Base Realignment and Closure (BRAC) of 1995, approximately 4,000 acres of the Installation's land was deemed excess and it was transferred to and split between Nottoway County and a Virginia University.

3.3 CIVILIAN COMMUNITY

As mentioned, Fort Pickett straddles or closely borders the counties of Nottoway, Dinwiddie, Brunswick, and Lunenburg. The areas adjacent to Fort Pickett are largely rural in nature and sparsely populated. Thus the housing is generally older, few new subdivisions are being created, and it is not uncommon for the employees of Fort Pickett to have commutes to work of 20-30 minutes. The town of Blackstone, which relies heavily on Fort Pickett for employment, had a population of 3,497 in 1990 and that increased to 3,675 in 2000. But by July of 2002, Blackstone's population is estimated to have actually dropped by a half-percent so it is clear that, at this time, growth pressures in the immediate area are negligible.

Growth pressures in the bordering counties are on par with, if not slightly higher, the State averages and National averages for the time period (See Table 3-1). Fort Pickett currently employs about 1,100 people and pays out approximately $5 million a year in salaries.

County	Population by Census Year		Percentage Change
	1990	2000	
Brunswick	15,987	18,419	+15.2
Dinwiddie	20,960	24,533	+10.1
Lunenburg	11,419	13,146	+15.1
Nottoway	14,993	15,725	+4.9
Blackstone (Town of)	3,497	3,675	+5.1
Virginia (State of)	6,187,358	7,078,515	+14.4
United States	248,709,873	281,421,906	+13.2

U.S. Census Bureau, Census 2000

Table 3-1 Population Surrounding Fort Pickett

3.4 FORT PICKETT MISSION AND TRAINING

Fort Pickett's mission is to provide a Maneuver Training Center (MTC) capable of handling the live-fire and maneuver training for Brigade-size elements of Army Reserve Components (RC) and Active Components (AC) of all services. The primary use of Fort Pickett is by the National Guard and Army reservists for live-fire exercises combined with maneuver training, and all arms (air and ground) of all branches of service (including aviation) train here. Units training at Fort Pickett are capable of firing all weapons in the Army's inventory with the exception of air defense weapons in an air defense mode. Table 3-2 lists Fort Pickett's live-fire ranges.

Range	Description	Location	Authorized Weapon/Ammo
2	25-meter range. 50 firing points	393018	7.62 and smaller, 12GA
3	LAW, AT-4, and M203 firing. Five firing points with foxholes and log walls	394019	LAW svc and subcaliber, M203 (40mm practice only) AT-4 svc and subcaliber
4B	Demolition Breaching	399027	Breaching Charges
4D	Demolition Range	410025	Demolition charges up to 50 pounds
5	Combat pistol range with pop-up targets and 15 firing points with pistol stands and seven lanes (105 targets)	403031	All caliber of pistols
6	Automated record fire range with 16 firing lanes.	401036	5.56mm
7	Automated record fire range with 16 firing lanes.	400047	5.56 and 7.62 mm Sniper Rifle
8	Familiarization fire	399051	7.62mm and smaller
9	25 meter range with 100 firing points with foxholes	401055	5.56mm and smaller
10	Indirect fire	401063	105mm and 155mm Howitzer
11	Three lanes 200 meters long. Crew served weapons firing. Range will support TT V and a modified TT IX 15 stationary target emplacements and two armor moving targets	405066	.50 caliber and smaller crew served weapons 105mm and 152 mm HEAT-TPT only, 120mm-HEAT and TPCSDS-T, Laser
12	25 and 50 meter firing lines	427064	7.62 and smaller, tank subcaliber
13	TT V through VIII TOW and dragon (inert only) crew served weapons firing. 15 stationary target positions and two moving armor targets. Screening and calibration target positions one maneuver course 600 meters in length with three turret defilade positions and AAC Boards and Tracking Manipulations Boards.	435065	.50 cal and smaller small arms; TOW and dragon inert only 152mm TPT and Shillelagh missiles 120mm TPT and TPDS 105mm TPT and
			TPDS-T. Laser
			MK19 Qual (TP)
14	25 and 50 meter firing lines	438066	.50 caliber and smaller

Range	Description	Location	Authorized Weapon/Ammo
15	Tank range with three maneuver roads. Subcaliber TT VII and VIII with telfare CEV gunnery; aerial gunnery; two moving armed targets and 12 stationary target positions.	421066	.50 cal and below aerial weapons; 7.62, 20mm and 2.75 rockets; CEV practice only; 105mm TPDS-T, HEAT-TPT.
16	Tank range with one maneuver road, five turret down positions, two armor moving targets, 12 stationary target positions, used primarily for TT VII and VIII, Solution Boards and Tracking Manipulations Boards	459059	.50 cal and smaller, 120mm TPT, TPDS, 105mm TPT and TPDS-T
17	M203 and hand grenade qualification	462051	Practice hand grenades M203 (practice only).
17HG	Hand grenade/M18AI claymore mine	462048	Live hand grenades/Live claymore mines
18	Forced march live fire range with three firing lanes, pop-up targets	467037	M203 practice only and 7.62mm and below
MA 23	Non-standard live fire	467037	7.62mm and below
19	Machine gun transition/qualification range with five firing lanes, pop-up targets. Scout squad/mech Inf Plt defensive course	468027	7.62 mm and below
20	Familiarization firing. No tower	466016	7.62mm and below, M203 (practice only)
DEMO Area A	Demolitions/explosives	429039	
DEMO Area B	Demolitions/explosives	445030	
OP6	TOW and dragon firing	467001	TOW and dragon HE
OP3	TOW and dragon	444991	TOW and dragon HE
MA 32	Non-standard live fire range		.50 cal and below

Table 3-2 Existing Ranges at Fort Pickett-MTC

Additionally, Fort Pickett-MTC has over 20 direct fire ranges (Figure 3-2) and over 70 indirect firing positions (Figure 3-3) capable of supporting rifle, mortar, cannon, and multiple launch rocket system (MLRS) fire. Figure 3-4 shows all of the training and maneuver areas, and how they are situated.

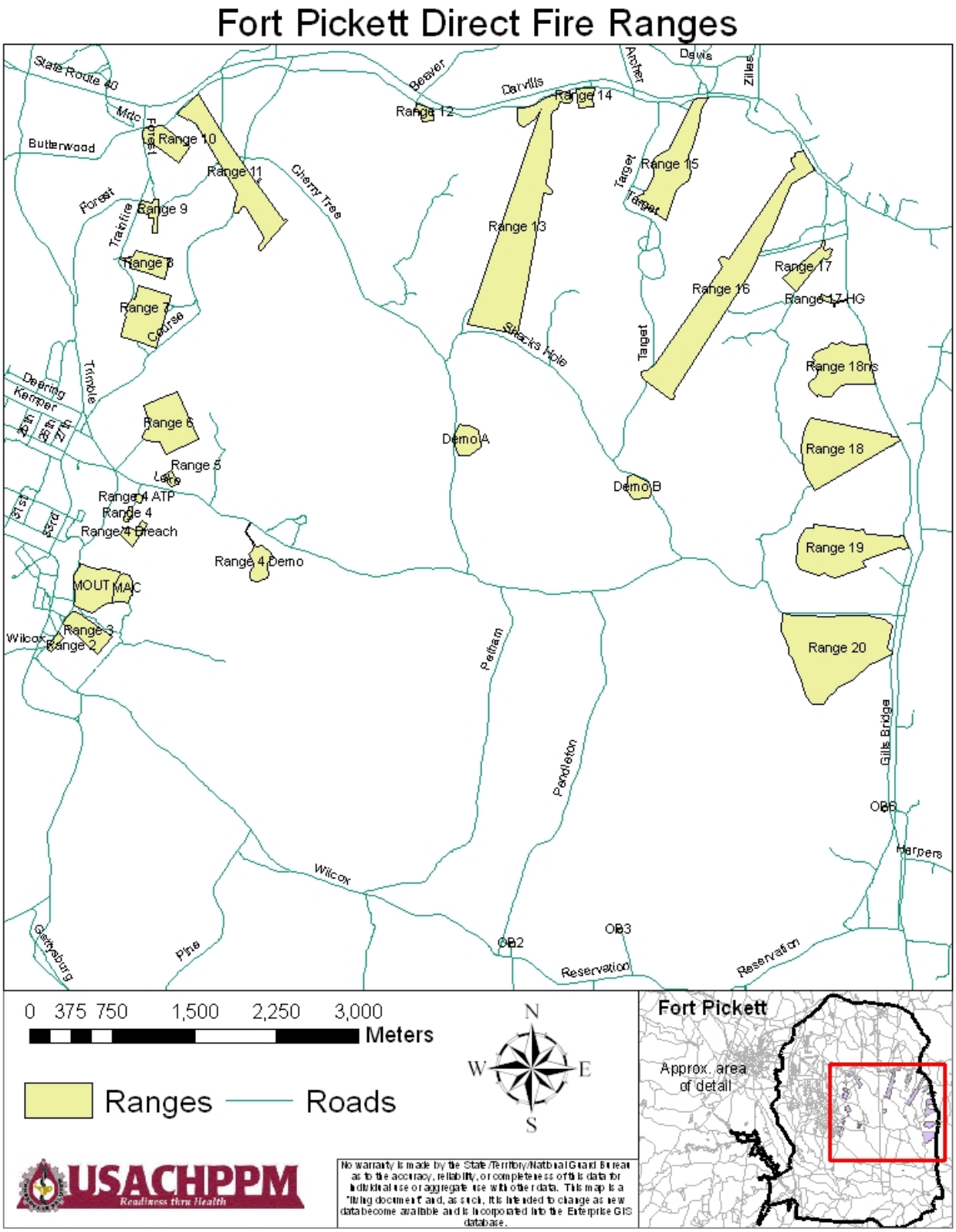
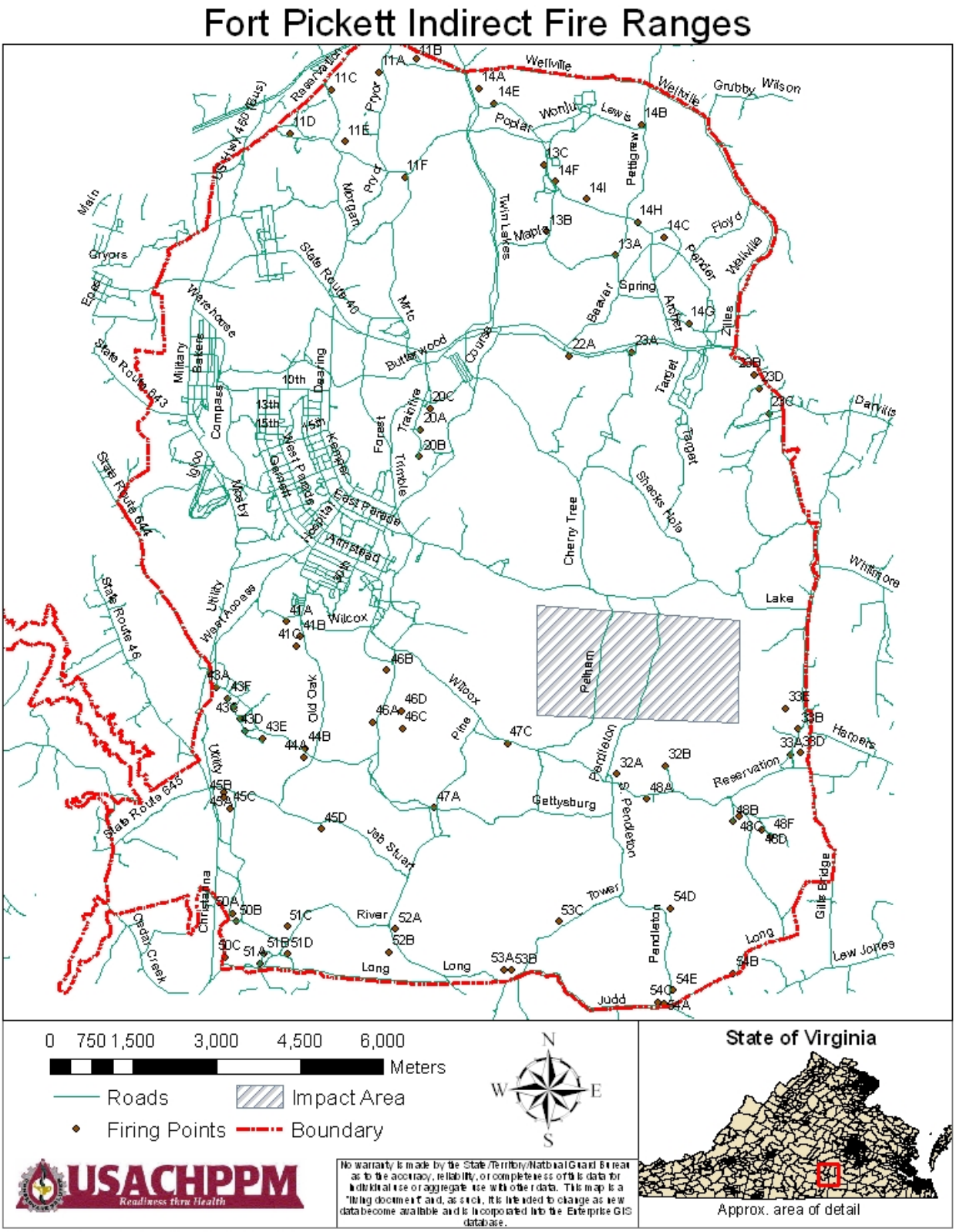


Figure 3-2 Direct Fire Ranges at Fort Pickett



Produced By: USACHPPM, September 2004
Data Source: USACHPPM, ESRI, and VaARNG

Figure 3-3 Indirect Fire Weapons Ranges at Fort Pickett

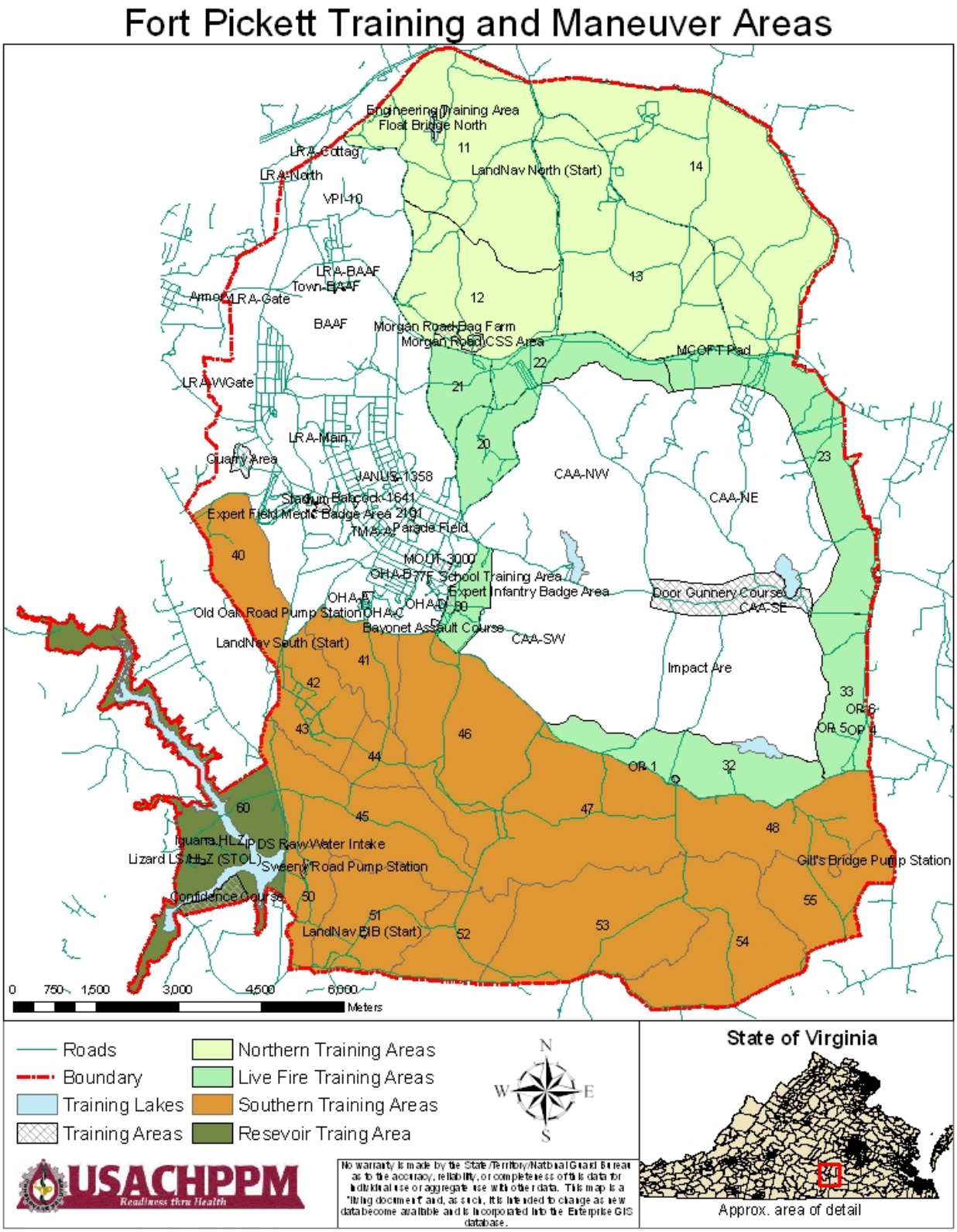


Figure 3-4 Fort Pickett's Training and Maneuver Areas

The maneuver training areas provide acreage for exercises that may or may not be force-on-force training. Currently, Fort Pickett has approximately 25,130 acres available for light and heavy maneuvers. The northernmost training area (11-14) is used primarily for mechanized maneuvers and tactical training–little live-fire occurs here with the exception of some indirect artillery firing). The southernmost training area (40-55) contains most of the live-fire artillery firing points and the amount of mechanized training is small when compared with the northern areas. The area in between contains the CAA/live-fire ranges, and area 60 (near Fort Pickett Reservoir) houses the leadership training/confidence course, some bivouacking, and limited water activities

Fort Pickett also has six drop-zones supporting a variety of airborne operations (See Table 3-3)

Drop Zone	Training/Capabilities
Blackstone	SL, HALO, HAHO, CDS, HVYEQ, LAPES
Quail	SL, HALO, HAHO, CDS
Rabbit	SL, HALO, HAHO, CDS
Rhino	HALO, HAHO (Spec Ops only)
Dove	SL, HALO, HAHO, CDS, HVEQ

SL – Static Line; HALO – High-Altitude Low-Opening; HAHO – High-Altitude High-Opening; CDS – Container Delivery System; HVYEQ – Heavy Equipment; LAPES – Low-Altitude Parachute Extraction System

Table 3-3 Fort Pickett's Drop Zones and Their Training Capabilities

3.4.1 FORT PICKETT USE

Because of its size and location, Fort Pickett provides unique training opportunities for National Guard units from several surrounding states, the active military (Army, Navy, Air Force Marines, and Coast Guard) and state and civilian agencies/organizations. Fort Pickett regularly supports National Guard units from other states including North Carolina (NCARNG), Tennessee (TNARNG), Pennsylvania (PAARNG), and West Virginia (WVARNG) with Pennsylvania and West Virginia maintaining pre-positioned equipment on a full-time basis.

3.4.2 FUTURE TRAINING AT FORT PICKETT

Beginning in fiscal year 2001 (FY01), the Army began the process of transforming into an Objective Force. This Objective Force is intended to be smaller, lighter, and easier to deploy all while maintaining the capabilities to execute the national military strategy. As this transformation takes place, the National Guard will receive some new and some legacy equipment from the active Army and by FY04 the first fielding of this new equipment will have occurred. By FY13, the Army National Guard will have an interim force and one transformed maneuver brigade, by FY26 the transformation is scheduled to be approximately 57% complete, and by FY32 there will be an Objective Force of 33 light maneuver brigades Army-wide.

Given Fort Pickett's size and location, it is likely that the installation will play a significant role in the training involved with these changes. For instance, in a nearly $23 million dollar project, Range 15 is currently being reconstructed as a 650-acre Multi-Purpose Range Complex (MPRC) that "will allow armored, mechanized, aviation, and future Army/National Guard Stryker Brigade units to conduct individual and collective live-fire training and qualification" (taken from an April 5, 2004 press release by the office of U.S. Senator George Allen).

3.5 NOISE ENVIRONMENT

The following discussion of conditions that currently exist at Fort Pickett deals with compatible and incompatible land uses. The federal guidelines pertaining to compatible and incompatible land use around military installations have been addressed briefly in other parts of this study. By determining the locations of noise zones and applying the federal guidelines to these zones, present and future land uses can be evaluated as to acceptability for various types of activities.

The majority of the noise generated at Fort Pickett is attributed to range activities and transportation-related sources such as tactical vehicles and aircraft. Minor noise sources include repair shop maintenance and equipment operations. Range activities include both small and large caliber weapons activities and, as shown above, Fort Pickett has approximately 75 surveyed indirect firing points use for firing mortars and howitzers.

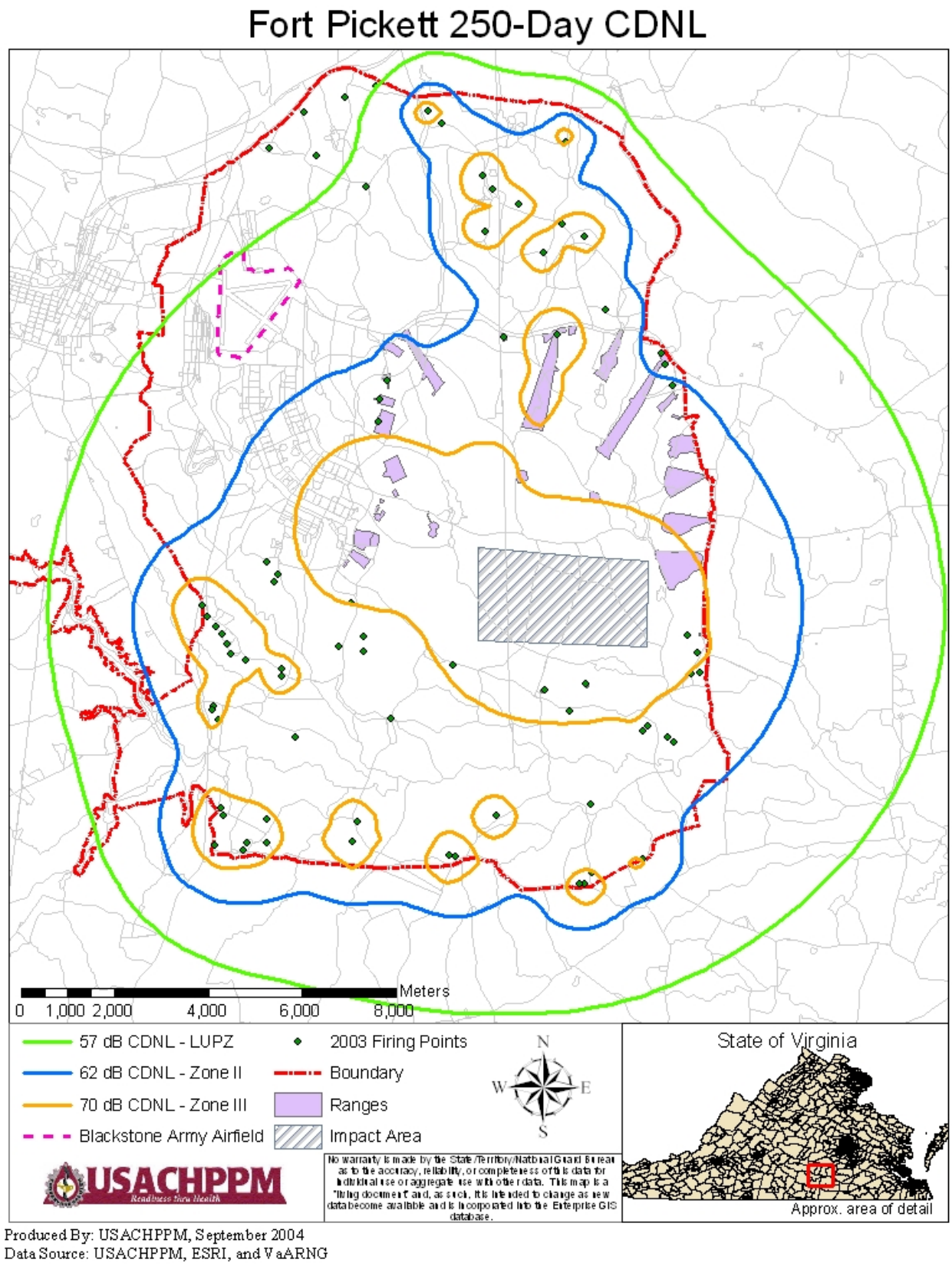
3.5.1 LARGE ARMS RANGES AND DEMOLITIONS

Large caliber weapons and demolition activity are assessed using the CDNL metric. The CDNL metric is used for low-frequency noise sources to take into account the vibration that can be caused by these sources. The CDNL considered in these analyses represents the time-integrated C-weighted noise level for an annual average day of activity, with a 10-dB penalty applied to all events occurring between 2200 and 0700 hours. The BNOISE2 model is used to assess low frequency impulsive noise from weapons with bore diameters larger than 20-mm, and characterizes noise levels using the CDNL metric. The firing point and target locations, as well as the number and type of ammunitions are entered into the model to generate the contours. A summary of the entries used for the baseline is listed in Table 3-4**.** Specific details concerning the data, assumptions, and procedures supporting the noise analyses in this subsection are contained the appendices

Weapon/Ammunition	Number of Rounds/Charges	
	Day (0700 - 2200)	Night (2200 - 0700)
M198 155 mm HE	2306	711
M109A1 155mm HE	4477	1713
20 mm inert	500	0
105 mm Howitzer HE	1398	548
TOW inert	47	0
81 mm Mortar HE	5437	1732
60 mm Mortar HE	421	0
120 mm Mortar HE	132	0
DRAGON inert	43	0
Demo	23110	0
LAW inert	17	0
2.75 in. Rocket	159	14
120 mm Abrams inert	3386	0
25 mm inert	3950	0
81mm Mortar inert	0	192
60 mm Mortar inert	0	57
M198 155 mm inert	0	117
M109a1 155 mm inert	0	244
105 mm Howitzer inert	0	80

Table 3-4 Fort Pickett Baseline Annual Data for Blast Noise Contours

As part of the Fort Pickett noise program, noise maps delineating three different noise zones defined in AR 200-1, Chapter 7 were developed. Section 2.4.1 describes the Noise Zone criteria. The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) conducted a study to identify noise zones caused by existing training activities on Fort Pickett. The analysis of existing large caliber weapons activity on Fort Pickett indicates that Zones II and III extend north and east of State Route 40 and beyond the limits of the eastern boundary (Figure 3-5). This area includes Butterwood Church and several residences; however Section 4, Paragraph 2-31 of Fort Pickett Reg. 350-2 states that no main gun firing is allowed on Ranges 13, 15, and16 from 0900-1200 Sundays so as not to interrupt local worship services. Additionally, there are small areas of off-post noise zones along the southern and western boundaries.



Produced By: USACHPPM, September 2004
Data Source: USACHPPM, ESRI, and VaARNG

Figure 3-5 Fort Pickett C-Weighted Day-Night Level Contours

PEAK LEVELS BLAST NOISE CONTOURS

As was discussed in Section 2.4.2, even in locations designated as "compatible" with average noise levels, people may still be annoyed if the peak noise level from a single event reaches a certain level. In fact, weather conditions can cause peak levels to vary significantly from day to day; even from hour to hour.

The BNOISE2 model that was used to generate the annual average contours can also be used to generate "Peak Contours" for single events. The peak contours show the expected level that one would get on a sound level meter when a weapon was fired. It should be noted that he peak contours will be the same whether one shot or one thousand shots are fired. So, noise levels within the peak contours might be compatible with residential land use according to Federal Guidelines, but there is the potential for single event levels to be high enough to cause complaints. Figures 3-6 and 3-7 show the 115 dBP and 130 dBP contours. They depict the "Peak 85" contour, so 85% of events would be expected to fall within the contour. But, under weather conditions that favor propagation, levels might reach 115 dBP outside of the contours approximately 15% of the time. Figure 3-6 shows the current large-caliber peak decibel contours, and Figure 3-7 shows the same map but with the addition of the Stryker training mentioned above (notice the slightly larger contours on the eastern boundary).

A discussion of the land use zoning into which these contours travel is located later in this section. One should reference these maps when determining whether or not a specific type of zoning under a particular contour could present an encroachment issue in the future.

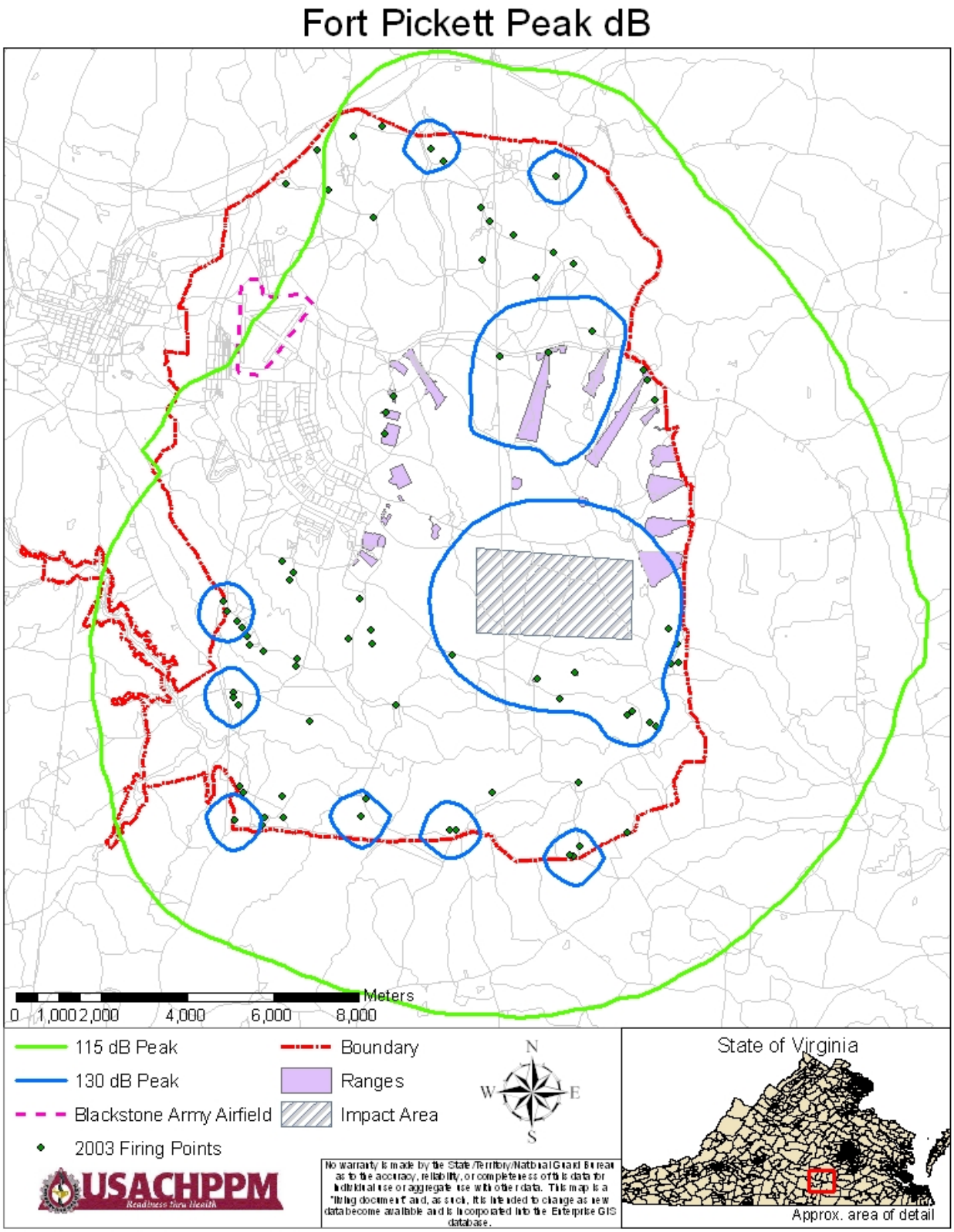
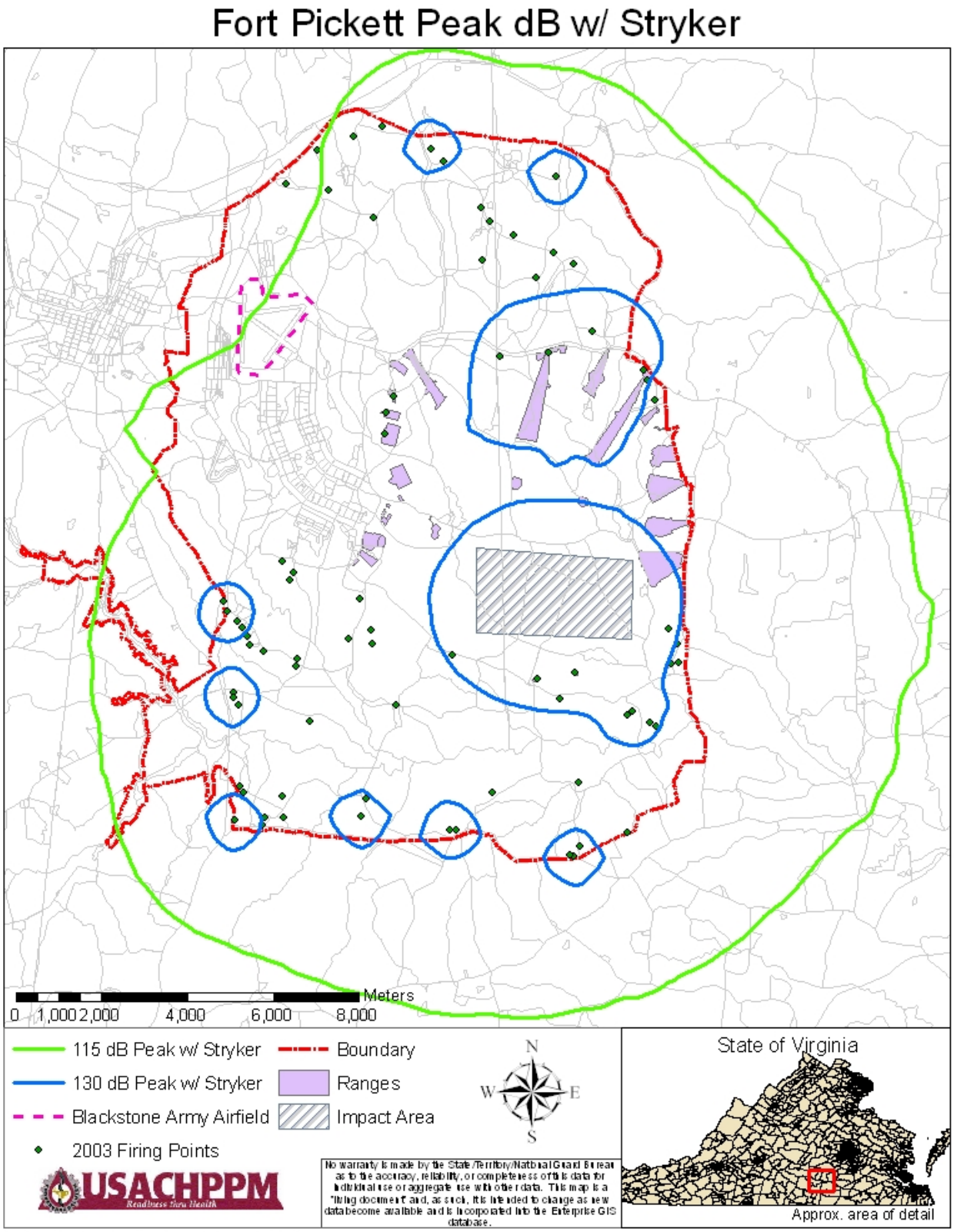


Figure 3-6 Fort Pickett Peak Decibel Contours



Produced By: USACHPPM, September 2004
Data Source: USACHPPM, ESRI, and VaARNG

Figure 3-7 Fort Pickett Peak Decibel Contours with Stryker Training

SMALL ARMS RANGES

The small arms ranges are assessed using the ADNL metric with a penalty added for the repetitive nature of small arms fire. The Small Arms Range Noise Assessment Model (SARNAM) is used to assess small arms noise emissions, and characterizes noise levels using the DNL metric. A summary of the entries used for baseline small arms data are shown in Table 3.5.

Small Arms	Number of Rounds	
Weapon/Ammunition	**Day (0700 - 2200)**	**Night (2200 - 0700)**
M16 (5.56 MM)	679877	228168
M2 (.50 CAL)	116620	45147
M4 (5.56 MM)	44403	5649
M60 (7.62 MM)	628386	138357
M249SAW (5.56 MM)	44842	12745
Shotgun (12 GA)	17957	5815
Pistol (9MM)	158774	49997
M14 (7.62 MM)	77692	26126
Pistol (.45 CAL)	30171	10359
Pistol (.357 CAL)	60791	19507
Pistol (.40 CAL)	6650	1050
M43 (7.62 MM)	5000	0

Table 3-5 Fort Pickett Baseline Annual Data for Small Arms Contours

Noise from existing small arms fire training on Fort Pickett is generally restricted to the post. A small area of the Noise Zone II for the small arms activity does extend beyond the eastern boundary, but the noise does not extend off-Post above acceptable thresholds.

3.5.4 AIRCRAFT TRAINING

The Blackstone Army Airfield (BAAF)/Allen C. Perkinson Municipal Airport is used by both private pilots and the military, and is operated by the local community. It is comprised of approximately 720 acres located adjacent to the northeast side of the Fort Pickett cantonment area (just south of SR 40) and is accessed directly via Dearing Avenue and the east entrance (See Figure 3.8).

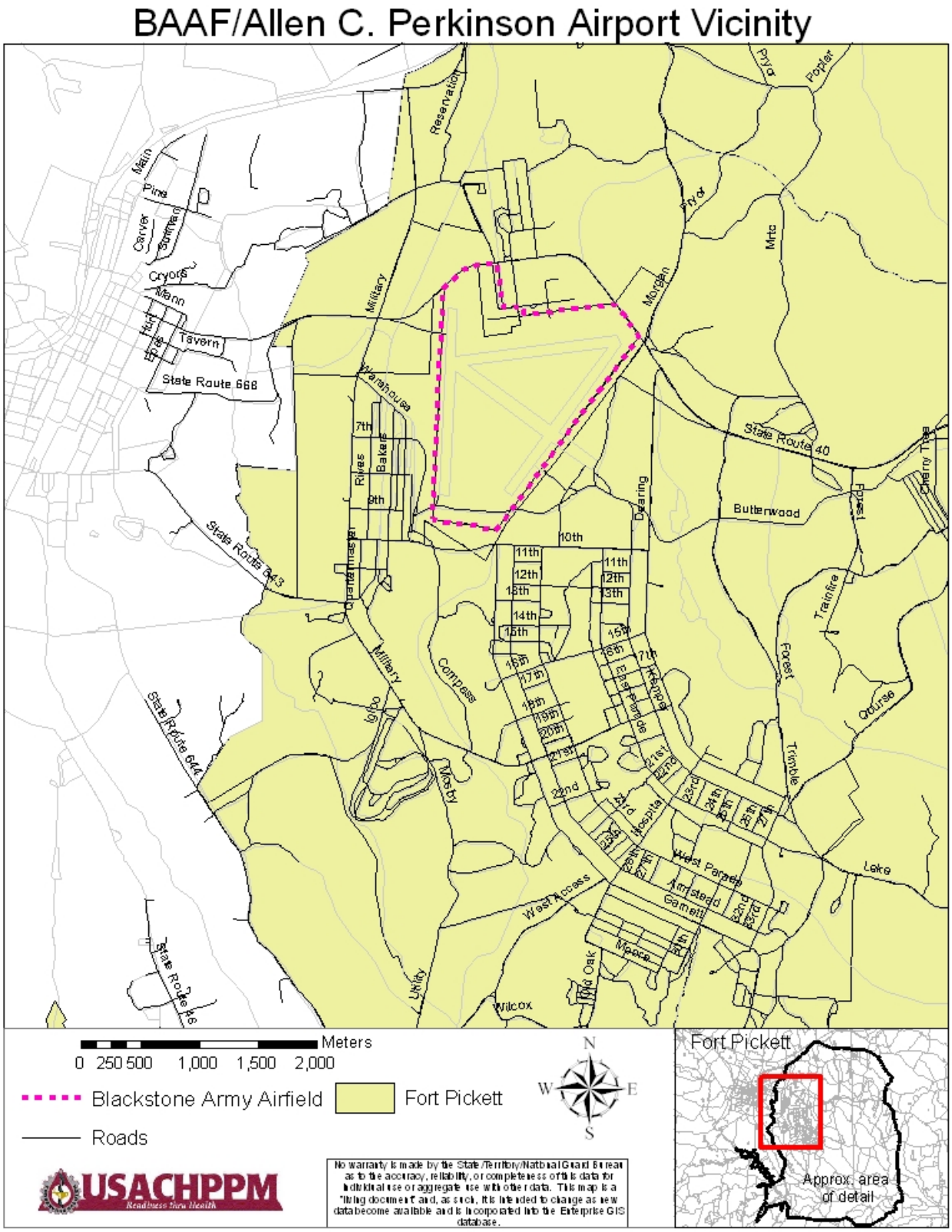


Figure 3-8 Blackstone Army Airfield/Allen C. Perkinson Municipal Airport Vicinity

The airfield has two operational runways (Runways 1-19 and 4-22), two helipads located on the closed east-west runway (Runway 8-26), and another helipad on the aircraft parking apron near the control tower. Runway 1-19 is closed to C-130 aircraft due to age and the weight bearing limitation of the runway but Runway 4-22 is C-130 and C-17 capable. Additionally, there are two additional helipads located in the cantonment area–one just east of the post headquarters, the other near the barracks area–and an assault training landing strip is located in the Tactical Training and Maneuver Area (Area No. 1) north of SR 40.

Other aircraft operations at Fort Pickett take place at the drop zones and at the air-to-ground ranges. While there are no aircraft permanently stationed at Fort Pickett, during annual training rotary aircraft such as the CH-46, Ch-47, UH-60 and OH-58 can be stationed at Fort Pickett for a few weeks at a time. When helicopter training occurs off of the installation, they follow FAA guidelines and maintain a minimum flight altitude of 500 feet above ground level (AGL).

The operations at BAAF were assessed using the NOISEMAP model. Inputs into the model include flight tracks and altitudes, aircraft power settings, numbers and types of aircraft used. As with all DNL contours, operations taking place between 2200 and 0700 hours have a 10 dB penalty added to the levels to reflect the increase in community sensitivity during the night period.

3.5.4.1 AIRCRAFT TRAINING NOISE SPECIFICS

The loudest fixed-wing aircraft at BAAF is the C-17. In CY03 there were 209 C-17 daytime operations and 6 C-17 nighttime operations. Since noise contours are based upon annual averages, the low numbers of annual operations at BAAF were not enough to generate a Noise Zone III or Noise Zone II contour that extends beyond the installation. Noise levels from activities at the drops zones and air-to-ground ranges are well below those suggested by applicable land use compatibility guidelines for residential and recreational areas. However, an occasional overflight might cause annoyance.

Table 2-10 presents the maximum noise levels of individual aircraft which can use Fort Pickett's airfield or air space. Note: High performance aircraft are not allowed to operate in the Fort Pickett area between 0900 and 1200 on Sunday and 0001 to 2400 Easter Sunday.

3.6 ZONING AROUND FORT PICKETT

As alluded to above, sound only becomes noise there are people around to be irritated by it. And whether or not there are people around to hear it has much to do with what types of uses are permitted, or the zoning, around the noise producers.

The VaARNG has recently released an Adjacent Property Zoning Report for Fort Pickett which details the specifics of the zoning found in each of the three counties that abut the Installation. The report came to the conclusion that the DoD "needs a comprehensive and coordinated approach to addressing encroachment issues. The approach should include an outreach strategy to increase public awareness of how essential realistic and effective training is to the readiness of U.S. Armed Forces."

The report also offered the following recommendations that mesh well with the recommendations of USACHPPM regarding cooperation with local governments to limit zoning incompatibilities:

- *Discuss future planning operations and zoning changes on property adjacent to Fort Pickett;*
- *Inform the counties of future military plans or significant changes concerning training that could affect noise levels at adjacent properties;*
- *Identify the population of those working and living within incompatible land use areas, if any; and*
- *Discuss the possibilities concerning the creation of buffer easements by the adjacent counties.* (Virginia Army National Guard, 5)

Figure 3-9 has been reproduced from this report and gives a strong visual representation of what types of zoning are in immediate proximity to Fort Pickett. While each county as many types of zoning, the areas containing zoning that would allow potentially incompatible uses are (by county):

- Dinwiddie County – Zoning types A-2 and R-1 both allow for relatively low-density, single-unit residential housing with R-1 further allowing certain additional uses such as churches, schools, parks, and other public facilities.

- Lunenburg County – Zoning type A-1 is rural in nature but located such that urban-type development (along with water and sewer facilities) may expand into it should the need arise.

- Nottoway – Zoning types R-1 and B-1 both allow for housing and business types that could be incompatible with the noise environment.

Note: More detailed descriptions of the individual counties' zoning regulations may be found in the source document (available from the VaARNG) or the local planning department of each county.

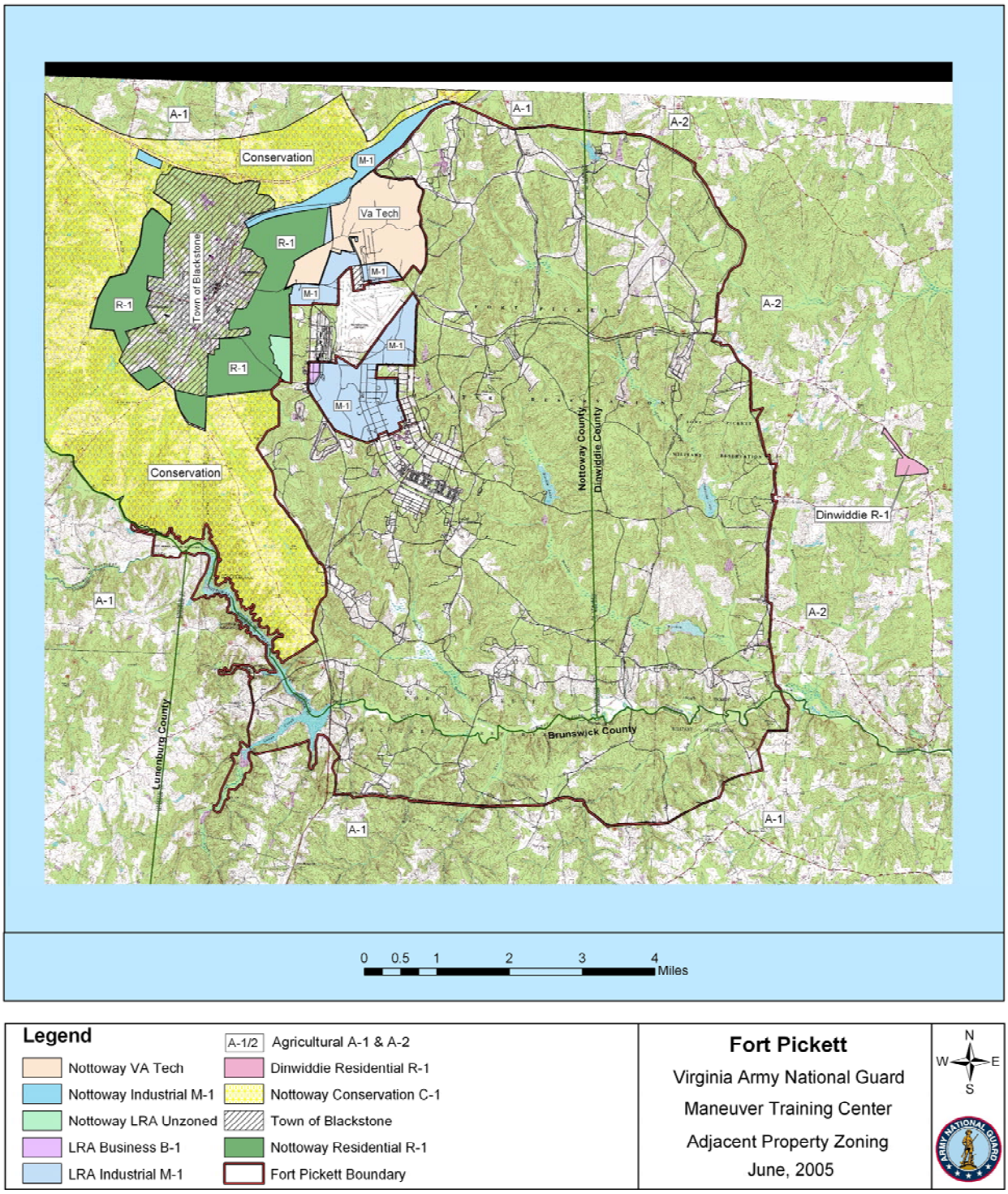


Figure 3-9 Fort Pickett Adjacent Zoning (reproduced from the June 2005 VaARNG Fort Pickett Adjacent Property Report)

3.7 SUMMARY

Compatible use planning is the primary tool used to minimize noise impacts from military operations. The Operational Noise Management Plan process, whether statewide or for a specific installation, is designed to protect the installations' mission from encroachment by off-post noise-sensitive land uses and to mitigate any identified existing noise impacts to off-post and non-military land uses. This requires quantification of the existing and future noise environment; coordination with state, regional, and local planning and zoning agencies; and exploration of possible mitigation measures to reduce noise impacts

Noise complaints at Fort Pickett are infrequent and there appears to be a general acceptance by the surrounding community of periodically elevated noise levels. However, it should be noted that, as shown by Figures 3-6 and 3-7 when compared the zoning details discussed above, there are many places where high levels of noise travel over the installation border. These places could be a future source of complaints if the area is developed with incompatible uses (see Appendix C for compatible uses) so Fort Pickett and the VaARNG must be proactive in attempts to limit incompatible development.

Lastly, it is worth noting again that, though rare, Fort Pickett staff investigates each noise complaint and operational limits are currently in place to control noise during certain days and hours of the week to minimize impacts to local residents.

This page left intentionally blank

SECTION FOUR

CAMP PENDLETON STATE MILITARY RESERVATION

4.1 CAMP PENDLETON STATE MILITARY REVERVATION (SMR) LOCATION

Camp Pendleton State Military Reservation (SMR) is a state-owned, 325 acre military installation located in Virginia along the coast of the Atlantic Ocean. Geographically, it is situated just southeast of the metro area created by the cities of Norfolk, Chesapeake, and Virginia Beach. See Figure 4-1 for vicinity map.

4.2 HISTORY

Camp Pendleton SMR was established in 1912, originally as the State Rifle Range. It was, as were most military installations, created in an area that was, at the time, sparsely populated so training noise was not an issue. Since then, the City of Virginia Beach as grown steadily around the installation and the resulting friction has lead to repeated requests by the City of Virginia Beach to take over the camp or, at the very least, convert portions of it to other uses.

As stated above, the installation consists of 325 acres that is home to over 100 buildings. In addition to the buildings, Camp Pendleton SMR also houses a small arms range, helicopter landing strip, maintenance garages, and training fields. The operation and maintenance of the installation is funded primarily by the federal government through the National Guard Bureau (NGB). There are several other tenants on the facility including the 203rd RED HORSE Air National Guard Armory and the Military Sealift Command.

Currently the use of Camp Pendleton SMR is in flux. Once the primary user, National Guard dependence on the facility is declining (due to the more desirable training environment at Fort Pickett) and Federal usage as a multi-service training facility is increasing. So, with this increase in Federal interest, Camp Pendleton State Military Range is finding that there continues to be less "state" in its focus.

4.3 CIVILIAN COMMUNITY

The properties adjacent to Camp Pendleton SMR are becoming more and more urbanized by the year. As Table 4-1 indicates, the cities of Virginia Beach and Chesapeake have experienced explosive growth over the last decade and this has increased the noise and safety pressures on the installation. Compounding the problem of encroachment is a shift in the economic demographics of the area. Since Norfolk has become the port of choice for disembarking cargo to the Mid-Atlantic States, few of the communities around the installation are dependent on the base for employment. Consequently, few residents feel any economic benefit to having the installation open and thus they are more willing to have issues with the that generate complaints, and less likely to tolerate or defend the installation's actions.

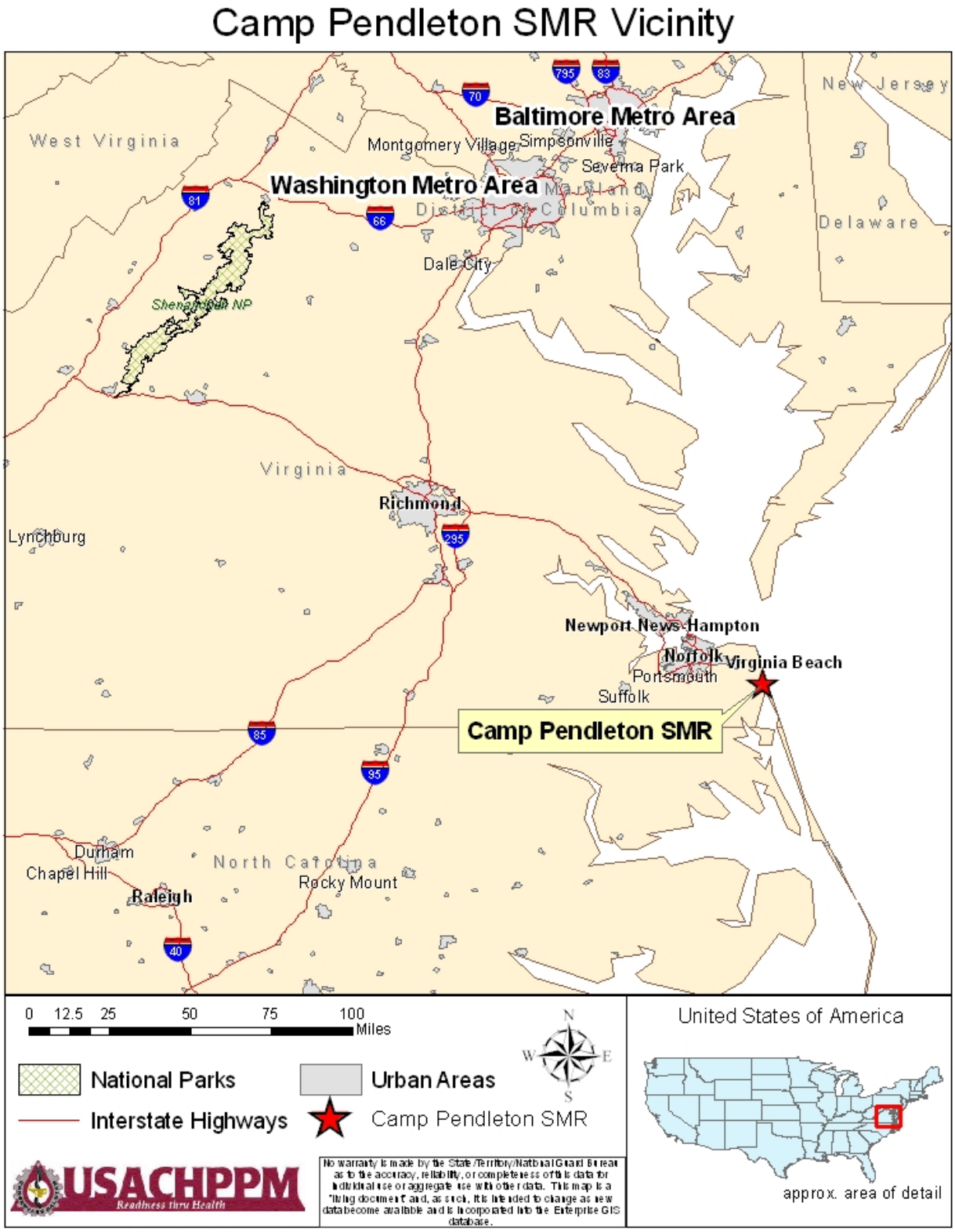


Figure 4-1 Camp Pendleton SMR Location

County/City	Population by Census Year		Percentage Change
	1990	2000	
Virginia Beach (City of)	393,069	425,257	+8.2
Norfolk (City of)	261,229	234,403	-10.3
Chesapeake (City of)	151,976	199,184	+31.1
Portsmouth (City of)	103,907	100,565	-3.2
Virginia (State of)	6,187,358	7,078,515	+14.4
United States	248,709,873	281,421,906	+13.2

Table 4-1 Population Surrounding Camp Pendleton SMR

4.4 CAMP PENDLETON SMR MISSION AND TRAINING

Camp Pendleton's primary mission is to provide the VaARNG and the Virginia Air National Guard (VaANG) with facilities that meet the federal requirements for inactive duty training of troops. The long-term plan is "to develop the installation as a computer/simulator classroom center, a land training site, and an administrative post for members of the VaARNG (SMR EA, 2003).

Current training includes specifically: small arms firing, maneuver training, force-on-force training with practice rounds, camouflage training, and helicopter extraction training.

4.5 NOISE ENVIRONMENT

Noise sources at Camp Pendleton SMR include small arms (M16 5.56mm rifle), wheeled and tracked vehicles, and rotary-wing aircraft.

4.5.1 SMALL ARMS NOISE ZONES

Camp Pendleton SMR has a single small arms range that is used infrequently. There is a proposal on the table to encapsulate the existing firing range using berms, cinder blocks, and wooden poles in order to increase the safety and operating hours of the range but this upgrade has not yet been completed. Figure 4-2, 4-3, and 4-4 are selected photos showing the existing small arms range in its current state. Note: Under close inspection, the tops of houses are visible in Figure 4-4.

Figure 4-2 Camp Pendleton SMR Existing Small Arms Range (facing downrange towards the Atlantic Ocean)

Figure 4-3 Camp Pendleton SMR Existing Small Arms Range Tower

Figure 4-4 Camp Pendleton Existing Small Arms Range Backstop and Berm

When the small arms range is in use, Table 4-2 shows the peak decibel levels that can be expected by distance and angle from the firing point.

Distance (meters)	**Predicted Sound Level (dBP)**		
	Azimuth		
	0°	**90°**	**180°**
50	135-150	112-127	102-117
100	113-128	106-121	95-110
200	106-121	99-114	89-104
400	93-108	86-101	78-93
800	85-100	77-92	69-84
1600	75-90	67-82	59-74

Table 4-2 Camp Pendleton SMR Predicted Peak Decibels for M-16 Live Fire

Figure 4-5 shows the actual peak noise contours. Is should be noted that generally there are few complaints from the firing at this range, and this noise is in fact barely noticed by residents as it is often masked by the jet noise emanating from the Naval Air Station Oceana.

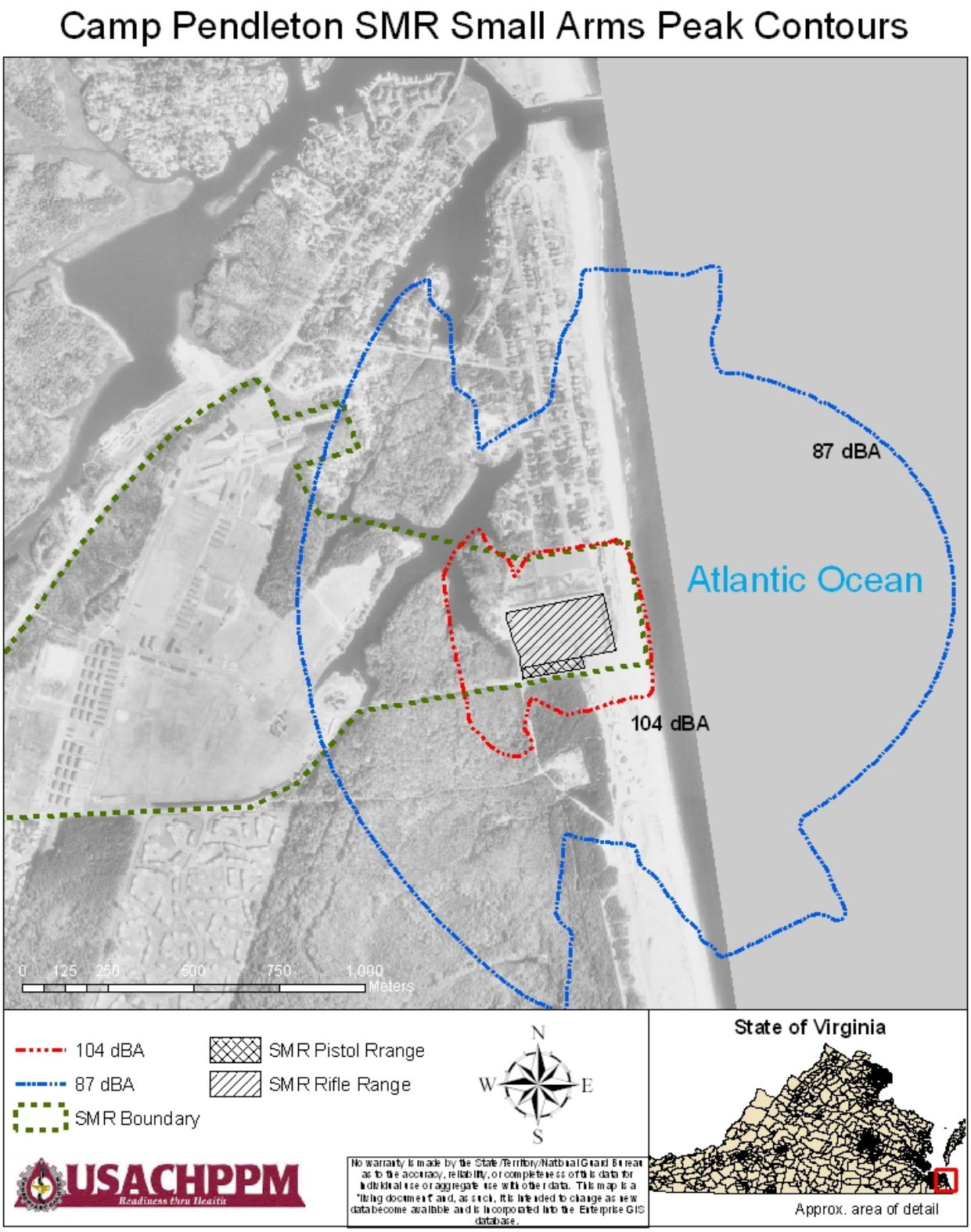


Figure 4-5 Camp Pendleton SMR Small Arms Peak Contours

4.5.2 AIRCRAFT TRAINING

Camp Pendleton aircraft operations generate very little aircraft noise, especially in the noise shadow of the Naval Air Station Oceana. The base houses only a single helicopter pad and it is used infrequently, primarily to transport people.

4.5.3 VEHICLE NOISE

The vehicle noise on Camp Pendleton SMR is negligible.

4.6 SUMMARY

Noise complaints about Camp Pendleton SMR are infrequent and there appears to be a general acceptance by the surrounding community of periodically elevated noise levels. However, as stated previously, staff investigates each noise complaint and operational limits are in place to control noise during certain days and hours of the week to minimize impacts to local residents. The proposed encapsulation of the small arms range, if carried out, would further reduce noise complaints.

SECTION FIVE

RICHMOND INTERNATIONAL AIRPORT (BYRD FIELD) ARMY AVIATION SUPPORT FACILITY (AASF)

5.1 LOCATION

Richmond International Airport (also known as Byrd Field) is the home to the VaARNG AASF. The airport is located approximately four miles southeast of downtown Richmond (please see Figure 5-1) in the area of Sandston, VA.

5.2 HISTORY

The Richmond International Airport was dedicated as Byrd Field in 1927, taking its name from the famous arctic explorer Adm. Richard E. Byrd. It is considered by many to be the gateway to central Virginia and, apart from its role as an AASF, the airport also serves as an international hub for civilian needs as well as the home to the Virginia Air National Guard's 192nd Fighter Wing. It is currently in the process of completing a major expansion.

5.3 CIVILIAN COMMUNITY

As indicated in Table 5-1, the actual city of Richmond is losing population (as are many major eastern cities), but the counties the surround the city and the airport are growing at a rate that is far greater than both the Virginia and National rates.

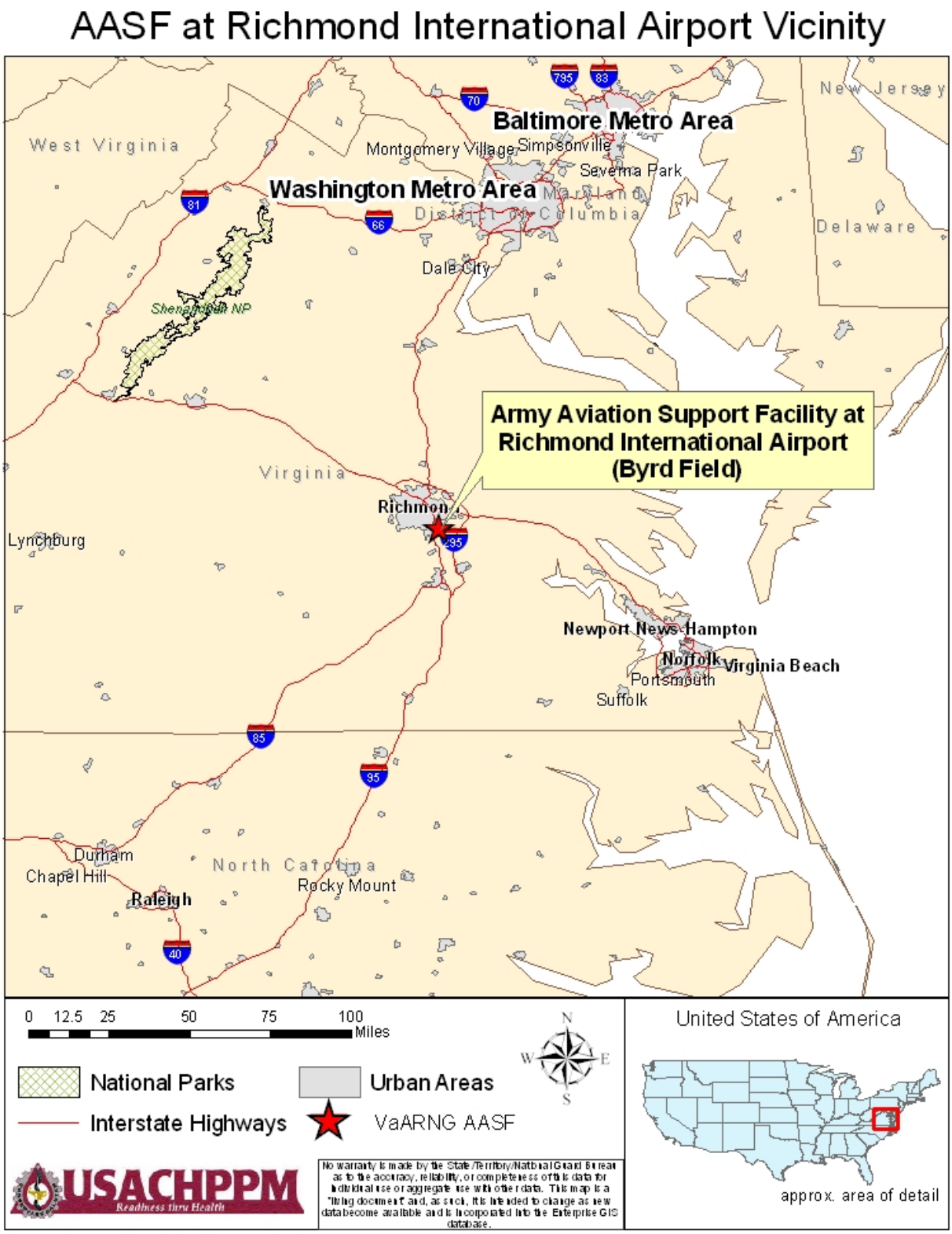


Figure 5-1 VaARNG Army Aviation Support Facility Vicinity Map

County/City	Population by Census Year		Percentage Change
	1990	2000	
Richmond (City of)	203,056	197,790	-2.4
Chesterfield County	209,271	259,903	+24.0
Henrico County	217,881	262,300	+20.4
Powhatan County	15,328	22,377	+46.0
Virginia (State of)	6,187,358	7,078,515	+14.4
United States	248,709,873	281,421,906	+13.2

Table 5-1 Population Surrounding the VaARNG Army Aviation Support Facility at Richmond International Airport

5.4 RICHMOND AASF MISSION AND TRAINING

The mission of the Richmond AASF is to provide support for the VaARNG rotary aircraft training requirements. Stationed there are approximately fifteen UH-60 Black Hawk and three OH-58 Kiowa Warrior helicopters. The UH-60s generate an average of 5-6 flights per day, seven days a week, with approximately 25% of those flights occurring at night. Use of the OH-58s is considerably less.

Figures 5-2 and 5-3 show examples of the types of helicopters that are found at the Richmond AASF.

Figure 5-2 Example of a UH-60 Black Hawk Helicopter

Figure 5-3 Example of an OH-58 Kiowa Warrior Helicopter

5.5 NOISE ENVIRONMENT

The Federal Aviation Administration (FAA) governs all flights originating from Richmond International Airport including those from the AASF. No complaints are generated largely because the noise from the small number of military flights originating from the airport is indistinguishable from the noise that the airport generates during its routine commercial operations. The small numbers of operations at the AASF are not enough to generate a noise contour by themselves, nor are they enough to effect the noise environment created by operations at the airport.

5.6 SUMMARY

As alluded to above, the AASF activities that take place at the Richmond International Airport have no specific adverse effects on the community because the relatively infrequent noise generated by Virginia National Guard training is indistinguishable in the overall noise environment created by a busy metropolitan airport. Still, though complaints are highly unlikely, AASF officials do take their duties seriously and are prepared to address any AASF-related noise complaints should they be received.

SECTION SIX

FEDERAL, STATE, AND LOCAL LAND USE POLICY AND CONTROL

6.1 GENERAL

The purpose of a land use policy and control is to promote the health, safety, convenience, order, prosperity, and general welfare of the present and future inhabitants.

6.2 FEDERAL

The Federal government, with the exception of fee owned land and easements at Federal facilities, has little land use control within the state of Virginia. Federal programs that may affect land uses are in place, but these are designed for aiding the private landowner to manage land resources and contain no actual requirements of the landowners to adhere to these recommendations. Federal agencies such as the U.S. Natural Resources Conservation Service, U.S. Forest Service, U.S. Agricultural Stabilization and Conservation Service, and U.S. Geological Survey provide assistance to landowners to manage their land and water resources to maintain agricultural and aesthetic quality.

6.3 STATE

Virginia legislation enables local counties and municipalities to establish planning commissions to develop and carry out comprehensive plans for the coordination of physical development and future needs of those municipalities and counties. The governing authority of each municipality may then adopt, amend, and enforce the planning commission's recommendations. In situations where provisions of local ordinances conflict with other standards, the stricter provisions govern.

6.4 LOCAL

Individual counties generally create Master Plans that determine the zoning and focus of development. The particulars of the individual systems vary from state to state (and sometimes county to county) but in general these master plans are created by offices of planning and zoning, commented on by the public, modified if needed, and then approved by mayors or city councils.

6.5 LAND USE PLANNING DETERMINANTS

Compliance with the laws, regulations, executive orders, and guidelines, which are applicable to current operations and to restoration of sites contaminated by previous activities, is fundamental to attaining DA goals associated with environmental protection and conservation of natural resources. In this respect, the DA has designated the achievement of the following goals, applicable in land use planning, as an integral part of the overall Army mission:

- Demonstrate leadership in environmental protection and improvement
- Minimize adverse environmental and health impacts while maximizing readiness and strategic preparedness
- Assure that consideration of the environment is an integral part of Army decision-making
- Initiate aggressive action to comply with all applicable federal, state, regional, and local environmental quality laws
- Restore lands and waters damaged through past waste disposal activities.

To achieve the foregoing DA goals, the policy of the VaARNG, which applies to all subordinate organizations, agencies, and activities, is to:

- Comply with Army Regulation 200-1, and all applicable federal, state, and local environmental quality laws, regulations, and other requirements.
- Plan, initiate, and carry out all actions and programs in a manner that will preserve, protect, restore, or mitigate the degradation of human and natural environments.
- Ensure that historic, archeological, and cultural sites, structures, and other objects under the VaARNG's jurisdiction will be preserved, restored, and maintained for the benefit of future generations.
- Eliminate or control environmental degradation resulting from training, operations, maintenance, repair, or construction of real property facilities owned, leased, or supported by the VaARNG.

6.6 LAND USE COMPATIBILITY

The rationale behind the National Guard's efforts, through the Statewide Operational Noise Management Plan, to achieve compatibility between military operations and private property interests should be apparent. The land utilized by the VaARNG is needed to conduct training and other mission essential operations, and an incompatibility with surrounding uses imperils the ability of the VaARNG to meet its responsibilities. One tool at the disposal of the various State National Guards to co-forge a compatible land use plan with local governments is the Joint Land Use Study (JLUS).

6.6.1 THE JOINT LAND USE STUDY (JLUS)

The JLUS is a collaborative land use planning effort involving the military installation and adjacent local governments that evaluates the planning rationale necessary to support and encourage compatible development of land surrounding the installation. Put another way, it is a means for the installation and local governments to develop a land-use plan that effectively addresses the long-term land-use needs of the surrounding communities yet still provides the military with the mission flexibility it needs to meet training doctrine.

Specifically, JLUS program is sponsored by the Department of Defense Office of Economic Adjustment (DODI, 1983) and it provides technical and financial assistance to the planning agencies for developing master plans that are consistent, when economically feasible, with the noise, accident potential, and safety concerns from an Installation's training and operations. The program can also assist the local communities and counties with implementing the Installation Compatible Use Zone (ICUZ) program.

The scope of the program is divided into three major tasks:

1. Impact Analysis. Provides an in-depth review of existing and proposed land use patterns: drainage, as it affects land use designations; mission encroachment, particularly noise; transportation improvements, existing and proposed routes; and noise/vibration as presented in the IENMP or ICUZ Study.

2. Land Use and Mission Compatibility Plan. Examines the above findings to identify conflicts in land use and provide alternative land use solutions; to project the impact on growth potential for adjacent areas; and to project the impact of military missions on the surrounding jurisdictions.

3. Implementation. Lists a series of actions and proposals for adoption by local jurisdictions to resolve land use conflicts and move toward a compatible land use plan for the installation and the adjacent counties and communities therein.

While the study report makes certain recommendations, it must be kept in mind that each participating jurisdiction must decide which recommendations are best suited to their particular needs. Implementation will follow the final recommendations at the discretion of the elected officials in each jurisdiction and the installation military command.

6.7 ENVIRONMENTAL JUSTICE

Environmental Justice (EJ) is defined by the U.S. Environmental Protection Agency as the "fair treatment of people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies."

Over the last decade, there has been growing attention focused on the impact of environmental pollution on particular segments of our society. The concern that some populations bear a disproportionate amount of adverse health and environmental effects led President Clinton in 1994 to

issue Executive Order 12898, focusing federal agency attention on these issues. To this end, the VaARNG will ensure that the EJ philosophy is embraced in the management of noise from its activities and the location and use of training activities (such as firing ranges) is always based strictly on the operational, safety, and environmental considerations of both the installation and all members of the civilian community.

6.8 SUMMARY

While the labyrinth of local land use regulations cannot be fully explained in this document, it is imperative that installation commanders and decision-makers become familiar with the land use regulations and development climate around their installation in order to properly gauge the possibility of impending encroachment issues. Maintaining a familiarization with local regulations by visiting local government offices; a knowledge of federal/installation-initiated tools and programs (such as the JLUS); and a consciously cultivated relationship with local government officials (by making the Installation's views and preferences know at local planning and zoning meetings) is the best way to address issues of encroachment before they in fact become issues.

Further guidance and assistance on the specifics of creating a voice for the Installation in the local planning and zoning process is available from USACHPPM's Operational Noise Program.

This page left intentionally blank

APPENDIX A

DESCRIPTION OF THE NOISE ENVIRONMENT, NOISE EVALUATORS AND NOISE CONTOURING PROCEDURES

A.1 INTRODUCTION

Noise is defined as unwanted sound. Sound is the variation of air pressure about a mean (atmospheric) pressure. These changes in the atmospheric pressure [100,000 Pascals (14.7 pounds per square inch) (psi)] vary from approximately 0.0006 Pascals for a whisper at 2 meters to 1,000 Pascals for firing an M16 rifle at the firer's ear. Because of this large range of sound pressure and the fact that the human ear responds more closely to a logarithmic scale rather than a linear scale, sound pressure level is defined as 20 times the common logarithm of the ratio of the sound pressure to the reference pressure (0.00002 Pascal). The sound pressure level is measured in decibels (dB). For example, if the sound pressure doubles from 0.2 to 0.4 Pascals, the level increases by 6 dB from 80 to 86 dB.

A characteristic of environmental noise is that it is not steady, but varies in amplitude from one moment to the next. To account for these variations in the sound pressure level with time, and to assess environmental noise in a consistent and practical manner, a statistical approach has been used to reduce the time-varying levels to single numbers. The currently accepted single-number evaluators are the equivalent sound level (LEQ) and the day-night level (DNL).

The physical basis of the noise system is the noise source, path and receiver relationship. Noise emanates from a source, travels along a path, and is perceived by the receiver. The affect of noise on the receiver can be considered the focal point of the entire system.

Before a noise problem can be resolved, however, the nature and intensity of the noise must be quantified. Because of the different types of noise, e.g., fixed- and rotary-wing aircraft flyovers, ground run-up, and explosive detonations, a weighting system was developed to measure these various types of noise.

In environmental noise, the sound pressure level is usually measured using one of the frequency networks of the sound level meter. Since the human ear is more sensitive to sounds of 1,000 Hertz and above than sounds of 125 Hertz and below, it is appropriate to apply a weighting function to the noise spectrum which will approximate the response of the human ear. The A-weighting frequency network of the sound level meter de-emphasizes the lower frequency portion of the noise spectrum to approximate the human ear's response to the noise. This A-weighting frequency response is specified by an American National Standards Institute (ANSI) standard (ANSI 1983). Thus, the A-weighting of the frequency content of the noise signal has been found to have an excellent correlation with the human subjective judgment of annoyance of the noise. The sound pressure levels measured using the A-weighting network are expressed as dBA.

To assess the additional annoyance caused by low frequency vibration of structures, the C-weighting network is used to evaluate the impulsive noise from all weapons larger than small arms. This weighting is also specified by the standard. The sound pressure levels measured using the C-weighting network are expressed as dBC.

A.2 HISTORY OF NOISE EVALUATORS

Before the mid 1970's, every organization had its own set of preferred environmental noise evaluators. This resulted in a wide variety of evaluators. Since each evaluator was developed for a specific purpose, a noise environment measured with one evaluator could not be compared with an environment measured using another evaluator.

In carrying out its responsibilities under the Noise Control Act of 1972 (PL 92-574 1972), the U.S. Environmental Protection Agency (EPA) recommended the adoption of a single environmental noise evaluator, the LEQ and its 24-hour version, DNL. The Department of Defense, along with most other U.S. Government agencies followed the EPA recommendation. The DNL is the most widely accepted descriptor for environmental noise (FAA, 1990) because of the following characteristics:

- The DNL is a measurable quantity.
- The DNL is simple to understand and use by planners and the public who are not familiar with acoustics or acoustical theory.
- The DNL provides a simple method to compare the effectiveness of alternative scenarios.
- The DNL is a "figure of merit" for noise impacts which is based on communities' reactions to environmental noise.
- The DNL is the best measure of noise exposure to identify significant impacts on the quality of the human environment.
- By Federal interagency agreement, the DNL is the best descriptor of all noise sources for land use compatibility planning.
- The DNL is the only metric with substantial body of scientific survey data on the reactions of people to noise.

In recommending the DNL, the EPA noted that most noise environments are characterized by repetitive behavior from day to day, with some variation imposed by differences between weekday and weekend activity, as well as seasonal variation. To account for these variations, an annual average is used.

Since annoyance is caused by long-term dissatisfaction with the noise environment, the annual average is an excellent predictor of the average community annoyance when there is not a large variation in the day to day or season to season DNL. The annual DNL is not a good predictor of noise complaints, since complaints represent the person's immediate dissatisfaction with the noise environment.

Currently, there are no guidelines for judging the land use compatibility for single noise events. Although much of the early work on annoyance was done on single events, each study was designed differently, and the results cannot be combined in a systematic fashion to form a statistically-valid sample. Most of these studies were either done inside a laboratory or, if done outdoors, in controlled settings. Only recently has equipment become available which would allow subjects to register their annoyance if single events are experienced during their routine activities. There is not enough of this information available to support setting standards on single events.

For impulsive noise, the Department of the Army uses the C-weighted DNL. The use of C-weighting is based on the findings of the National Academy of Sciences Committee on Hearing, Bioacoustics and Biomechanics (CHABA) (CHABA, 1981). Studies have been performed by the U.S. Army Construction Engineering Research Laboratory (USACERL) (U.S. Army, 1984) to define the average annoyance as a function of the C-weighted DNL. The ANSI (ANSI, 1986) has endorsed this method for predicting the annoyance caused by impulsive noise.

Recent research by the USACERL (Schomer, 1994) confirms what Luz and Lewis (Luz, 1979) previously found. Annoyance from impulsive noise does not increase at the same rate as annoyance from continuous noise. It increases twice as fast. That is, if an increase in the continuous noise level causes the annoyance to double, the same increase in the impulsive noise level will cause the annoyance to increase fourfold. At a sound exposure level (SEL) of 103 decibels (dB) the annoyance from continuous and impulsive noise is equal.

A.3 LEQ/DNL NOISE EVALUATORS

The LEQ is defined as the equivalent steady state sound level which, in a stated period of time, would contain the same acoustic energy as the time-varying sound during the same period. The LEQ is an energy average. The energy average puts more emphasis on the higher sound pressure levels than the arithmetic average. The LEQ is usually computed for a 1-minute, 10-minute, 30-minute, 1-hour, 8-hour or 24-hour segment of environmental noise.

To assess the added annoyance of the environmental noise during the nighttime hours (2200 - 0700 hours), the DNL is used. The DNL is the 24-hour LEQ, with a 10 dB penalty added to the nighttime levels.

By using the LEQ and DNL, the three important determinants of noise annoyance can be described by using a single number. The three determinants are the intensity of the noise event, the duration of the noise event, and the number of times the noise event takes place. Numerous laboratory and field studies have confirmed that the tradeoff between intensity, duration and number is adequately described by averaging the total acoustical energy.

A.4 NOISE CONTOURS

Noise contours for all noise sources are generated using the A- or C-weighted DNL. The contours are computed by averaging over the time period of interest, the acoustical energy from the operations of the set of noise sources of interest. The averaging period is usually a busy day, a training cycle, or a year. The contours, representing the boundaries between the noise zones, are constructed by connecting points of equal acoustical energy.

For example, the contours for an airfield are computed by averaging at many points the acoustical energy arriving at these points from aircraft operations. A 10 dB penalty is added to all nighttime operations. The contours for the airfield are constructed by connecting all points having a total acoustical energy equal to 65 dBA and connecting all points equal to 75 dBA.

A.4.1 IMPULSIVE NOISE

The noise simulation program used to assess heavy weapons noise is MicroBNOISE (U.S. Army, 1986). The MicroBNOISE program requires operational data concerning type of weapons fired from each range or firing point including demolitions, the number and type of rounds fired from each weapon, the location of targets for each range or firing point and the amount of propellant used to reach the target. Existing records on range utilization along with reasonable assumptions are used as MicroBNOISE inputs.

A.4.2 AIRCRAFT NOISE

The noise contours for aircraft activity were generated using the NOISEMAP 6.5 computer program. This program was developed for the US Air Force by Wyle Laboratories (U.S. Air Force, 1990a). The required inputs to the program are the location of the flight tracks and the number of each type of aircraft using each flight track. The BASEOPS program (U.S. Air Force, 1990b) was used to enter these data into the NOISEMAP input file.

The noise zones for the Nap of the Earth (NOE) routes were generated using the NOISESLICE computer program. The NOISESLICE is a simplified version of the NOISEMAP computer program. It was developed to predict the noise from operations at remote landing areas and from nap of the earth routes. The required inputs to this model include the number and type of aircraft using each area and the altitude of the aircraft at the point of interest.

The noise contours for the corridors used for entering and exiting the air to ground range area were generated using ROUTEMAP (U.S. Air Force, 1988). The ROUTEMAP is a model developed for the U.S. Air Force by Wyle Laboratories used for predicting noise exposure from aircraft operations on military training routes. The inputs to the model are the altitude, power setting, speed and number of operations by aircraft type for a one month period.

The ROUTEMAP model computes and plots the equivalent sound level (LEQ), the A-weighted day-night level (ADNL), the onset rate-adjusted monthly day-night level (DNMRL), and the probability of high annoyance. These levels are computed for distances perpendicular to the corridor.

A.4.3 SMALL ARMS NOISE

Small arms noise contours were generated using the Small Arms Range Noise Assessment Model (SARNAM). It incorporates the latest available information on weapons noise source models (including directivity and spectrum), sound propagation, effects of noise mitigation and safety structures (walls, berms, ricochet barriers), and community response protocols for small arms noise. SARNAM uses a more suitable noise metric than has been previously used for small arms in the US. It includes an extensive selection of weapons in the source library, can handle multiple ranges of various types, and is designed to maximize user productivity. The graphical output shows noise contours and range boundaries and can also display installation features.

A.4.4 SINGLE EVENTS

The noise level from a single event, such as artillery firings or explosive detonations, is useful to predict the annoyance and potential complaints caused by these events. To provide this supplemental information, single event levels are included in this assessment.

The single event levels from detonations were predicted using the USAEHA's SHOT computer model (Lewis, 1994). This model is used to predict the expected mean linear peak sound level and the distribution of the levels about this mean for the proposed detonation weights and selected receiver locations. The effect of topography features between the noise source and the receiver is included in the model.

The inputs to this model are the explosive weight, distance between the source and the receiver, burial depth, and location and height of a barrier, if one exists, between the source and receiver.

The SHOT model is based on an extensive measurement project by the U.S. Army Construction Engineering Research Laboratory (USACERL) at Fort Leonard Wood (U.S. Army, 1976) and our analysis of these measurements (Luz, 1985). These measurements of 5 pound charges are corrected for the different charge weights (U.S. Army, 1988b) with the relationship used by CERL in their linear peak sound level model. The accuracy of this model for large detonations was checked with the measurements taken at Sierra

Army Depot (U.S. Army 1988a and U.S. Army 1989). For the 29 measurements taken at Sierra, the mean level predicted by the SHOT model underpredicted the measured levels by an average of 1.4 decibels.

The effect of the topography is also included in the SHOT program. The topography model was derived from our monitoring at Forts Knox and Indiantown Gap (Raspet, 1986). This model was verified with the results of extensive monitoring at Picatinny Arsenal (U.S. Army, 1991) and Navajo Depot Activity (U.S. Army, 1992).

A.5 CONCLUSION

A significant amount of noise is produced by military installations. By careful consideration of noise sources, the paths this noise will take and the effect it has on the receiver, adequate land use plans can be designed and adopted for military installations and adjacent land.

By cooperative efforts on the part of military and civilian planners, the communities can be protected from sound levels that could endanger citizens' health, safety and welfare and, at the same time, protect the military mission of the installations that produce this noise.

APPENDIX B

NOISE CONTOUR OPERATIONAL DATA

B.1 INTRODUCTION

This Appendix contains the data that was used to generate the noise contours for the VaARNG's Statewide Operational Noise Management Plan (SONMP). The data was used as input to the BNOISE (large arms/demolition) noise model.

B.2 FORT PICKETT LARGE ARMS/DEMOLITION DATA

The operational data used to generate the noise contours for Fort Pickett is provided in Table B-1 and these numbers were generated based on interviews with Fort Pickett Range Control personnel.

FIRING POINT	WEAPON	NUMBER OF ROUNDS	
		0700-2300	2300-0700
Firing Point 13A	155mm Howitzer, HE	569	141
Firing Point 13A	155mm Howitzer, Inert	12	16
Firing Point 13B	155mm Howitzer, HE	371	92
Firing Point 13B	155mm Howitzer, Inert	90	14
Firing Point 13C	155mm Howitzer, HE	248	61
Firing Point 13C	155mm Howitzer, Inert	0	8
Firing Point 14A	155mm Howitzer, HE	74	19
Firing Point 14A	155mm Howitzer, Inert	5	1
Firing Point 14B	155mm Howitzer, HE	128	19
Firing Point 14B	155mm Howitzer, Inert	5	1
Firing Point 14C	155mm Howitzer, HE	711	19
Firing Point 14C	155mm Howitzer, Inert	71	1
Firing Point 14E	155mm Howitzer, HE	74	19
Firing Point 14E	155mm Howitzer, Inert	5	1
Firing Point 14F	155mm Howitzer, HE	92	19
Firing Point 14F	155mm Howitzer, Inert	5	1
Firing Point 14G	155mm Howitzer, HE	92	19
Firing Point 14G	155mm Howitzer, Inert	5	1
Firing Point 14H	155mm Howitzer, HE	92	19
Firing Point 14H	155mm Howitzer, Inert	5	1
Firing Point 14I	155mm Howitzer, HE	92	19
Firing Point 14I	155mm Howitzer, Inert	5	1
Firing Point 32A	AT4 Rocket, Inert	2	0
Firing Point 32A	C4, 1.25 lb	66	0
Firing Point 32A	Claymore, Mine	17	0
Firing Point 32B	AT4 Rocket, Inert	2	0
Firing Point 32B	C4, 1.25 lb	66	0
Firing Point 32B	Claymore, Mine	17	0
Firing Point 41A	155mm Howitzer, HE	2	0

Firing Point 41B	155mm Howitzer, HE	2	0
Firing Point 41C	155mm Howitzer, HE	110	0
Firing Point 42A	105mm Howitzer, Inert	100	0
Firing Point 42A	155mm Howitzer, HE	629	157
Firing Point 42A	155mm Howitzer, Inert	0	8
Firing Point 43A	155mm Howitzer, HE	105	7
Firing Point 43A	155mm Howitzer, Inert	6	10
Firing Point 43B	155mm Howitzer, HE	61	7
Firing Point 43B	155mm Howitzer, Inert	6	10
Firing Point 43C	105mm Howitzer, HE	497	124
Firing Point 43C	105mm Howitzer, Inert	0	125
Firing Point 43C	155mm Howitzer, HE	365	106
Firing Point 43C	155mm Howitzer, Inert	149	97
Firing Point 43D	155mm Howitzer, HE	30	7
Firing Point 43D	155mm Howitzer, Inert	6	10
Firing Point 43E	155mm Howitzer, HE	30	7
Firing Point 43E	155mm Howitzer, Inert	6	10
Firing Point 43F	105mm Howitzer, HE	67	0
Firing Point 43F	155mm Howitzer, HE	30	7
Firing Point 43F	155mm Howitzer, Inert	91	59
Firing Point 44A	155mm Howitzer, HE	267	0
Firing Point 44A	155mm Howitzer, Inert	20	0
Firing Point 44B	155mm Howitzer, HE	65	0
Firing Point 45A	155mm Howitzer, HE	29	7
Firing Point 45A	155mm Howitzer, Inert	50	43
Firing Point 45B	155mm Howitzer, HE	106	7
Firing Point 45B	155mm Howitzer, Inert	8	1
Firing Point 45C	155mm Howitzer, HE	27	7
Firing Point 45C	155mm Howitzer, Inert	8	1
Firing Point 45D	155mm Howitzer, HE	27	7
Firing Point 45D	155mm Howitzer, Inert	8	1
Firing Point 46A	155mm Howitzer, HE	69	0
Firing Point 46A	155mm Howitzer, Inert	9	0
Firing Point 48A	105mm Howitzer, HE	112	28
Firing Point 48A	105mm Howitzer, Inert	0	1
Firing Point 48C	105mm Howitzer, HE	423	0
Firing Point 50A	155mm Howitzer, HE	103	26
Firing Point 50A	155mm Howitzer, Inert	10	21
Firing Point 50B	155mm Howitzer, HE	180	26
Firing Point 50B	155mm Howitzer, Inert	10	21
Firing Point 50C	155mm Howitzer, HE	103	26
Firing Point 50C	155mm Howitzer, Inert	10	21
Firing Point 51A	155mm Howitzer, HE	99	13
Firing Point 51A	155mm Howitzer, Inert	6	3
Firing Point 51B	155mm Howitzer, HE	99	13
Firing Point 51B	155mm Howitzer, Inert	6	3
Firing Point 51C	155mm Howitzer, HE	213	13
Firing Point 51C	155mm Howitzer, Inert	68	3

Firing Point 51D	155mm Howitzer, HE	203	39
Firing Point 51D	155mm Howitzer, Inert	6	15
Firing Point 52A	155mm Howitzer, HE	282	71
Firing Point 52A	155mm Howitzer, Inert	0	16
Firing Point 52B	155mm Howitzer, HE	255	64
Firing Point 52B	155mm Howitzer, Inert	12	143
Firing Point 53A	155mm Howitzer, HE	391	98
Firing Point 53A	155mm Howitzer, Inert	82	26
Firing Point 53B	155mm Howitzer, HE	86	21
Firing Point 53B	155mm Howitzer, Inert	52	26
Firing Point 53C	155mm Howitzer, HE	238	60
Firing Point 53C	155mm Howitzer, Inert	85	26
Firing Point 54A	155mm Howitzer, HE	60	15
Firing Point 54A	155mm Howitzer, Inert	24	22
Firing Point 54B	155mm Howitzer, HE	60	15
Firing Point 54B	155mm Howitzer, Inert	24	22
Firing Point 54C	155mm Howitzer, HE	60	15
Firing Point 54C	155mm Howitzer, Inert	24	22
Firing Point 54D	155mm Howitzer, HE	60	15
Firing Point 54D	155mm Howitzer, Inert	24	22
OP2	105mm Howitzer, HE	98	0
OP2	20mm Gun, HE	100	0
OP2	60mm Mortar, Inert	80	0
OP2	81mm Mortar, HE	13	0
OP2	TOW Missile, Inert	3	0
OP3	155mm Howitzer, HE	144	0
OP3	155mm Howitzer, Inert	59	0
OP4	60mm Mortar, Inert	716	99
OP4	81mm Mortar, HE	260	65
OP4	81mm Mortar, Inert	100	13
Range 3	40mm Grenade, HE	2587	0
Range 3	AT4 Rocket, HE	32	0
Range 3	AT4 Rocket, Inert	148	0
Range 3	LAW Rocket, HE	8	0
Range 3	SMAW Rocket, HE	9	0
Range 4 Breach	C4, 1.25 lb	108	0
Range 4 Breach	Demo Sheet, M980	1168	0
Range 4 Breach	Demo Sheet, M984	153	0
Range 4 Breach	TNT, 0.5 lb	50	0
Range 4 Breach	TNT, 1 lb	10	0
Range 4 Demo	Bangalore	6	0
Range 4 Demo	C4, 1.25 lb	1455	0
Range 4 Demo	C4, 2.5 lbs	160	0
Range 4 Demo	Claymore, Mine	67	0
Range 4 Demo	Crater Charge, 40 lbs	14	0
Range 4 Demo	Demo, 3.5 lbs	15	0
Range 4 Demo	Demo Sheet, M981	2	0
Range 4 Demo	PETN, 2 lbs	5	0

Range 4 Demo	Shape Charge, 15 lbs	10	0
Range 4 Demo	Shape Charge, 40 lbs	2	0
Range 4 Demo	TNT, 0.25 lb	4	0
Range 4 Demo	TNT, 0.5 lb	4	0
Range 4 Demo	TNT, 1 lb	4	0
Range 10	81mm Mortar, Inert	162	0
Range 13	120mm Tank, Inert	154	0
Range 13	40mm Grenade, HE	1540	0
Range 13	Claymore, Mine	3	0
Range 17	Claymore, Mine	6	0
Range 17	M67, Hand grenade	135	0
Range 18	Claymore, Mine	16	0
Range 18 NS	Claymore, Mine	13	0
Range 20	C4, 1.25 lb	2	0

Table B-1 Data Used to Create Fort Pickett Annual BNOISE Contours

FIRING POINT	WEAPON	NUMBER OF ROUNDS	
		0700-2300	2300-0700
Range 15	105mm Stryker Tank, Inert	800	200

Table B-2 Data Used to Calculate Future BNOISE Contours with the Addition of Stryker Training

FIRING POINT	WEAPON
Firing Point 14A	155mm Howitzer, HE
Firing Point 14B	155mm Howitzer, HE
Firing Point 14G	155mm Howitzer, HE
Firing Point 43A	155mm Howitzer, HE
Firing Point 45A	155mm Howitzer, HE
Firing Point 48A	105mm Howitzer, HE
Firing Point 50A	155mm Howitzer, HE
Firing Point 52B	155mm Howitzer, HE
Firing Point 53A	155mm Howitzer, HE
Range 13	120mm Tank, Inert

Table B-3 Data Used to Calculate Fort Pickett's Peak BNOISE Contours

FIRING POINT	WEAPON
Range 15	105mm Stryker Tank, Inert

Table B-4 Data Used to Calculate for Pickett's Future Peak BNOISE Contours with the Addition of Stryker Training

B.3 CAMP PENDLETON/SMR SMALL ARMS DATA

As there is only one range at Camp Pendleton/SMR and only one type of weapon is fired (M-16) no actual firing data is needed in order for the SARNAM computer model to generate peak noise contours.

This page left intentionally blank

APPENDIX C

GUIDELINES FOR COMPATIBLE LAND USE

C.1 DOD COMPATIBLE LAND USE GUIDELINES FOR CLEAR ZONES AND ACCIDENT POTENTIAL ZONES (U.S. Army 1981)

LAND USE CATEGORY	COMPATIBILITY[1]		
	CLEAR ZONE	APZ I	APZ II
A. RESIDENTIAL			
Single Family Unit	No	No	Yes[2]
2-4 Family Units	No	No	No
Multifamily Dwellings (Apartments)	No	No	No
Group Quarters	No	No	No
Residential Hotels	No	No	No
Mobile Home Parks or Courts	No	No	No
Other Residential	No	No	No
B. INDUSTRIAL & MANUFACTURING[3]			
Food and Kindred Products	No	No	Yes
Textile Mill Products	No	No	Yes
Apparel	No	No	No
Lumber and Wood Products	No	Yes	Yes
Furniture and Fixtures	No	Yes	Yes
Paper and Allied Products	No	Yes	Yes
Printing, Publishing	No	Yes	Yes
Chemicals and Allied Products	No	No	No
Petroleum Refining and Related Industries	No	No	No
Rubber and Miscellaneous Plastic Goods	No	No	No
Stone, Clay and Glass Products	No	Yes	Yes
Primary Metal Industries	No	Yes	Yes
Fabricated Metal Products	No	Yes	Yes
Professional, Scientific and Controlling Instruments	No	No	No
Miscellaneous Manufacturing	No	Yes	Yes

LAND USE CATEGORY	COMPATIBILITY[1]		
	CLEAR ZONE	APZ I	APZ II
C. TRANSPORTATION, COMMUNICATIONS & UTILITIES[4]			
Railroad, Rapid Rail Transit (on-grade)	No	Yes[4]	Yes
Highway and Street Rights-of-Way	Yes[5]	Yes	Yes
Auto Parking	No	Yes	Yes
Communications	Yes[5]	Yes	Yes
Utilities	Yes[5]	Yes[4]	Yes
Other Transportation, Communications and Utilities	Yes[5]	Yes	Yes
D. COMMERCIAL & RETAIL TRADE			
Wholesale Trade	No	Yes	Yes
Building Materials (Retail)	No	Yes	Yes
General Merchandise (Retail)	No	No	Yes
Food (Retail)	No	No	Yes
Automotive, Marine, and Aviation (Retail)	No	Yes	Yes
Apparel and Accessories (Retail)	No	No	Yes
Furniture, Home Furnishings (Retail)	No	No	Yes
Eating and Drinking Facilities	No	No	No
Other Retail Trade	No	No	Yes
E. PERSONAL & BUSINESS SERVICES[6]			
Finance, Insurance, and Real Estate	No	No	Yes
Personal Services	No	No	Yes
Business Services	No	No	Yes
Repair Services	No	Yes	Yes
Professional Services	No	No	Yes
Contract Construction Services	No	Yes	Yes
Indoor Recreation Services	No	No	Yes
Other Services	No	No	Yes
F. PUBLIC AND QUASI-PUBLIC SERVICES			
Government Services	No	No	Yes[6]
Educational Services	No	No	No
Cultural Activities	No	No	No
Medical and Other Health Services	No	No	No
Cemeteries	No	Yes[7]	Yes[7]

LAND USE CATEGORY	COMPATIBILITY[1]		
	CLEAR ZONE	APZ I	APZ II
Non-profit Organizations Including Churches	No	No	No
Other Public and Quasi-Public Services	No	No	Yes
G. OUTDOOR RECREATION			
Playgrounds and Neighborhood Parks	No	No	Yes
Community and Regional Parks	No	Yes[8]	Yes[8]
Nature Exhibits	No	Yes	Yes
Spectator Sports Including Arenas	No	No	No
Golf Courses[9], Riding Stables[10]	No	Yes	Yes
Water Based Recreational Areas	No	Yes	Yes
Resort and Group Camps	No	No	No
Entertainment Assembly Areas	No	No	No
Other Outdoor Recreation	No	Yes[8]	Yes
H. RESOURCE PRODUCTION & EXTRACTION & OPEN LAND			
Agriculture[11]	Yes	Yes	Yes
Livestock Farming, Animal Breeding[12]	No	Yes	Yes
Forestry Activities	No	Yes	Yes
Fishing Activities and Related Services[13]	No[14]	Yes[13]	Yes
Mining Activities	No	Yes	Yes
Permanent Open Space	Yes	Yes	Yes
Water Areas[13]	Yes	Yes	Yes

Footnotes:

1 A "Yes" or "No" designation for compatible land use is to be used only for gross comparison. Within each, uses exist where further definition may be needed as to whether it is clear or usually acceptable/unacceptable owing to variations in densities of people and structures. For heliports and stagefields, the takeoff safety zone is equivalent to the clear zone and the approach-departure zone is equivalent to APZ I for these land use guidelines.

2 Suggested maximum density 1-2 dwelling units per acre, possibly increased under a Planned Unit Development where maximum lot coverage is less than 20 percent.

3 Factors to be considered: Labor intensity, structural coverage, explosive characteristics, and air pollution.

[4] No passenger terminals and no major above ground transmission lines in APZ I.

[5] Not permitted in graded area, except as noted in Table 2-7, TM 5-803-7.

[6] Low intensity office uses only. Meeting places, auditoriums, etc., not recommended.

[7] Excludes chapels.

[8] Facilities must be low intensity.

[9] Clubhouse not recommended.

[10] Concentrated rings with large classes not recommended.

[11] Includes livestock grazing but excludes feedlots and intensive animal husbandry.

[12] Includes feedlots and intensive animal husbandry.

[13] Includes hunting and fishing.

[14] Controlled hunting and fishing may be permitted for the purpose of wildlife control

C.2 GUIDELINES FOR CONSIDERING NOISE IN LAND USE PLANNING AND CONTROL (FICUN 1980)

		NOISE ZONES/ADNL LEVELS (dBA)						
		NZ I		NZ II		NZ III		
SLUCM No.	LAND USE	0-55	55-65	65-70	70-75	75-80	80-85	85 +
10	**RESIDENTIAL**							
11	Household Units	Yes	Yes*	25[1]	30[1]	No	No	No
12	Group Quarters	Yes	Yes*	25[1]	30[1]	No	No	No
13	Residential Hotels	Yes	Yes*	25[1]	30[1]	No	No	No
14	Mobile Home Parks or Courts	Yes	Yes*	No	No	No	No	No
15	Transient Lodgings	Yes	Yes*	25[1]	30[1]	35[1]	No	No
16	Other Residential	Yes	Yes*	25[1]	30[1]	No	No	No
20,30	**MANUFACTURING**							
21	Food & Kindred Products	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
22	Textile Mill Products	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
23	Apparel/Other Finished Products	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
24	Lumber & Wood Products	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
25	Furniture & Fixtures	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
26	Paper & Allied Products	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
27	Printing, Publishing & Allied Industries	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
28	Chemicals & Allied Products	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
29	Petroleum Refining & Related Industries	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
31	Rubber & Misc Plastic Products - Manufac	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
32	Stone, Clay & Glass Products - Manufac	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
33	Primary Metal Industries	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No

SLUCM No.	LAND USE	NOISE ZONES/ADNL LEVELS (dBA) NZ I 0-55	NZ I 55-65	NZ II 65-70	NZ II 70-75	NZ III 75-80	NZ III 80-85	NZ III 85+
20,30	**MANUFACTURING continued:**							
34	Fabricated Metal Products - Manufac	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
35	Professional, Scientific & Controls	Yes	Yes	Yes	25	30	No	No
39	Miscellaneous Manufacturing	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
40	**TRANSPORT, COMMS & UTIL**							
41	Railroad, Rapid Rail Transit & Street Rail	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	Yes[4]
42	Motor Vehicle Transportation	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	Yes[4]
43	Aircraft Transportation	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	Yes[4]
44	Marine Craft Transportation	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	Yes[4]
45	Highway & Street Right-of-Way	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	Yes[4]
46	Automobile Parking	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
47	Communications	Yes	Yes	Yes	25[5]	30[5]	No	No
48	Utilities	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	Yes[4]
49	Other Transportation, Comms & Utilities	Yes	Yes	Yes	25[5]	30[5]	No	No
50	**TRADE**							
51	Wholesale Trade	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
52	Retail - Building Materials, Hardware/ Farm	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
53	Retail - General Merchandise	Yes	Yes	Yes	25	30	No	No
54	Retail - Food	Yes	Yes	Yes	25	30	No	No

SLUCM No.	LAND USE	NOISE ZONES/ADNL LEVELS (dBA) NZ I 0-55	NZ I 55-65	NZ II 65-70	NZ II 70-75	NZ III 75-80	NZ III 80-85	NZ III 85 +
50	**TRADE continued:**							
55	Retail - Auto, Marine, Aircraft & Parts	Yes	Yes	Yes	25	30	No	No
56	Retail - Apparel & Accessories	Yes	Yes	Yes	25	30	No	No
57	Retail - Furniture, Furnishings & Equipment	Yes	Yes	Yes	25	30	No	No
58	Retail - Eating & Drinking Facilities	Yes	Yes	Yes	25	30	No	No
59	Other Retail Trade	Yes	Yes	Yes	25	30	No	No
60	**SERVICES**							
61	Finance, Insurance & Real Estate Services	Yes	Yes	Yes	25	30	No	No
62	Personal Services	Yes	Yes	Yes	25	30	No	No
62.4	Cemeteries[11]	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	Yes[6]
63	Business Services	Yes	Yes	Yes	25	30	No	No
64	Repair Services	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
65	Professional Services	Yes	Yes	Yes	25	30	No	No
65.1	Hospitals, Nursing Homes	Yes	Yes[*]	25[*]	30[*]	No	No	No
65.1	Other Medical Facilities	Yes	Yes	Yes	25	30	No	No
66	Contract Construction Services	Yes	Yes	Yes	25	30	No	No
67	Government Services	Yes	Yes[*]	Yes[*]	25[*]	30[*]	No	No
68	Educational Services	Yes	Yes[*]	25[*]	30[*]	No	No	No
69	Miscellaneous Services	Yes	Yes	Yes	25	30	No	No
70	**CULTURAL, ENTERTAINMENT & REC**							
71	Cultural Activities, Including Churches	Yes	Yes[*]	25[*]	30[*]	No	No	No
71.2	Nature Exhibits	Yes	Yes[*]	Yes[*]	No	No	No	No

SLUCM No.	LAND USE	NOISE ZONES/ADNL LEVELS (dBA) NZ I 0-55	NZ I 55-65	NZ II 65-70	NZ II 70-75	NZ III 75-80	NZ III 80-85	NZ III 85 +
70	**CULTURAL, ENTERTAINMENT & REC continued:**							
72	Public Assembly	Yes	Yes	Yes	No	No	No	No
72.1	Auditoriums, Concert Halls	Yes	Yes	25	30	No	No	No
72.11	Outdoor Music Shells, Amphitheaters	Yes	Yes*	No	No	No	No	No
72.2	Outdoor Sports Arenas, Spectator Sports	Yes	Yes	Yes[7]	Yes[7]	No	No	No
73	Amusements	Yes	Yes	Yes	Yes	No	No	No
74	Recreational Activities	Yes	Yes*	Yes*	25*	30*	No	No
75	Resorts, Groups & Camps	Yes	Yes*	Yes*	Yes*	No	No	No
76	Parks	Yes	Yes*	Yes*	Yes*	No	No	No
79	Other Cultural, Entertainment & Recreation	Yes	Yes*	Yes*	Yes*	No	No	No
80	**RESOURCE PRODUCT & EXTRACT**							
81	Agriculture (Except Livestock)[11]	Yes	Yes	Yes[8]	Yes[9]	Yes[10]	Yes[10]	Yes[10]
81.5-81.7	Livestock Farming & Animal Breeding	Yes	Yes	Yes[8]	Yes[9]	No	No	No
82	Agricultural Related Activities[11]	Yes	Yes	Yes[8]	Yes[9]	Yes[10]	Yes[10]	Yes[10]
83	Forestry Activities & Related Services[11]	Yes	Yes	Yes[8]	Yes[9]	Yes[10]	Yes[10]	Yes[10]
84	Fishing Activities & Related Services	Yes	Yes	Yes	Yes	Yes	Yes	Yes
85	Mining Activities & Related Services	Yes	Yes	Yes	Yes	Yes	Yes	Yes
89	Other Resource Production & Extraction	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Legend:

SLCUM	Standard Land Use Coding Manual
Yes	Land use and related structures compatible without restrictions.
No	Land use and related structures are not compatible and should be prohibited.
ADNL	A-weighted day-night sound level
NZ	Noise Zone
Yes[x]	"Yes" but with restrictions. Land use and related structures generally compatible; see footnotes.
25, 30, 35	Land use and related structures generally compatible; measures to achieve noise level reduction (NLR) of 25, 30 or 35 must be incorporated into design and construction of structure.
25[*], 30[*], 35[*]	Land use generally compatible with NLR; however, measures to achieve an overall NLR do not necessarily solve noise difficulties and additional evaluation is warranted.
NLR	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

Footnotes:

[*] The designation of these uses as "compatible" in this zone reflects individual Federal agencies' consideration of general cost and feasibility factors as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider.

a) Although local conditions may require residential use, it is discouraged in 65-70 ADNL and strongly discouraged in 70-75 ADNL. The absence of viable alternative development options should be determined and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these zones should be conducted prior to approvals.

b) Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor NLR of at least 25 dB (65-70 ADNL) and 30 dB (70-75 ADNL) should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to

provide a NLR of 20 dB, thus the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels.

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

[2] Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.

[3] Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.

[4] Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.

[5] If noise-sensitive, use indicated NLR; if not, use is compatible.

[6] No buildings.

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

[8] Residential buildings require a NLR of 25.

[9] Residential buildings require a NLR of 30.

[10] Residential buildings not permitted.

[11] In areas with ADNL greater than 80, land use not recommended, but if community decides use is necessary, hearing protection devices should be worn by personnel.

APPENDIX D

GLOSSARY OF TERMS, ACRONYMS & ABBREVIATIONS

D.1 GLOSSARY OF TERMS

A-Weighted Sound Level, A-Level (AL) - The ear does not respond equally to sounds of all frequencies, but is less efficient at low and high frequencies than it is at medium or speech range frequencies. Thus, to obtain a single number representing the sound pressure level of a noise containing a wide range of frequencies in a manner approximating the response of the ear, it is necessary to reduce, or weight, the effects of the low and high frequencies with respect to the medium frequencies. Thus, the low and high frequencies are de-emphasized with the A-weighting.

The A-scale sound level is a quantity, in decibels, read from a standard sound-level meter with A-weighting circuitry. The A-scale weighting discriminates against the lower frequencies according to a relationship approximating the auditory sensitivity of the human ear. The A-scale sound level measures approximately the relative "noisiness" or "annoyance" of many common sounds.

Accident Potential Zone I (APZ I) [Class A Runway Accident] - an area 1,000 feet wide by 2,500 feet long located just beyond the Clear Zones at each end of the runway. Less critical than the Clear Zone it still possesses significant potential for accidents. Land use compatibility guidelines allow a wide variety of industrial, manufacturing, transportation, communication, utilities, wholesale trade, open space, recreation and agricultural uses. Uses that concentrate people in small areas are not acceptable in APZ I.

Accident Potential Zone II (APZ II) [Class A Runway] - an area 1,000 feet wide and extending 2,500 feet beyond APZ I. This area is less critical than APZ I but still possesses potential for accidents. Acceptable land uses include those in APZ I, as well as low density, single family residences. Also acceptable are personal and business services and commercial retail trade uses of low intensity or scale of operation. High-density functions such as multi-story buildings, places of assembly (e.g., theaters, schools, churches, and restaurants) and high-density office uses are not considered appropriate.

Aircraft - fixed-wing (FW) (Airplane) and rotary-wing (RW) (Helicopter).

Airfield - an area prepared for the accommodation (including any buildings, installations, and equipment), landing and takeoff of aircraft.

Annual Average Busy Day - the average of the 12 monthly averages of workday operations. This is obtained by computing a workday average over a monthly period for each month and then averaging the 12 values.

Approach-Departure Zone - an area on ground or water located beneath the approach-departure clearance surface. It begins at the outer edge of the Takeoff Safety Zone and the boundaries are identical to the horizontal dimensions of the approach-departure clearance surface. It corresponds to the Accident Potential Zone I for land use planning purposes.

Approach-Departure Clearance Surface (VFR) - an inclined plane above the limits of the approach-departure zone, symmetrical about the runway or helipad extended longitudinal centerline. It starts at the end of the primary surface with the same width and at the established elevation of the landing surface. It extends outward and upward at a slope ratio of 8 to 1 until an elevation of 150 feet above the established helicopter runway or helipad elevation is reached. The outer width at the end of the 1,200 foot length is 600 feet, and it continues at this width until the minimum en route altitude is reached. Note: When helicopter facilities are located separately, from fixed-wing runways, the approach-departure clearance surface extends horizontally to the limits of that surface and then continues on an 8 to 1 slope ratio until minimum en route altitude is reached.

Average Sound Level - the mean-squared sound exposure level of all events occurring in a stated time interval, plus ten times the common logarithm of the quotient formed by the number of events in the time interval, divided by the duration of the time interval in seconds.

C-Weighted Sound Level, C-Level (CL) - a quantity, in decibels, read from a standard sound level meter with C-weighting circuitry. The C-scale incorporates slight de-emphasis of the low and high portion of the audible frequency spectrum.

Class A Runway - a runway intended primarily for small light aircraft. Such runways either do not have the potential for development for use by heavy aircraft or there is no foreseeable requirement for such use. Ordinarily, less than 10 percent of the operations at airfields with Class A runways involve aircraft in the Class B category and the runway(s) are less than 8,000 feet long.

Class B Runway - all runways other than Class A runways, for example, runways that accommodate heavy aircraft or have the potential for development to heavy aircraft use.

Clear Zone (CZ) [Class A Runway] - an area 1,000 feet wide by 3,000 feet long located at the immediate end of the runway. The accident potential in this area is so high that no building is allowed. For safety reasons, the Army is authorized to purchase the land for these areas if not already part of the installation.

Community - those individuals, organizations, or special interest groups affected by or interested in decisions affecting towns, cities, or unincorporated areas near or adjoining a military installation; and officials of local, state and federal governments, and Native American tribal councils responsible for decision making and administration of programs affecting those communities.

Community Involvement Program - a carefully designed program, using a variety of techniques, which, in addition to informing the public of possible decisions and their potential consequences, provides opportunities for consultation with the public, and considers the public's views before making decisions and taking actions.

Continuous Noise - on-going noise whose intensity remains at a measurable level without interruption over an indefinite or a specified period of time.

Controlled Firing Area - airspace wherein firing activities are conducted under conditions so controlled as to eliminate hazardous to nonparticipating aircraft and to ensure the safety of persons and property on the ground.

Day-Night Average Sound Level (DNL) - the 24-hour average frequency-weighted sound level, in decibels, from midnight to midnight, obtained after addition of 10 decibels to sound levels in the night from midnight up to 7 a.m. and from 10 p.m. to midnight (0000 up to 0700 and 2200 up to 2400 hours). A-Weighting is understood unless otherwise specified.

Decibels (dB) - a logarithmic sound pressure unit of measure.

Encroachment - unguided use or development of the land surrounding a military installation.

Equivalent Sound Level (LEQ) - the level of a constant sound which, in a given situation and time period, has the same energy as does a time varying sound. For noise sources, which are not in continuous operation, the equivalent sound level may be obtained by summing individual sound exposure level (SEL) values and normalizing over the appropriate time period.

Established Airfield Elevation - the elevation (in feet above mean sea level) of the highest point on the usable landing surface.

Fixed-Wing Aircraft - a powered aircraft that has wings attached to the fuselage so that they are either rigidly fixed in place or adjustable, as distinguished from aircraft with rotating wings, like a helicopter.

Frequency - number of complete oscillation cycles per unit of time. The unit of frequency is the Hertz (Hz).

Helicopter - an aircraft deriving both lift and control from one or more power driven rotors rotating on substantially vertical axes.

Hertz - unit of frequency equal to one cycle per second.

Impulse Noise (Impulsive Noise) - noise of short duration (typically less than one second), especially of high intensity, abrupt onset and rapid decay, and often rapidly changing spectral composition. Impulse noise is characteristically associated with such sources as explosions, impacts, the discharge of firearms, the passage of supersonic aircraft (sonic boom) and many industrial processes.

Instrument Flight Rules (IFR) - rules that govern the procedure for conducting instrument flight.

Intermittent Noise - fluctuating noise whose level falls one or more times to low or immeasurable values during an exposure.

Military Operations Area (MOA) - a special use airspace assignment of defined vertical and lateral dimensions established outside positive control areas to separate/segregate certain military activities from IFR traffic and to identify for VFR traffic where these activities are conducted.

Modularity – the military concept where forces are constructed of highly skilled relatively standardized units (training and equipment) to maintain the greatest possible combat flexibility.

Noise - any sound without value.

Noise Exposure - the cumulative acoustic stimulation reaching the ear of a person over a specified period of time (e.g., a work shift, a day, or a lifetime).

Noise Hazard (Hazardous Noise) - acoustic stimulation of the ear which is likely to produce noise-induced permanent threshold shift in some portion of the population.

Noise Level Reduction (NLR) - the difference, in decibels, between the A-weighted sound level outside a building and the A-weighted sound level inside a designated room in the building. The NLR is dependent upon the transmission loss characteristics of the building surfaces exposed to an exterior noise source, the particular noise characteristics of the exterior noise source and the acoustic properties of the designated room in the building.

Noise Zone III (NZ III) - consists of an area around the source of the noise in which the day-night sound level (DNL) is greater than 75 decibels, A-weighted (dBA) or 70 decibels, C-weighted (dBC). The noise level within NZ III is considered so severe that noise-sensitive activities should not be conducted therein.

Noise Zone II (NZ II) - consists of an area where the day-night sound level is between 65 and 75 dBA or 62 and 70 dBC. Exposure to noise within this area is considered significant and use of the land within NZ II should normally be limited to activities such as industrial, manufacturing, transportation and resource production.

Noise Zone I (NZ I) - includes all areas around a noise source in which the day-night sound level is less than 65 dBA or 62 dBC. This area is usually suitable for all types of land use activities.

Obstacle - a natural or manmade object that violates airfield or heliport clearances, or projects into imaginary airspace surfaces.

Prohibited Area - designated airspace within which the flight of aircraft is prohibited (Refer to Enroute Charts).

Public - the same thing as "community" (for the purposes of this management plan).

Public Information Program - a carefully designed effort, using a variety of techniques, to inform those people most likely to be interested or affected by actions resulting from the Environmental Noise Management Program and Plan.

Restricted Area - airspace designated under FAR, Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use and IFR/VFR operations in the area may be authorized by controlling ATC facility when it is not being utilized by the using agency. Restricted areas are depicted on enroute charts. Where joint use is authorized, the name of the ATC controlling facility is also shown. (Refer to FAR, Part 73)

Runway - a designated rectangular area, on an airfield or heliport prepared for the landing and takeoff run of aircraft along its length.

Scaled Distance - parameter used by the mining industry and equal to the source-to-receiver distance divided by the cube root of the mass of the explosive material, $S=d/m^{1/3}$, with distance d in feet and explosive mass m in pounds. Unit = feet per cube root of pounds.

Sound Exposure Level (SEL) - the level of the sound pressure squared, integrated over a given time.

Sound Level Meter - an instrument that provides a direct reading of the sound pressure level at a particular location. It consists of a microphone and electronic amplifier together with a meter having a scale graduated in decibels. Using appropriate built-in electrical filters, it is possible to directly measure the overall A- and C-weighted sound pressure levels. Standard sound level meters must satisfy the requirements of American National Standards Institute (ANSI) Specification for Sound Level Meters, S1.4-1983.

Standard Land Use Coding Manual (SLUCM) - standard system for identifying and coding land use activities. Published by the U.S. Department of Commerce, 1965.

Vibration - an oscillation where the quantity is a parameter that defines the motion of a mechanical system.

Visual Flight Rules (VFR) - rules that govern the procedures for conducting flight under visual conditions.

Warning Area - special use airspace, which may contain hazards to nonparticipating aircraft in international airspace.

D.2 GLOSSARY OF ACRONYMS AND ABBREVIATIONS

A

AAF	Army Airfield
ADNL	A-weighted Day-Night Average Sound Level
A-DZ	Approach-Departure Zone
AGL	Above Ground Level
AHO	Above Highest Obstacle
AL	A-weighted Sound Level
ANSI	American National Standards Institute
AO	Area of Operation
APZ	Accident Potential Zone
APZ I	Accident Potential Zone I
APZ II	Accident Potential Zone II
AR	Army Regulation
ARNG	Army National Guard
ATC	Air Traffic Control

B

BN	Battalion

C

CDNL	C-weighted Day-Night Level
CHABA	National Academy of Sciences Committee on Hearing, Bioacoustics and Biomechanics
CIP	Capital Improvement Program
CL	C-weighted Sound Level
CZ	Clear Zone

D

DA	Department of the Army
dB	Decibels
dBA	Decibels, A-weighted
dBC	Decibels, C-weighted
dBP	Decibels, Unweighted Peak
DNL	Day-Night Average Sound Level
DOD	Department of Defense
DODI	Department of Defense Instruction

E

EA	Environmental Assessment
EDA	Economically Distressed Area
EEO	Equal Employment Opportunity
EIS	Environmental Impact Statement
EJ	Environmental Justice
ENMP	Environmental Noise Management Plan

EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency

F

FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FICUN	Federal Interagency Committee on Urban Noise
FORSCOM	U.S. Army Forces Command
FW	Fixed-wing Aircraft
FY	Fiscal Year

G

GIS	Geographic Information System

H

HQ	Headquarters
HQDA	Headquarters, Department of the Army
HR	U.S. House of Representatives
HUD	U.S. Department of Housing and Urban Development
Hz	Hertz

I

ICUZ	Installation Compatible Use Zone
IFR	Instrument Flight Rules
IG	Inspector General
IONMP	Installation Operational Noise Management Plan

J

JLUS	Joint Land Use Study

K

None

L

ADNL	A-weighted Day-Night Sound Level
CDNL	C-weighted Day-Night Sound Level
LEQ	Equivalent Sound Level

M

MAST	Military Assistance to Safety and Traffic
MEDEVAC	Medical Evacuation
MMB	Multi-Media Branch
MOA	Military Operations Area
MP	Military Police
MSL	Mean Sea Level

N

NAS	Naval Air Station
NAVAIDS	Aids to Navigation
NE	Northeast
NEPA	National Environmental Policy Act
NFS	National Forest Service
NGB	National Guard Bureau
NLR	Noise Level Reduction
NOE	Nap of the Earth
NW	Northwest
NZ	Noise Zone
NZ I	Noise Zone I
NZ II	Noise Zone II
NZ III	Noise Zone III

O

OMB	Office of Management and Budget
ONMP	Operational Noise Management Plan

P

PAO	Public Affairs Officer
PL	Public Law
PMO	Provost Marshal Office

Q

None

R

R&D	Research and Development
RC	Reserve Components
ROTC	Reserve Officers Training Corps
RW	Rotary-wing Aircraft (Helicopter)

S

SCS	Soil Conservation Service (US)
SE	Southeast
SEL	Sound Exposure Level
SGS	Secretary of the General Staff
SJA	Staff Judge Advocate
SLUCM	Standard Land Use Coding Manual
SONMP	Statewide Operational Noise Management Plan
SR	State Route
STC	Sound Transmission Class
SW	Southwest

T

TDR	Transfer of Development Rights
TM	Technical Manual
TRADOC	U.S. Army Training and Doctrine Command

U

USACERL	U.S. Army Construction Engineering Research Laboratories
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAF	U.S. Air Force
USAR	U.S. Army Reserve
USC	U.S. Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service

V

VA	U.S. Department of Veterans Affairs
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

W, X, Y, Z

None

This page left intentionally blank

APPENDIX E

REFERENCES AND SOURCES

ANSI, 1983, S1.4-1983, American National Standard Specifications for Sound Level Meters.

ANSI, 1986, S12.4-1986, American National Standard method for Assessment of High-Energy Impulsive Sounds with Respect to Residential Communities.

Bureau of Mines, 1980, Report No. RI 8507, Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting.

Census, 1970, "General Social and Economic Characteristics, U.S. Census of Population 1970.

Census, 1980, "General Social and Economic Characteristics, U.S. Census of Population 1980.

CHABA, 1981, Committee on Hearing, Bioacoustics, and Biomechanics Working Group 84 Report, Assessment of Community Response to High-Energy Impulsive Sounds.

Cumerlato, 1994, C.L. Cumerlato and D.E. Siskind, "Residential Structural Responses tp Airblast from Munitions Disposal at the McAlester Army Ammunition Plant," Proceedings, Tenth Annual Symposium on Explosives and Blasting Research.

DODI, 1977, Department of Defense Instruction 4165.57, Air Installation Compatible Use Zones.

DODI, 1983, Department of Defense Instruction 3030.2, Community Planning and Impact Assistance.

FAA, 1976, Report No. FAA-RD-76-87, Statistical model of sonic boom structural damage.

FAA, 1990, "Day Night Average Sound Level (DNL), The Descriptor of Choice for Airport Noise Assessment." Federal Aviation Administration.

FICUN, 1980, Guidelines for Considering Noise in Land Use Planning and Control. Federal Interagency Committee on Urban Noise.

Fort Knox, 1994, Fort Knox, Kentucky Joint Land Use Study (JLUS).

HAI, 1983, Helicopter Association International I Fly Neighborly.

Lewis, 1994, "Prediction of Impulsive Noise Levels: A Different Approach," Presented at the 127th Meeting of the Acoustical Society of America, Cambridge, Massachusetts.

Luz, G.A. and N.D. Lewis, 1979, "Problems in using the C-weighted day-night level to assess military blast noise environments," Presented at the 97th Meeting of the Acoustical Society of America, Cambridge, Massachusetts.

Luz, 1985, "A statistical model for predicting the probability of complaints from Army weapon noise", presented at the 110th Meeting of the Acoustical Society of America, Nashville, Tennessee.

Virginia Army National Guard, June 2005, Adjacent Property Zoning Report—Virginia Army National Guard Maneuver Training Center, Fort Pickett.

Pater, 1976, "Noise Abatement Program for Explosive Operations at NSWC/DL", presented at the 17th Explosives Safety Seminar of the DOD Explosives Safety Board.

Public Law 92-574, 1972, 92nd U.S. Congress, Noise Control Act of 1972.

Public Law 95-609, 1978, 95th U.S. Congress, Quiet Communities Act of 1978.

Rand McNally, 1998, Rand McNally Road Atlas.

Raspet and Lewis, 1986, "Reduction of artillery noise by natural barriers", Journal of Applied Acoustics, Volume 19, Number 2, pages 117 - 130.

Rylander, *et al*., 1974, "Re-Analysis of Aircraft Noise Annoyance Data Against the dBA Peak Concept", Journal of Sound and Vibration, Volume 36, pages 399 - 406.

Rylander and Bjorkman, 1988, "Maximum Noise Levels as Indicators of Biological Effects", Journal of Sound and Vibration, Volume 127, pages 555 - 563.

Schomer, P.D., 1994, "New Descriptor for High-Energy Impulsive Sounds," Noise Control Engineering Journal.

Siskind, 1989, "Vibrations and Airblast Impacts on Structures from Munitions Disposal Blasts," Proceedings, Inter-Noise 89, G.C. Maling, Jr., editor, pages 573 - 576.

U.S. Air Force, 1977, AARML Report No. ARML-TR-73-110, Community Noise Exposure resulting from Aircraft Operations, Volume 2, Acoustic Data on Military Aircraft: Air Force Bomber/Cargo Aircraft.

U.S. Air Force, 1978, AARML Report No. ARML-TR-73-110, Community Noise Exposure resulting from Aircraft Operations, Volume 3, Acoustic Data on Military Aircraft: Air Force Attack/Fighter Aircraft.

U.S. Air Force, 1988, Report No. AARML-TR-88-060, ROUTEMAP Model for Predicting Noise Exposure from Aircraft Operations on Military Training Routes.

U.S. Air Force, 1990a, Report No. AARML-TR-90-011, Air Force Procedure for Predicting Aircraft Noise Around Airbases: Noise Exposure Model (NOISEMAP) User's Manual.

U.S. Air Force, 1990b, Report No. AARML-TR-90-012, Air Force Procedure for Predicting Aircraft Noise Around Airbases: Airbase Operations Program (BASEOPS) Description.

University of Utah, 1958, Explosives Research Group Report No. 12, Measurement of Air and Ground Shock Disturbances Arising from Demolition Activities at Letterkenny Ordnance Depot.

U.S. Army, 1976, USACERL Technical Report N-13, The Statistics of Amplitude and Spectrum of Blasts Propagated in the Atmosphere.

U.S. Army, 1978, Technical Manual 5-803-2, Planning in the Noise Environment.

U.S. Army, 1978, Technical Manual 5-803-4, Planning of Army Aviation Facilities.

U.S. Army, 1981, Technical Manual 5-803-7, Airfield and Heliport Planning Criteria.

U.S. Army, 1984, Construction Engineering Research Laboratory Technical Report N-167, Community Reaction to Impulsive Noise: A 10 Year Research Summary, 1984.

U.S. Army, 1986, USACERL Technical Report No. N86/12, MicroBNOISE: A User's Manual

U.S. Army, 1987a, Expedient Methods for Rattle-Proofing Certain Housing Components, USACERL Technical Report No. N-87/24

U.S. Army, 1988a, Construction Engineering Research Laboratory Technical Report N-88/19, Procedures for Conducting Installation Compatible Use Zone (ICUZ) Studies, August 1988.

U.S. Army, 1988b, Army Regulation 95-2, Air Traffic Control, Airspace, Airfields, Flight Activities and Navigational Aids.

U.S. Army, 1988c, Construction Engineering Research Laboratory Technical Report N-88/19, Procedures for Conducting Installation Compatible Use Zone (ICUZ) Studies.

U.S. Army, 1988d, USAEHA Environmental Noise Assessment No. 52-34-0413-89, Results of Demolition Range Monitoring, Sierra Army Depot, Herlong, California, 12-20 September 1988.

U.S. Army, 1988e, USACERL Technical Report No. N-88/07, Procedures for Estimating the Flat-Weighted Peak Level Produced by Surface and Buried Charges.

U.S. Army, 1989, USAEHA Environmental Noise Study No. 52-34-0421-90, Results of Demolition Range Monitoring, Sierra Army Depot, Herlong, California, 31 July-10 August 1989.

U.S. Army, 1991, USAEHA Environmental Noise Consultation No. 52-34-0652-91, Noise Contours and Monitoring Results, Picatinny Arsenal, Dover, New Jersey, 26 November - 20 December 1990.

U.S. Army, 1992, USAEHA Environmental Noise Survey No. 52-34-Q492-92, Results of Impulsive Noise Monitoring, Navajo Depot Activity, Bellemont, Arizona, 15 May - 13 November 1991.

U.S. Army, 1994, Center for Health Promotion and Preventive Medicine Environmental Noise Study No. 52-34-QK33-95, Results of Eastern Shore Vibration Monitoring, Aberdeen Proving Ground, Maryland, September 1993 - November 1994.

U.S. Army, 1994, Fort Knox, Joint Land Use Study (JLUS).

U.S. Army, 1996, Center for Public Works, The DPW/DEH Reference Book.

U.S. Army, 1997, Army Regulation 200-1, Environmental Protection and Enhancement.

U.S. Army, undated, U.S. Army Training and Doctrine Command, Installation Compatible Use Zone (ICUZ) Training Course, page 1-2.