FORT CARSON
INSTALLATION COMPATIBLE USE ZONE STUDY

July 2018

Environmental Noise Branch
Army Public Health Center

Fort Carson

ICUZ

INSTALLATION COMPATIBLE USE ZONE

STUDY

July 2018

Prepared by:
Environmental Noise Branch
Environmental Health Sciences Division
Army Public Health Center (APHC)

8252 Blackhawk Road
Aberdeen Proving Ground
Maryland, 21010

EXECUTIVE SUMMARY

OVERVIEW

One of the goals of the Department of the Army is to plan, initiate, and carry out actions and programs designed to minimize adverse impacts upon the quality of the human environment without impairing the Army's mission. The Installation Compatible Use Zone (ICUZ) Program implements Army policy for such planning. The ICUZ study quantifies the noise environment from military training sources and recommends the most appropriate uses of noise-impacted areas. This study replaces the July 2012 Installation Operational Noise Management Plan and provides information that reflects the most accurate account of activities as of 2018.

Army Regulation (AR) 200-1 lists housing, schools, and medical facilities as examples of noise-sensitive land uses. Regulation guidelines state for land use planning purposes, noise-sensitive land uses are acceptable within the Noise Zone I, generally not compatible in Noise Zone II, and incompatible in Noise Zone III. AR 200-1 offers land use recommendations, which if adopted both on and off the installation, would facilitate future development that is unaffected by military noise. These guidelines are applied throughout the ICUZ document as individual training operations are analyzed.

The principle noise sources at Fort Carson and Piñon Canyon Maneuver Site (PCMS) include weapons and demolition training and aircraft operations. The City of Colorado Springs adjacent to the northern boundary is the largest population center in the local area. Several other smaller municipalities including Fountain (northeast), Pueblo West (southeast), and Penrose (southwest) are also just beyond the installation boundary. These cities, along with several small communities in the unincorporated county areas geographically east and west of the Fort, tend to receive the largest noise impacts annually. Population exposure to training noise from day-to-day operations is relatively low. However, single events show certain training operations are audible and may be loud in many areas outside the Fort.

CONCLUSIONS

SMALL ARMS WEAPONS OPERATIONS

Fort Carson Small Arms Ranges

Small arms operations at Fort Carson take place at both dedicated small arms ranges in the small arms impact area in the north, and within the larger multi-purpose training complexes in the central and southern portions of the Fort. Small arms firing activities at these ranges occur frequently throughout the year. Multiple ranges concurrently firing can be a common daily occurrence on the installation.

The Noise Zones from small arms firing are generally contained to training lands on post, with the exception of several areas beyond the eastern boundary. Zone II extends beyond the boundary east into the City of Fountain and El Paso County lands. Several homes within the El Rancho subdivision are contained within the Zone II. Other land uses within Zone II are considered compatible. Zone III extends beyond the eastern boundary outside the northeast corner of the large impact area. Land use in this area is considered compatible.

On post, Zone II and Zone III from firing at the small impact area range complex extend into the cantonment area. Zone II contains multiple enlisted barracks buildings north and west of the small impact area. Zone III mostly contains storage facilities and vehicle maintenance shops. Zone III does not contain any noise-sensitive land uses.

PCMS Small Arms Ranges

Live-fire small arms at PCMS are limited to several ranges in the range complex just south of the PCMS cantonment. Zone II extends beyond the west boundary into undeveloped open lands. Zone III is contained within the PCMS boundary. There are no impacts to sensitive land uses on or off post.

Non-Fixed Firing Ranges

Training activities which require the firing of small arms weapons using blank ammunition occur in multiple special use and collective training facilities throughout the Fort. A large majority of the training areas also support these operations at Fort Carson and PCMS. In most cases, weapons fire takes place far enough from the installation and/or maneuver site boundary that noise impacts would be considered minimal.

LARGE CALIBER WEAPONS AND EXPLOSIVES OPERATIONS

Fort Carson Land Use Compatibility

The cumulative large caliber and demolition operations Noise Zones show impacts to sensitive land uses are generally limited to the areas beyond Fort Carson's eastern boundary. Zones II and III extending beyond the boundary are primarily concentrated outside the ranges in the large impact area. Noise-sensitive land use within Zone II includes homes in the El Rancho subdivision, adjacent to the installation boundary. Zone II also extends just beyond the boundary south into undeveloped ranch land. There are no noise-sensitive land uses contained within Zone III. The Land use Planning Zone (LUPZ) extends further east, encompassing a larger portion of Fountain in the northeast and more homes in the El Rancho subdivision. The LUPZ also extends beyond the western boundary in several localized areas, containing scattered residences. Noise-sensitive land use within the LUPZ is considered compatible per Army guidelines; however, the LUPZ is delineated to indicate areas of emphasis for land use planners. These areas, although below Zone II limits, represent noise levels that some communities may still find unacceptable.

On post, the Noise Zones remain primarily contained to range and training area lands. The LUPZ extends north into the cantonment as far as the airfield property, but does not contain any noise-sensitive land uses. There are no noise-sensitive land uses in Zone II or III within the cantonment area.

Fort Carson Single Event Levels

Peak levels correlate with the receiver's perception of noise levels and can be a good predictor of complaints. Peak sound levels are included in this study as a supplement to land use compatibility Noise Zones. People in an area experiencing peak sound pressure levels between 115 and 130 dB may describe events as noticeable and distinct. Peak sound pressure levels above 130 dB are generally objectionable, and are often described as very loud and startling. Peak levels can vary significantly for the same activity based upon weather conditions. Peak sound levels in this study were modeled with two meteorological conditions (unfavorable and neutral weather) applied.

Under unfavorable weather, peak sound levels between 115 and 130 dB extend well beyond the boundary east, west, and south. Noise exposure is spread across the smaller communities and subdivisions east and west of the Fort. The areas south are comprised primarily of open grazing lands, which are protected under conservation easements restricting residential development. Peak sound levels above 130 dB extend beyond the boundary in similar fashion east, west and one area south. The area east outside of the large impact area extends up to into the El Rancho development, containing single family homes. Sensitive land uses west include a trailer home park adjacent to Training Area 9 and homes in the Red Rock Valley Estates and Turkey Canyon Ranch developments.

On post, peak sound levels between 115 and 130 dB extend north from limited training activities at Range 60. The contour contains family housing areas, enlisted barracks, and the Evans Army Community Hospital. Peak sound levels above 130 dB are primarily contained to the Training Area boundaries. There are no noise-sensitive land uses in the 130 dB and above contour.

Under neutral weather conditions, peak sound levels diminish considerably, particularly along the eastern and southern boundaries. However, noise impacts remain greatest in the areas east and west, where residential land uses are in close proximity to the installation boundary. Peak sound levels above 130 dB also extend beyond the installation boundary in several small areas east and west, along with one small area south. Although these areas are significantly reduced under neutral weather, several homes in the El Rancho (east) and Turkey Canyon Ranch (west) neighborhoods are contained within these high noise areas.

On post, the peak sound level contours do not encompass any sensitive land use. Although, a cluster of enlisted barracks buildings remain just outside the contour 115-130 dB. On occasion, these buildings may be subjected to loud-than-normal noise levels.

PCMS Single Event Levels

Live-fire large caliber and demolition operations at PCMS are limited to C4 and Bangalore torpedo demolition charges at six approved sites in the central portion of the installation. These operations do not occur frequently enough to generate CDNL Noise Zones. The detonation sites for these activities are located far enough inside PCMS that single event peak sound levels, extending beyond the boundary, would correlate to a low risk of receiving complaints, according to Army guidelines. Given this distance and the frequency of demolition operations, noise exposure from demolition operations at PCMS is considered negligible.

AVIATION OPERATIONS

Butts Army Airfield

The cumulative Noise Zones from operations at Butts Army Airfield (BAAF) show minimal impacts beyond the installation boundary. Zone III is contained to the runway and heliport areas. Zone II extends beyond the boundary east into undeveloped industrial land. The LUPZ extends off post east-southeast as far as Interstate 25 and west in one small area just beyond the boundary. Land use in the area east is primarily industrial gravel pit operations, while the area west is residential. On post, Zone II is primarily contained to the airfield property and impact area north. The LUPZ contains multiple enlisted barracks facilities just west of the airfield.

Unmanned Aerial Systems

Unmanned Aerial System (UAS) launch and recovery operations take place at several different facilities throughout the Fort, using several different types of UAS aircraft. Training flights with UAS take place within the restricted airspace R-2601 at Fort Carson or within approved training areas on PCMS. Generally, the noise produced from UAS activities within the shared airspace is considerably quieter than other larger aircraft activities. Once UAS aircraft reach mission altitudes the annoyance potential from overflight is considered low. Future flight training missions with the Gray Eagle UAS are expected in the airspace between Fort Carson and PCMS, pending a certificate of authorization from the Federal Aviation Administration. Again, based on mission altitudes and known overflight levels, noise impacts from Gray Eagle flights to land use in these areas would be minimal.

Single Overflight

Aircraft operating outside of Fort Carson restricted airspace either in or out of designated flight corridor, aviation training area, maintenance test flight area, or within the Local Flying Area all have the potential to cause annoyance and possibly generate noise complaints from single overflight. Measures are currently in place to help mitigate the effects of aircraft noise, including minimum flight altitudes and avoidance procedures. However, helicopter overflight still generates the majority of all noise complaints received by Fort Carson.

RECOMMENDATIONS

The ICUZ is a proactive planning tool, which can help guide future development in surrounding communities. At a minimum, local municipal governments are encouraged to support public disclosure of all Noise Zones and supplemental metrics which may convey how military training operations affect the noise environment.

The ICUZ study describes the noise characteristics of a specific operational environment, and as such, will change if a significant operational change is made. Therefore, if Fort Carson's mission, training, or training facilities undergo changes, the ICUZ should be reviewed to determine if the current noise assessment is sufficient. At a minimum, it is recommended that every five years the ICUZ and/or Noise Zones be updated to incorporate pertinent changes to the noise environment.

SECTION

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

AAD	Average Annual Day
ABCT	Armored Brigade Combat Team
AC	Active Component
ACUB	Army Compatible Use Buffer
ADNL	A-Weighted Day-Night Average Sound Level
AGL	Above Ground Level
AR	Army Regulation
AT&A	Air Traffic & Airspace
BAAF	Butts Army Airfield
BCT	Brigade Combat Team
CAB	Combat Aviation Brigade
CDNL	C-Weighted Day-Night Average Sound Level
COANG	Colorado Air National Guard
CY	Calendar Year
dB	Decibel(s)
dBA	Decibels, A-Weighted
dBC	Decibels, C-Weighted
dBP	Decibels, Unweighted Peak
DEM	Digital Elevation Model
DNL	Day-Night Average Sound Level
DoD	Department of Defense
DODI	Department of Defense Instruction
DPTMS	Directorate of Plans, Training, Mobilization and Security
DZ	Drop Zone
EOC	Emergency Operations Center
ERG	Explosives Research Group
FAA	Federal Aviation Administration
FICUN	Federal Interagency Committee on Urban Noise
FORSCOM	US Army Forces Command
FY	Fiscal Year
GIS	Geographic Information Systems
HAMET	High Altitude Environmental Mountain Training
HE	High Explosive
IBCT	Infantry Brigade Combat Team
ICUZ	Installation Compatible Use Zone
JLUS	Joint Land Use Study
KM	Kilometer
LEQ	Equivalent Sound Level
LFA	Local Flying Area
LUPZ	Land Use Planning Zone
LZ	Landing Zone
M	Meter
MOUT	Military Operations in Urban Terrain
MPRC	Multi-Purpose Range Complex

MSL	Mean Sea Level
MTA	Mountain Training Area
MTF	Maintenance Test Flight
NEW	Net Explosive Weight
NLR	Noise Level Reduction
OEA	Office of Economic Adjustment
PAO	Public Affairs Office
PCMS	Piñon Canyon Maneuver Site
PPACG	Pikes Peak Area Council of Governments
ROZ	Restricted Operating Zone
SARNAM	Small Arms Range Noise Assessment Model
SEL	Sound Exposure Level
STRAC	Standards in Training Commission
TA	Training Area
TFA	Test Flight Area
TNC	The Nature Conservancy
UAC	Urban Assault Course
UAS	Unmanned Aerial System
USACHPPM	U. S. Army Center for Health Promotion and Preventive Medicine
USAPHC	U.S. Army Public Health Command

1 INTRODUCTION

1.1 GENERAL

The Installation Compatible Use Zone (ICUZ) study provides a strategy for noise management in the areas surrounding Fort Carson and the Piñon Canyon Maneuver Site (PCMS). Elements of the ICUZ program include military noise analysis, education about noise and Army noise metrics, complaint management, and when necessary, noise abatement procedures.

The report is provided to assist both installation personnel and local community officials. Specifically, the ICUZ provides a methodology for analyzing noise exposure associated with military operations and provides land use guidelines for achieving compatibility between the noise generated by the Army and the surrounding communities.

As local communities prepare and modify comprehensive development plans, it is recommended that the conclusions from this study be considered in the planning process with a goal to encourage compatible land use.

1.2 PURPOSE AND NEED

The Army has an obligation to U.S. citizens to recommend land use around its installations which will: (a) protect citizens from noise and other hazards; and (b) protect the public's investment in these training facilities. To meet these obligations, the Army will recommend land uses that are compatible with military operations while allowing maximum beneficial use of adjacent properties. The U.S. Department of Defense (DoD) and component Services have published guidelines that reflect these land use recommendations.

Through Army Regulation (AR) 200-1, noise exposure on communities is translated into Noise Zones. Regulation guidelines state that for land use planning purposes, noise-sensitive land uses range from acceptable to not compatible within the Noise Zones. These guidelines are applied throughout the ICUZ as individual or combined training operations are analyzed. The program defines the following four Noise Zones:

- Zone III - Noise-sensitive land uses are not recommended (incompatible).
- Zone II - Although local conditions such as availability of developable land or cost may require noise-sensitive land uses in Zone II, this type of land use is generally not compatible and is strongly discouraged on the installation and in surrounding communities. All viable alternatives should be considered to limit development in Zone II to non-sensitive activities such as industry, manufacturing, transportation and agriculture.
- Zone I - Noise-sensitive land uses are acceptable within the Zone I. However, though an area may only receive Zone I levels, military operations may be loud enough to be heard - or even judged loud on occasion. Zone I is not one of the contours shown on the map; rather it is the entire area outside of the Zone II contour.
- The Land Use Planning Zone (LUPZ) is a subdivision or upper limit of Zone I. The LUPZ represents an area starting at the lower limit of Zone II and extends outward to a distance

significant enough to allow for a 5 decibel (dB) reduction in sound level for large caliber and aircraft noise (There is no LUPZ for small arms activity Noise Zones). Within this area, noise-sensitive land uses are generally acceptable. However, communities and individuals often have different views regarding what level of noise is acceptable or desirable. To address this, some local governments have implemented land use planning measures out beyond the Zone II limits. Additionally, implementing planning controls within the LUPZ can develop a buffer to avert future noise conflicts.

The need for noise compatibility assessments in the Army is a greater challenge today than at any point in the past. Rapid population growth has brought land development directly adjacent to many Army installations, which were at one point relatively remote locations. This development, often referred to as encroachment, has brought military installations and civilian communities in much closer proximity, leading to issues of incompatibility.

To prevent incompatibilities between military operations and civilian land use from reaching a significant level, the Army must take reasonable steps to protect the community from training noise, and it must work with the local governments and land owners to make sure that adjoining lands are developed in ways compatible with the noise environment. Of particular concern are areas within the aforementioned Noise Zones, as well as areas that may occasionally be subjected to noise levels that the local community may find objectionable.

1.3 PROCESS AND PROCEDURE

1.3.1 REGULATORY REQUIREMENTS

This assessment has been conducted in accordance with the DoD Instruction Directive 4715.13 *subject: DoD Noise Program* (DoD 2005) and Army Regulation (AR) 200-1, *Environmental Protection and Enhancement,* Chapter 14, *Operational Noise* (U.S. Army 2007).

1.3.2 NOISE EXPOSURE MODELS

Operational data includes the types of weapons and ammunitions fired, number of rounds fired, time of day in which rounds are fired, and the location of firing areas and targets. The data were input into computer software models which calculate noise exposure levels associated with the multiple types of military operations ongoing at Fort Carson and PCMS. A summary of the computer models is provided below:

- The computer model used to create the Noise Zones for small arms (.50 caliber and below) ranges is the Small Arms Range Noise Assessment Model (SARNAM). SARNAM incorporates information on weapons noise source models, directivity, sound propagation, and the effects of noise mitigation and safety structures when necessary. The SARNAM calculation algorithms assume weather conditions or wind direction that favors sound propagation. Small caliber weapons noise is addressed utilizing peak levels and therefore has no assessment period.
- The BNOISE2 modeling program calculates noise levels generated by firing large arms (20mm and greater) and high-explosive charges. The sounds from large arms, demolitions, and other impulsive sounds generally create the largest complaint issues

because the sound can travel far, is difficult to mitigate and can be accompanied by vibration that may increase the public's annoyance. Noise Zones for large caliber weapons are addressed using the C-weighted Day-Night average sound Level (CDNL) with an assessment period of 250 days. This is the Army standard assessment period for all Active Army training installations and ranges per AR 200-1 guidance.

- NOISEMAP is a suite of computer programs and components developed by the Air Force to predict noise exposure in the vicinity of an airfield due to aircraft flight, maintenance, and ground run-up operations. Aircraft flight data are obtained to derive average daily operations by runway and type of aircraft.

1.4 NOISE BASICS

Sound is defined as a physical disturbance in a medium (i.e. gas, liquid, or solid) that is capable of being detected by the human ear. Sound waves in air are caused by variations in pressure above and below an even (static) value in atmospheric pressure. These changes in atmospheric pressure as they relate to human hearing can have great variance, for example a whisper at two meters would be as low as 0.0006 Pascals, whereas an M16 rifle fired near the shooter's ear would be 1,000 Pascals.

Due to this large range of sound pressures and that the human ear responds more closely to a logarithmic scale (rather than a linear), the decibel (dB) system was developed to quantify sound energy (loudness) into a meaningful and manageable scale. On this scale, the range of average human hearing runs from approximately zero (threshold of hearing) to 140. Using the example above, the whisper at two meters would register 30 dB and the M16 rifle shot near the shooter's ear would be 154 dB.

1.4.1 NOISE METRICS

When measuring sound, the levels are often filtered (i.e. frequency weighted) to accommodate how the human ear functions. This process is known as "A-weighting" and can be assumed for all sound levels in this report unless otherwise specified. Military impulsive sounds (e.g., explosions, artillery blasts) can be felt as well as heard and utilize "C-Weighting" where the low-frequency components of these sounds are not de-emphasized to the same extent as A-weighting. Explanations of the noise metrics that are used in this assessment are listed below.

- **Day–Night Average Sound Level (DNL).** DNL is a noise metric describing the average noise level over the course of a 24-hour period. A 10 dB adjustment is applied to operations that happen during night time hours (10 p.m. through 7 a.m.) because noise tends to be more intrusive at night than during the day. DNL accounts for the total or cumulative noise level at a given location over a specified assessment (time) period. In the case of large caliber and aircraft noise, the assessment period is an annual average.
- **Maximum Sound Level (Lmax)**. The highest sound level measured during a single event in which the sound level changes value with time (e.g., an aircraft overflight) is called the maximum sound level, or Lmax. The maximum sound level is important in judging the interference caused by a noise event with conversation, television or radio listening, sleeping, or other common activities.

- **Peak (dBP).** Peak is a single-event sound level without frequency weighting. There is no time component or assessment period with Peak such as with DNL. The peak level is the same day or night. It's also the same whether one round is fired or a thousand rounds fired at a given range. It is a singular measure of the peak sound produced at that instance.
- **PK15(met).** PK15(met) is a computer modeled single-event peak level that is exceeded only 15 percent of the time by the loudest munitions type detonation. This metric accounts for variations caused by weather conditions and favors noise propagation. The PK15(met) metric does not communicate any information about how often the loudest munitions type is detonated.
- **PK50(met).** PK50(met) is similar to the PK15(met) except that it represents the peak noise level that is exceeded 50 percent of the time. This metric also accounts for weather but assumes conditions which are not favorable for noise propagation, rather average or neutral weather conditions with regards to noise.

1.4.2 SOUND PROPAGATION

The principle influence on sound propagation is weather. Wind and temperature significantly influence how far sound travels from a source and how loud it will be at the receiver's location. As sound travels through air, a receiver downwind of the source will be subjected to higher sound levels than a receiver upwind; in effect the wind is actually helping move the sound to the downwind receiver, while upwind the sound must "swim against the current."

Combine wind direction with temperature variation (as a rule, sound usually travels further in cold temperatures) and one may observe the phenomena of *atmospheric refraction*. This is the process by which atmospheric conditions actually bend and/or focus sound waves toward some areas and away from others.

When a temperature inversion is present, military operations may sound much louder than normal, or be heard at greater distances. The inversion layer acts as a boundary for the sound, trapping it close to the ground. This can create areas of high intensity sound far from the sound's source. As a result, on most days it may be possible to detonate 10 pounds of explosives without disturbing a community (neutral weather conditions), while on another day with a temperature inversion, the detonation of 1 pound at the same location may be disruptive (unfavorable weather conditions).

Figure 1-1 illustrates how temperature inversions bend (refraction) the sound created by a typical explosion. The sound waves from the explosion initially travel upward, but the inversion reflects the sound back downward toward the ground, generating high noise levels many miles away. Under normal conditions, the noise levels at that distance would otherwise be much lower.

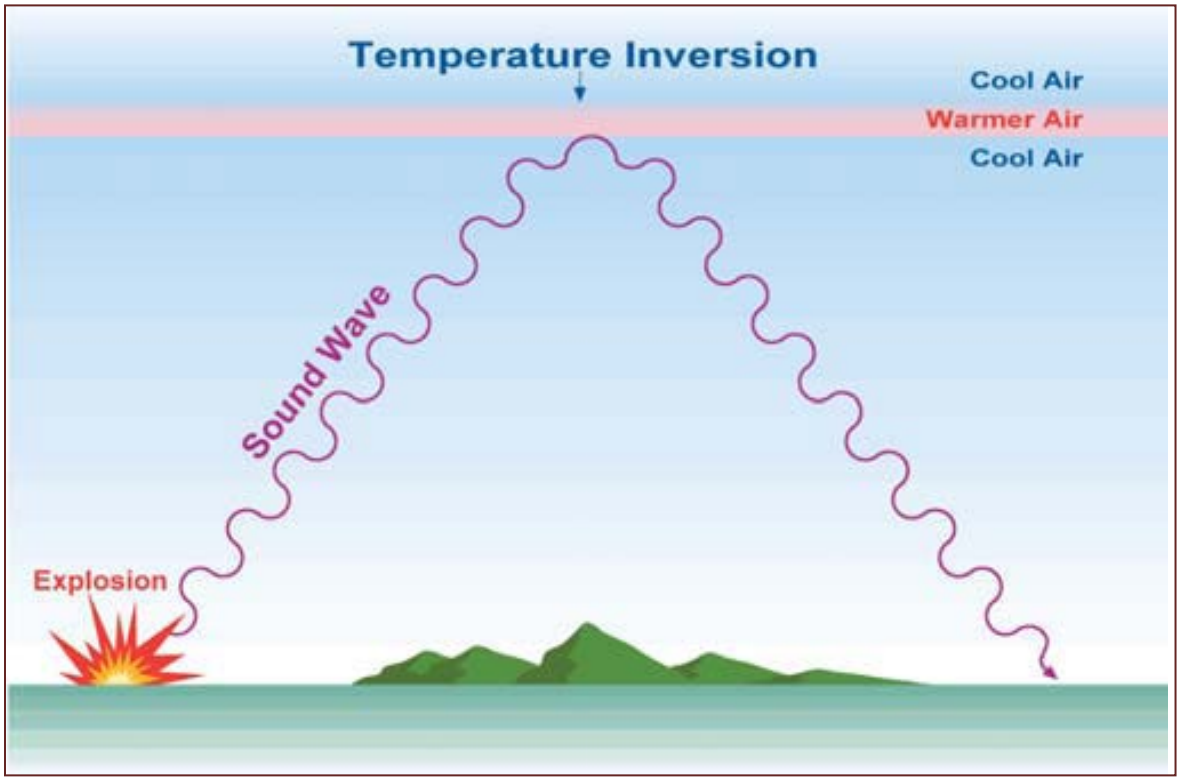


Figure 1-1. Example of a Temperature Inversion

Based on these phenomenon it is easy to see how predicting sound travel can be very difficult, but the Explosives Research Group (ERG) and the University of Utah developed guidelines to help determine what would be "good" or "bad" firing times. These guidelines are summarized in Table 1-1.

Another factor in sound propagation can be the natural topography of the land in and around the firing ranges and impact areas, as well as outside the installation. Naturally occurring terrain features have an effect on blast noise sound waves (air-blast) through both reflection and diffraction. To account for terrain effects, the BNOISE2 model uses algorithms in the calculation engine along with USGS Digital Elevation Model (DEM) data. It should be noted that the mitigation effects of topography on blast noise are highly dependent upon the terrain features location and size.

Table 1-1. University of Utah Criteria for "Good" and "Bad" Firing Conditions

"Good" Firing Conditions	"Bad" Firing 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 (5-10 mph) with gusts of greater velocities (above 20 mph) in the direction of nearby residences. 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 36°F) between day and night are observed. Generally high barometer readings with low temperatures.

Source: University of Utah, 1958

1.5 NOISE MANAGEMENT PROGRAM

In accordance with AR 200-1, Army installations are responsible for maintaining a Noise Management Program. The program includes two main components:

(1). *Evaluate and document the impact of noise produced by ongoing and proposed actions/activities.*

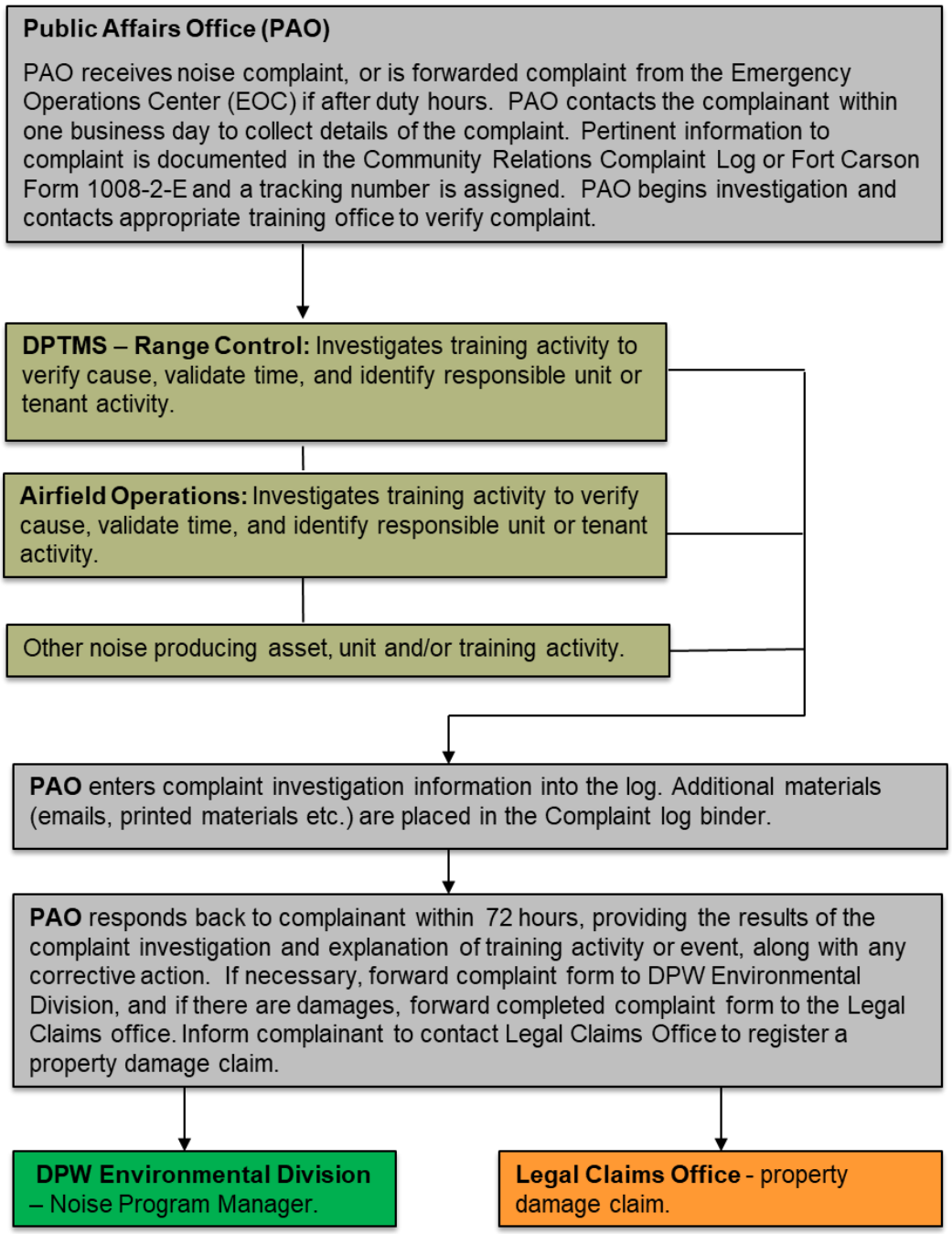
(2). *Monitor, record, archive and address operational noise complaints*.

The ICUZ study is generally the center of the installations noise management program. The ICUZ study along with an effective noise complaint procedure will help installations address complaints, advise local planning commissions, and be instrumental in developing action plans which may limit future encroachment threats.

1.5.1 NOISE COMPLAINT MANAGEMENT

The goal of a complaint procedure is to reduce the potential for noise complaints by keeping the public informed about what is happening and to satisfy the complainants so that noise complaints do not escalate. A proactive noise complaint program will help prevent the degradation of the mission due to controversy over noise impacts, while at the same time protecting the health and safety of the local community, both civilian and military, on and off the installation.

At Fort Carson the Garrison Public Affairs Office (PAO) is responsible for addressing noise and vibration complaints, per the Fort Carson Training Noise Management Guide, dated August 2014, the 4th Infantry Division and Fort Carson Regulation 200-1, Environmental Protection and Enhancement, paragraph 2-10 (e) and 17-5 (b), dated 1 February 2013. Complaint management procedures are laid out in the Noise and Environmental Complaint Standard Operating Procedure (Fort Carson 2018). The diagram below illustrates the basic complaint process:



2 FORT CARSON

2.1 LOCATION

Fort Carson is located in south central Colorado, just south of Colorado Springs at the base of the Rocky Mountain Front Range. The 137,404, acre installation resides primarily in El Paso County, but also extends south into Pueblo County and west into Fremont County. Interstate 25 runs just east of the installation, with Colorado 115 to the west and U.S. Highway 50 to the south.

Piñon Canyon Maneuver Site (PCMS), an additional 235,896 acre training site to Fort Carson, is located in Las Animas County, approximately 100 miles southeast of Fort Carson and roughly 25 miles from the Colorado-New Mexico state line. The nearest cities include Trinidad, approximately 35 miles to the southwest, and La Junta approximately 48 miles northeast.

2.2 ORGANIZATION AND MISSION

Fort Carson is a Forces Command (FORSCOM) installation, the largest major command in the U.S. Army. Serving as a major power projection platform, Fort Carson provides a full spectrum of individual and collective training for combat, combat service, and combat service support personnel. The Fort Carson Garrison team provides mission readiness, support and services for installation soldiers and families. Fort Carson is home to the 4th Infantry Division (ID), one of four divisions of III Corps, a major subordinate command of FORSCOM. The 4th ID units at Fort Carson include the following:

- Headquarters and Headquarters Battalion
- 1st Stryker Brigade Combat Team
- 2nd Infantry Brigade Combat Team
- 3rd Armored Brigade Combat Team
- 4th Combat Aviation Brigade
- 4th Sustainment Brigade
- 4th Division Artillery

Additional units and/or commands at Fort Carson include the following:

- 10th Special Forces Group (Airborne)
- 13th Air Support Operation Squadron
- 4th Engineer Battalion
- 71st Explosive Ordnance Division
- 743rd Military Intelligence Battalion
- 759th Military Police Battalion
- Army Field Support Battalion
- 627th Hospital Center
- Medical Department and Dental Activity

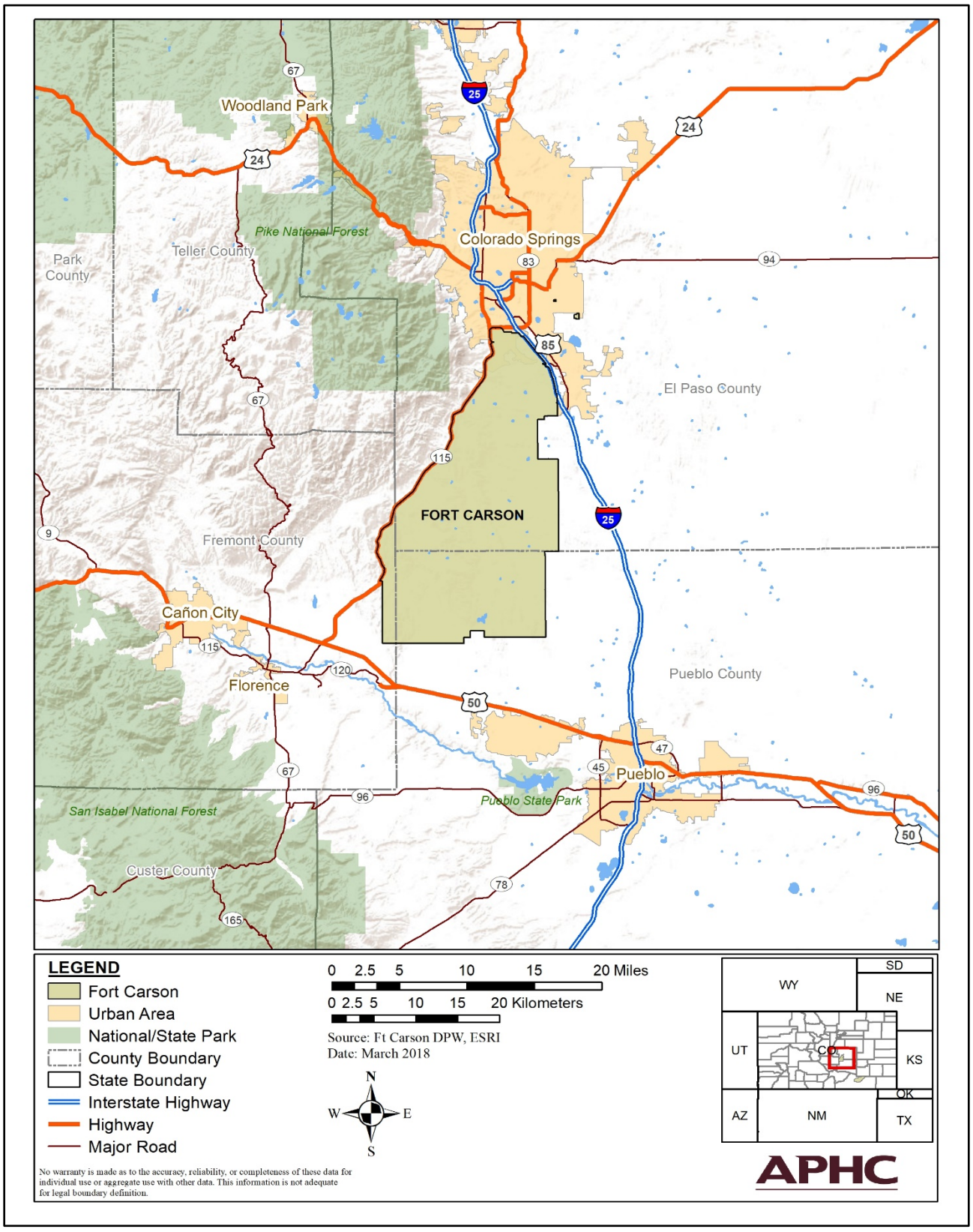


Figure 2-1. Fort Carson General Location

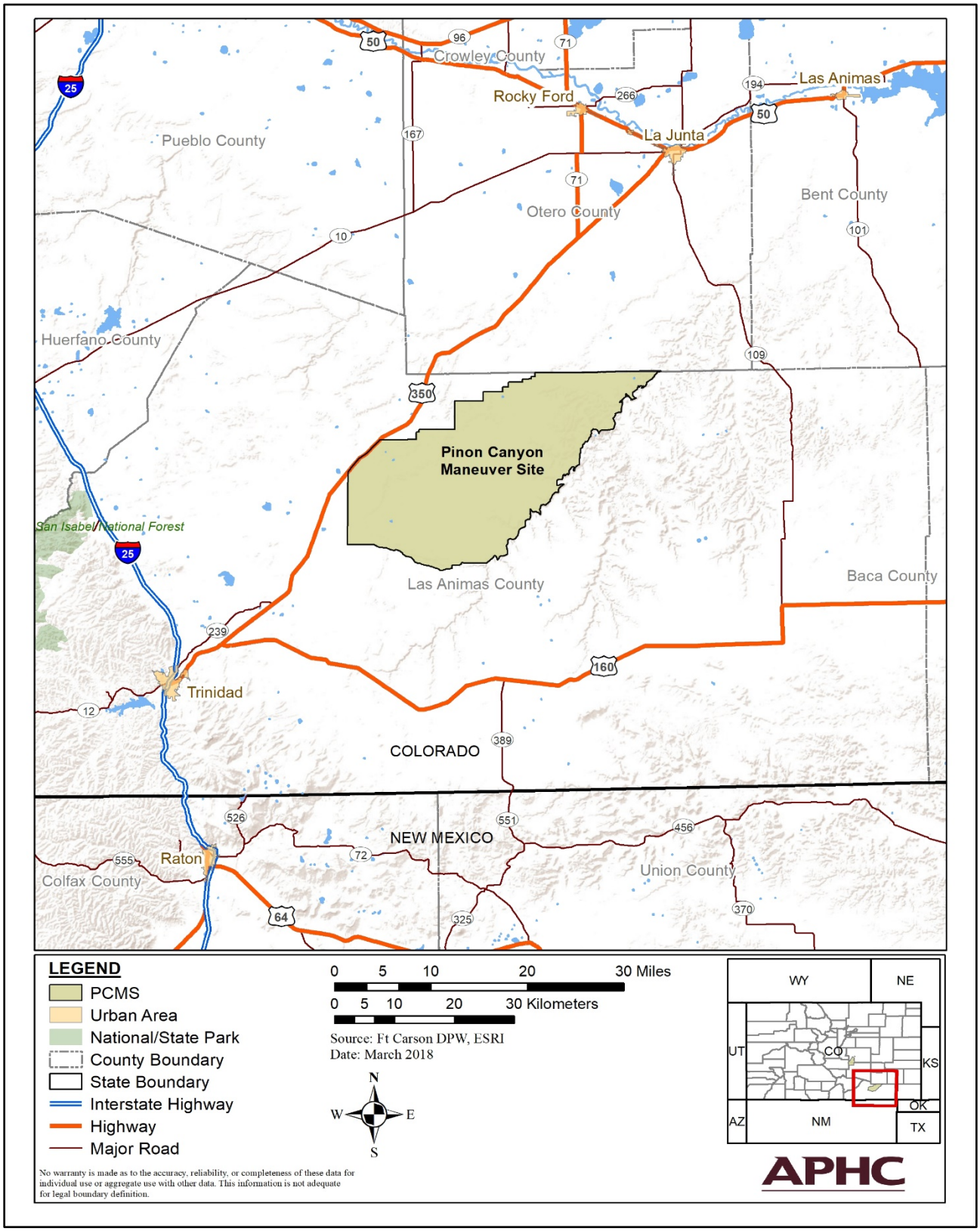


Figure 2-2. Piñon Canyon Maneuver Site General Location

2.3 TRAINING FACILITIES AND RANGES

2.3.1 FORT CARSON

Fort Carson's total acreage encompasses just over 137,404 acres, consisting of 96,201 acres of maneuver area, 30,827 acres of range and training areas, 8,345 acres of cantonment and other developed lands and 2,031 acres of special use areas, such as the Bird Farm Recreation Area, Camp Falcon, Haymes, Teller and Townsend Reservoirs, and the Turkey Creek Complex.

Training at Fort Carson includes live-fire weapons training (small arms qualification and tank, artillery and helicopter gunnery), maneuver training, both mounted and dismounted and aviation training. Maneuver training is primarily squad- to battalion sized maneuvers and lane training for active and reserve components. Occasionally, brigade-sized exercises are conducted at Fort Carson (Fort Carson 2017a).

The Fort is divided into 56 training areas (TA), with 84 ranges and four dedicated urban training areas. There are two active impact areas; a small impact area and a large impact area. The small arms impact area is for non-dudded munitions. The large artillery impact area is an access-restricted, dudded impact area with an associated safety buffer that supports mortar firing, cannon artillery, aircraft bombing, and Multiple Launched Rocket Systems firing. Figure 2-3 illustrates the range, impact and TA locations on Fort Carson.

Butts Army Airfield (BAAF), located in the southeast corner of the Main cantonment area, provides operations and support to all Army aviation assets assigned to the 4th Combat Aviation Brigade (CAB) and visiting transient aviation units. In addition to the airfield, there are airborne Drop Zones (DZ) located throughout the Fort and several landing strips and/or helipads on the installation used for tactical air supply and support training. Unmanned Aerial Systems (UAS) training is conducted at two separate UAS training complexes on Fort Carson.

Aviation units on Fort Carson train at all echelons from individual through battalion/squadron. Training tasks may include all tactical maneuvers, nap-of-the-earth, contour, and low-level flight. Fixed-wing aircraft of the Air Force and Air National Guard also conduct training missions within Fort Carson airspace and use impact areas on the installation for weapon delivery practice.

2.3.2 PCMS

PCMS supports readiness training for units up to brigade size stationed at Fort Carson and for visiting Reserve and National Guard units, as well as other Federal agencies and local civil authorities (Fort Carson 2015). The cantonment is the only developed area on PCMS, encompassing 1,642 acres along the western boundary. Approximately 224,434 acres, or 95 percent of PCMS, is categorized as training lands. PCMS is divided into 23 training areas, 6 of which are dismounted training only. There are 6 live-fire ranges, including small arms below 50-Caliber, five urban villages, and six approved explosive breach sites for small demolition charges. Figure 2-4 depicts the range, maneuver and TA locations. The area along the eastern boundary, which runs along the Purgatoire River, is designated as a special use area that is off limits to training. This area totals 9,820 acres (Fort Carson 2017a).

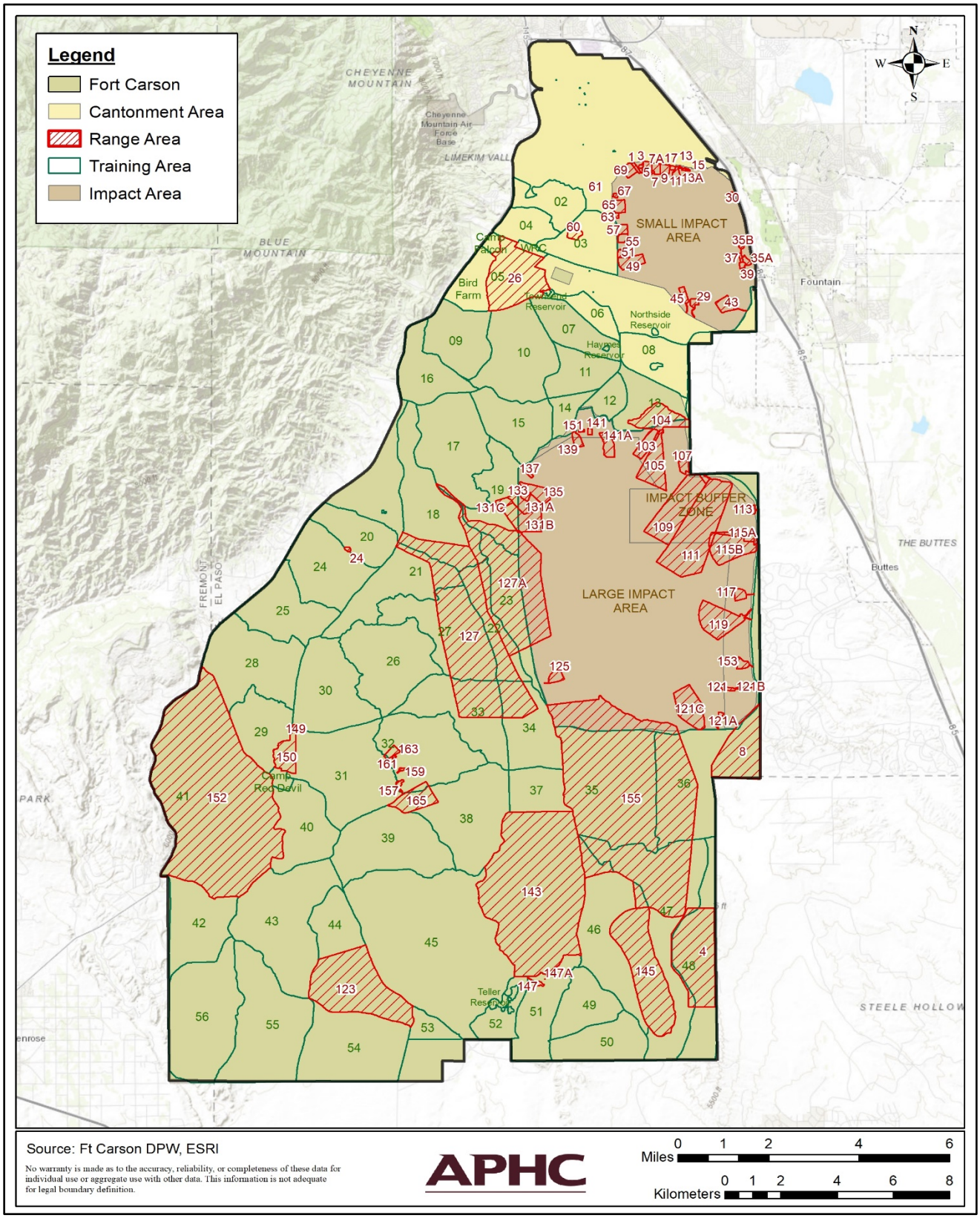


Figure 2-3. Fort Carson Range, Training and Maneuver Area Locations

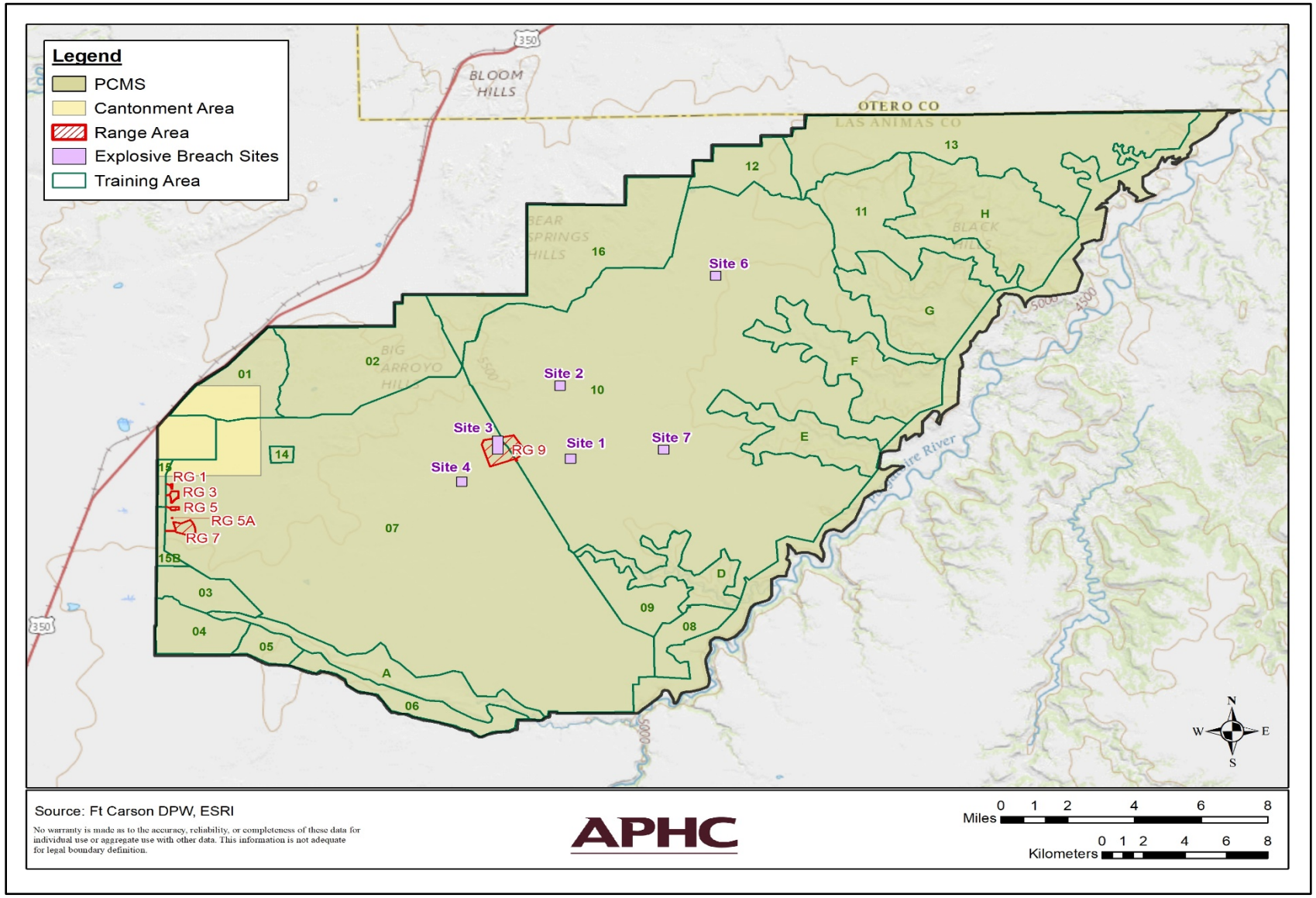


Figure 2-4. PCMS Range, Training and Maneuver Area Locations

The expansive maneuver areas on PCMS allow for large scale force-on-force training exercises that integrate ground and air resources of mechanized, infantry, support and aviation units. PCMS also supports a full range of aviation training outside of combined arms exercises for aviation units training independently.

2.4 LOCAL COMMUNITIES

The largest urban centers surrounding Fort Carson include Colorado Springs to the immediate north and the City of Pueblo approximately ten miles from the southern boundary. Several other smaller towns and Census Designated Places surround Fort Carson including Fountain, Security, and Widefield to the east; Pueblo West to the south; and Penrose and Rock Creek Park to the west. Some additional communities and/or developments occur east and west of the Fort, along with privately-owned ranches to the south. Figure 2-5 shows the development areas in the immediate proximity of the installation boundary.

As seen in Table 2-1, El Paso County has continued to see significant population increases with a growth rate exceeding 10 percent since 2010. A large portion of this growth is attributable to Colorado Springs, the county's largest city and county seat, which grew at 11.6 percent, adding an estimated 48,674 residents. Pueblo County has also seen steady population growth since 2010, although at a much more modest pace (~3.8 percent). Fremont County has seen relatively stagnant growth in this same time period, adding an estimated 622 people for a growth rate of 1.3 percent.

Table 2-1. Population Surrounding Fort Carson

	2000	2010	2016 (Est)
Colorado Springs	360,890	416,427	465,101
Fountain	15,197	25,846	28,753
Security-Widefield	29,845	32,882	n/a
Rock Creek Park	47	58	n/a
Pueblo	101,947	106,595	110,291
Penrose	4,070	3,582	n/a
El Paso County	516,929	622,263	688,284
Pueblo County	141,472	159,063	165,123
Fremont County	46,145	46,824	47,446

Source: U.S. Census Bureau (www.census.gov)

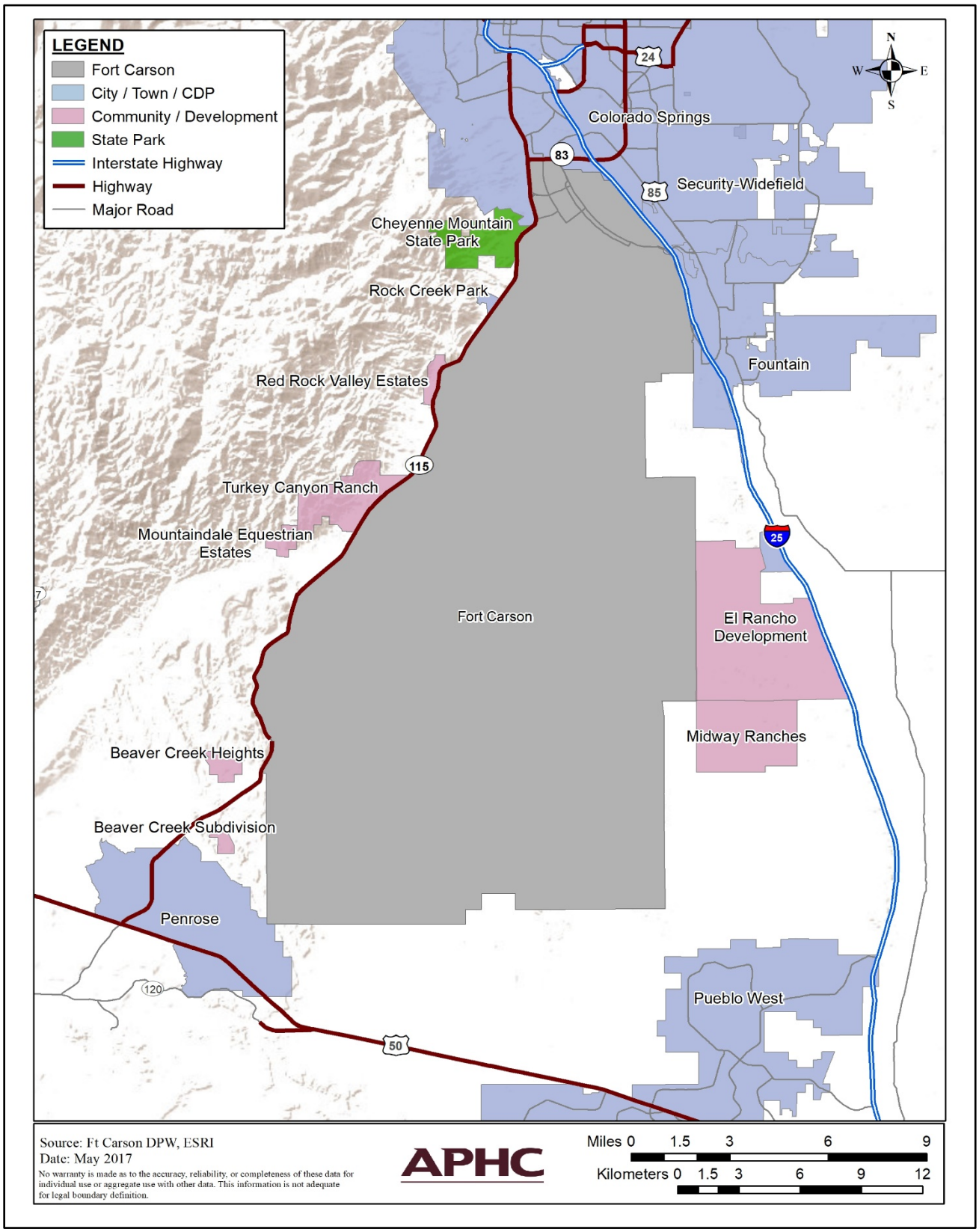


Figure 2-5. Local Communities and Municipalities Surrounding Fort Carson

Figure 2-6 illustrates the population density (per square mile) in the local region surrounding Fort Carson. Although development beyond the immediate boundary east and west is common, these areas have remained low density (<100 persons per square mile) in nature. The highest densities occur north in Colorado Springs and the communities northeast along Interstate Highway 25. Conservation lands along the southern boundary keep densities low in those areas.

PCMS is surrounded on three sides by agricultural and cattle grazing lands. The Comanche National Grassland, which is managed by the U.S. Forest Service, lies immediately north and east of PCMS and consists of undeveloped open land, recreation sites, and various cultural and historical attractions (Fort Carson 2015).

Population density surrounding PCMS has remained exceedingly low (<5 persons per square mile). Trinidad, the largest city in the region is approximately 35 miles from the maneuver site. PCMS is surrounded on three sides by agricultural and cattle grazing lands. The Comanche National Grassland, which is managed by the U.S. Forest Service, lies immediately north and east of PCMS and consists of undeveloped open land, recreation sites, and various cultural and historical attractions (Fort Carson 2015).

Development around PCMS is limited to several small communities (Model, Tyrone, and Thatcher) located west of the PCMS boundary along U.S. 350. Tracts of private farm and ranch lands along the northern boundary also contain several residences.

2.5 FORT CARSON COMMUNITY

Fort Carson's main cantonment area contains troop barracks, billets, family housing areas, office and administrative buildings of the 4th ID, other tenant commands, and the Garrison Commander; as well as schools, Child Development Centers, the Evans Army Community Hospital, community facilities, and outdoor recreation, and a variety of other public works facilities typically found in a small municipality. In fact, the daily population living and/or working on Fort Carson often exceeds many of the local communities beyond boundary. Table 2-2 provides an accounting of the on-post and supported retiree population at Fort Carson for Fiscal Year (FY) 2017.

Table 2-2. Fort Carson Population

Population	**Total**
Military Population	25,886
Family Members	44,255
Civilian Employees	3,350
Retirees and Family Members	54,811
Total	**128,302**

Source: Fort Carson 2017b – USAG Fort Carson Fact Sheet

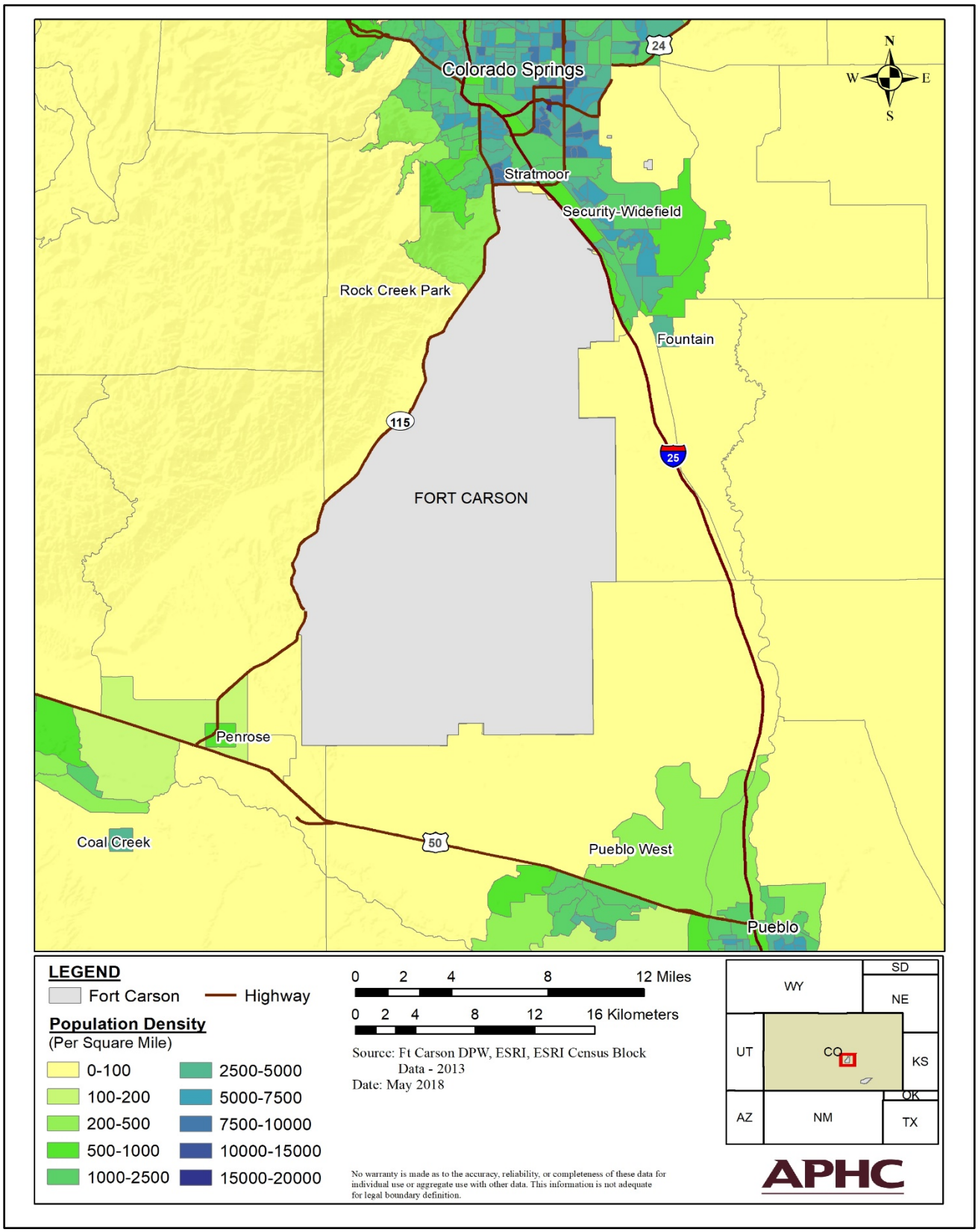


Figure 2-6. Population Density (2013) Surrounding Fort Carson

2.6 ECONOMIC IMPACT

The operations at Fort Carson generate substantial revenues to local economies through military and civilian wages, equipment rentals, utilities, supplies, construction contractor payments and other prime contract awards. As one of the area's largest employers, the economic impact of Fort Caron on the local economy cannot be understated. In FY 2016, Fort Carson's economic impact was in excess of two billion dollars. Table 2-3 shows the breakdown of economic impact factors for FY 2016.

Table 2-3. Economic Impact (FY 2016)

	Total
Military Payroll	$1.5 billion
DA Civilian Payroll	$230.4 million
NAF Civilian Payroll	$23.4 million
Local Purchases/GPC/Contracts	$16 million
Utilities	$22.1 million
Military Construction	$103 million
Tuition Assistance/Grants	$6.8 million
TRICARE Payments	$271.7 million
Total	**$2.17 billion**

Source: Fort Carson 2017b – USAG Fort Carson Fact Sheet

3 NOISE ASSESSMENT GUIDELINES

The APHC recommends land use options based on the type of noise source. Table 3-1 lists the noise limits as shown in Army Regulation (AR) 200-1. Tables B-1 through B-3 (Appendix B) contain detailed land use recommendations for each noise source.

Table 3-1. Noise Limits for Noise Zones

Noise Zone	Noise Limits			Noise-Sensitive Land Use
	Aviation ADNL (dB)	Impulsive CDNL (dB)	Small Arms dBP	
LUPZ	60 – 65	57 – 62	n/a	Generally Compatible
I	< 65	< 62	< 87	Generally Compatible
II	65 – 75	62 – 70	87 – 104	Generally Not Compatible
III	> 75	> 70	> 104	Not Compatible

Source: AR 200-1
Notes: dB = decibel, ADNL = A-weighted Day-Night Level, CDNL = C-weighted Day-Night Level, P = Peak

There are often existing "noise-sensitive" land uses defined as non-conforming within a Noise Zone. In most cases this is not a risk to community quality of life or mission sustainment. Average noise levels may be the best tool for long-term land use planning, but they may not adequately assess the probability of community annoyance. As recommended in AR 200-1, this assessment includes supplemental metrics to identify where noise from aviation overflights, demolition activity, and large caliber weapons may periodically reach levels high enough to generate complaints. In many instances Noise Zones will indicate land use compatibility; however, noise complaints from impulsive noise, often referred to as blast noise, typically are attributable to a specific event rather than annual average noise levels. Peak levels are useful for estimating the risk of receiving a noise complaint from blast noise, as they correlate with the receiver's perception of noise levels. Table 3-2 lists the Army's Complaint Risk Guidelines.

Table 3-2. Complaint Risk Guidelines

Perceptibility	**dBP**	**Risk of Receiving Noise Complaints**
May be Audible	< 115	Low
Noticeable, Distinct	115 - 130	Moderate
Very Loud, May Startle	> 130	High
*Perceptibility is subjective. The classifications are based on how a typical person might describe the event.		

- People in an area experiencing peak sound pressure levels between 115 and 130 dB may describe events as noticeable and distinct. From within this area, the installation has a moderate risk of receiving noise complaints. The magnitude of the complaint risk is dependent upon frequency of occurrence in addition to factors such as time of day activity occurs, propagation conditions under which activity takes place, and noise sensitivity of individuals in these areas.
- Peak sound pressure levels above 130 dB are generally objectionable, and are often described as very loud and startling. These levels correlate with a high risk of noise complaints.
- If the operations which generate high peak sound pressure levels in the community are very infrequent, land use controls may not be warranted. However, prior public notification is important for mitigating complaint risk, and also an import role of being good neighbors.
- Peak sound pressure levels directly correlate with airborne vibration which is the dominant cause of structural response from military training. Peak sound pressure levels above 120 dB may rattle windows or loose ornaments (e.g. pictures on walls) and annoy occupants but will not cause structural damage. It is widely recognized that structural damage is improbable when peak sound pressure levels do not exceed 140 dB.

Peak levels can vary significantly for the same activity dependent on weather conditions. Thus, supplemental metric Peak noise contours are modeled with the following weather conditions applied:

- Unfavorable Weather Conditions: PK15(met) is the peak sound level, factoring in the statistical variations caused by weather, that is likely to be exceeded only 15 percent of the time (i.e., 85 percent certainty that sound will be within this range). This “85 percent solution” gives the installation and the community a means to consider the areas that at times may be impacted by training noise. PK15(met) levels would occur under unfavorable weather conditions that enhance sound propagation.
- Neutral Weather Conditions: PK50(met) is the Peak level that is likely to be exceeded 50 percent of the time (i.e., 50 percent certainty that sound will be within this range). These levels would be seen during neutral weather conditions. It should be noted that if activities take place under favorable weather conditions, such as the wind blowing away from the receiver, noise levels would be lower.

The unfavorable weather conditions PK15(met) metric is a good tool to indicate areas that may periodically be exposed to high noise levels. When land use planning programs such as real estate disclosure, a Joint Land Use Study or the Army Compatible Use Buffer are implemented, the PK15(met) complaint risk areas can and should be used to delineate areas of focus. However, since the complaint risk areas are based on individual event levels and are not dependent on the number of events, planners should also consider frequency of operations when making land use decisions.

4 RANGE NOISE ASSESSMENT

4.1 SMALL ARMS NOISE

The small arms designation includes weapons of .50 caliber or less. Small arms weapons utilized at Fort Carson include a multitude of rifles, machine guns, pistols, and shotguns with various ammunition. The SARNAM model was used to calculate and plot the peak noise levels based on the loudest weapon at each small arms range from the operations data described in Appendix C. To generate noise contours using SARNAM, specific firing point and target point locations must be entered into the program. Therefore, ranges without set firing points or target point locations such as firing at collective training facilities and urban terrain facilities are addressed via predicted peak noise levels in the Non-fixed Firing Point Area subsection.

4.1.1 FORT CARSON SMALL ARMS NOISE ZONES

The small arms ranges at Fort Carson are heavily utilized and are operational year round depending upon training mission requirements, such as the type of training to be completed; the unit being trained; and deployment status. Based on range records from FY 2016-2017, small arms ammunition expenditures at Fort Carson averaged 8.6 million rounds per year.

The Noise Zones for small arms firing activity are illustrated in Figure 4-1. These Noise Zones represent a maximum small arms training scenario (all ranges actively firing) for live-fire ammunition operations. As previously mentioned, there is no assessment period with the Peak noise metric. Thus, only Noise Zones II and III are depicted in the map figures (Note: Zone I includes all areas outside the Zone II noise limit of 87 dBP).

Although large in size, the Noise Zones from small arms firing are generally contained to the range and impact areas, with the exception of lands beyond the eastern boundary. Zone II extends beyond the boundary east in several areas, although most prominently outside of the large impact area up to approximately 1,500 meters (m). Zone III extends beyond the eastern boundary in two small areas outside Ranges 107 and Range 115 (A/B). Table 4-1 lists the total, off post, and cantonment acreages for each small arms Noise Zone. It should be noted that the cantonment acreage calculation listed in Table 4-1 only includes those areas in the cantonment which are outside of the small impact area.

Table 4-1. Fort Carson Small Arms Noise Zones Acreage

Noise Zone	Noise Zone Acreage		
	Total	Cantonment	Off Post
Zone II	67,843	2,224	4,097
Zone III	14,019	207	58

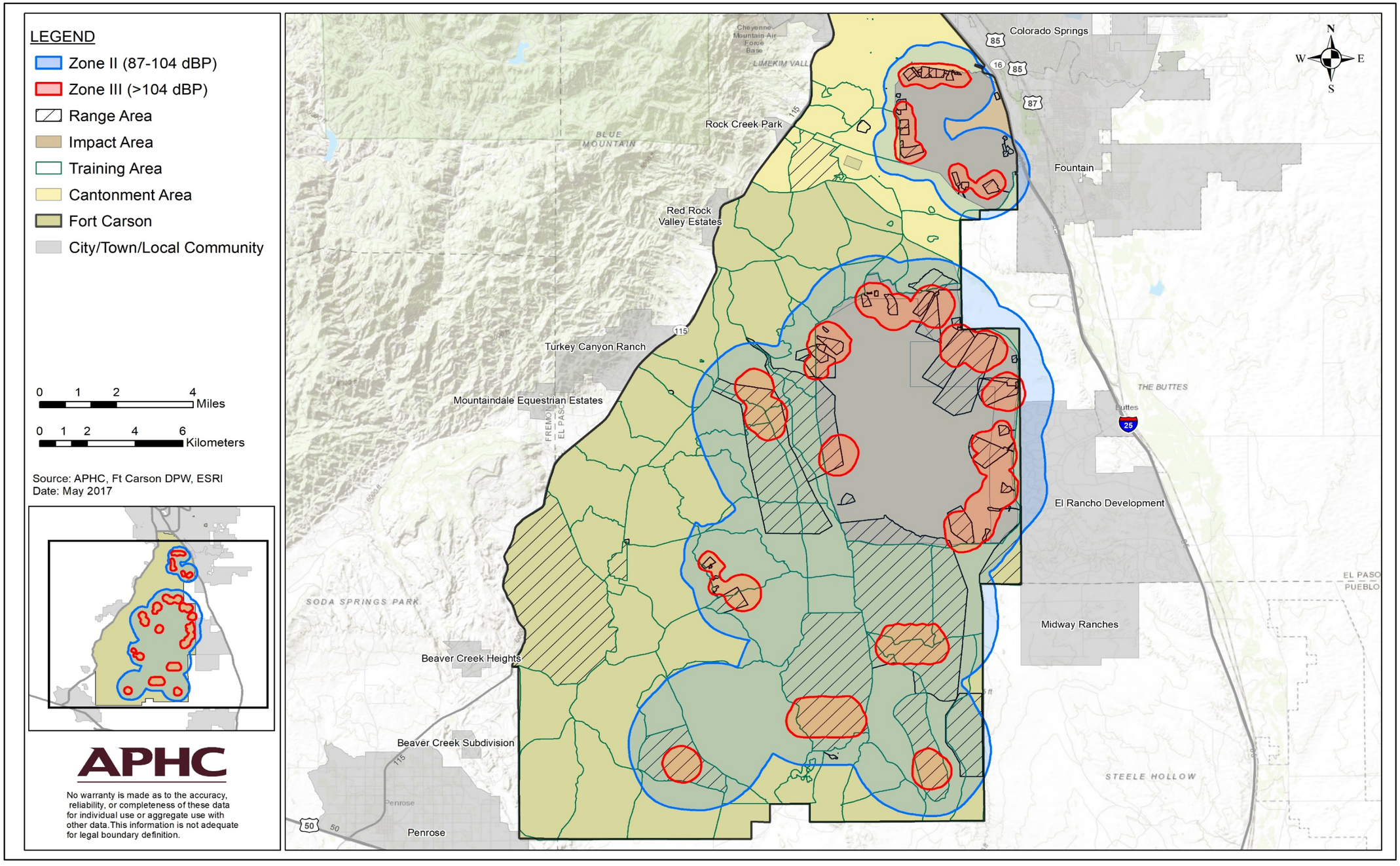


Figure 4-1. Fort Carson Small Arms Noise Zones

Zone II from firing in the small impact area extends east just beyond Interstate 25 into the City of Fountain. Land uses within the Zone II are primarily commercial, industrial and open lands in this area. Zone II east of the large impact area contains lands used for gravel mining and utilities purposes by a private construction firm and the City of Colorado Springs. Zone II also contains a portion of the El Rancho residential development, adjacent to the east boundary, which consists of single-family homes in low to medium density (Figure 4-2). The Zone III areas extending beyond the east boundary do not contain any sensitive land uses.

On post, Zone II and Zone III extend into the cantonment area from firing at the small impact area range complex. Zone II contains multiple enlisted barracks buildings north and west of the small impact area. Zone III mostly contains storage facilities and vehicle maintenance shops. Zone III does not contain any noise-sensitive land uses.

Table 4-2 lists the daytime and nighttime ambient population exposure within the Noise Zones on and off post, based on an analysis using the LandScan™ dataset. The highest concentration of affected population occurs on post in the Main cantonment at the soldier housing facilities. However, it should be noted that small arms training predominantly occurs during daytime hours, which significantly reduces noise exposure.

Table 4-2. Population Exposure in Small Arms Noise Zones

Population	Noise Zone	
	Zone II	Zone III
Off Post		
Daytime	62	0
Nighttime	171	0
On Post (Cantonment Area)		
Daytime	240	16
Nighttime	833	0

Note:
Land Analysis Ambient Population Exposure: The LandScan™ ambient population estimates used in this plan are based on the 2013 annual mid-year national population estimates from the Geographic Studies Branch, U.S. Bureau of Census.[1] The daytime and nighttime LandScan™ data were derived based on the habits and movements of people over a day. Whereas a national census only measures the population based on residences, the LandScan™ dataset measures areas where people tend to be during a typical day. For instance, traveling along roadways to get to a destination or where they may work.[2] Nighttime estimates are representative of residential figures.

[1] This product was made utilizing the LandScan (2012)™ High Resolution global Population Data Set copyrighted by UT-Battelle, LLC, operator of Oak Ridge National Laboratory under Contract No. DE-AC05-00OR22725 with the United States Department of Energy. The United States Government has certain rights in this Data Set. Neither UT-BATTELLE, LLC NOR THE UNITED STATES DEPARTMENT OF ENERGY, NOR ANY OF THEIR EMPLOYEES, MAKES ANY WARRANTY, EXPRESS OR IMPLIED, OR ASSUMES ANY LEGAL LIABILITY OR RESPONSIBILITY FOR THE ACCURACY, COMPLETENESS, OR USEFULNESS OF THE DATA SET.
[2] http://www.personal.psu.edu/ddj118/Geog482/Project3.html

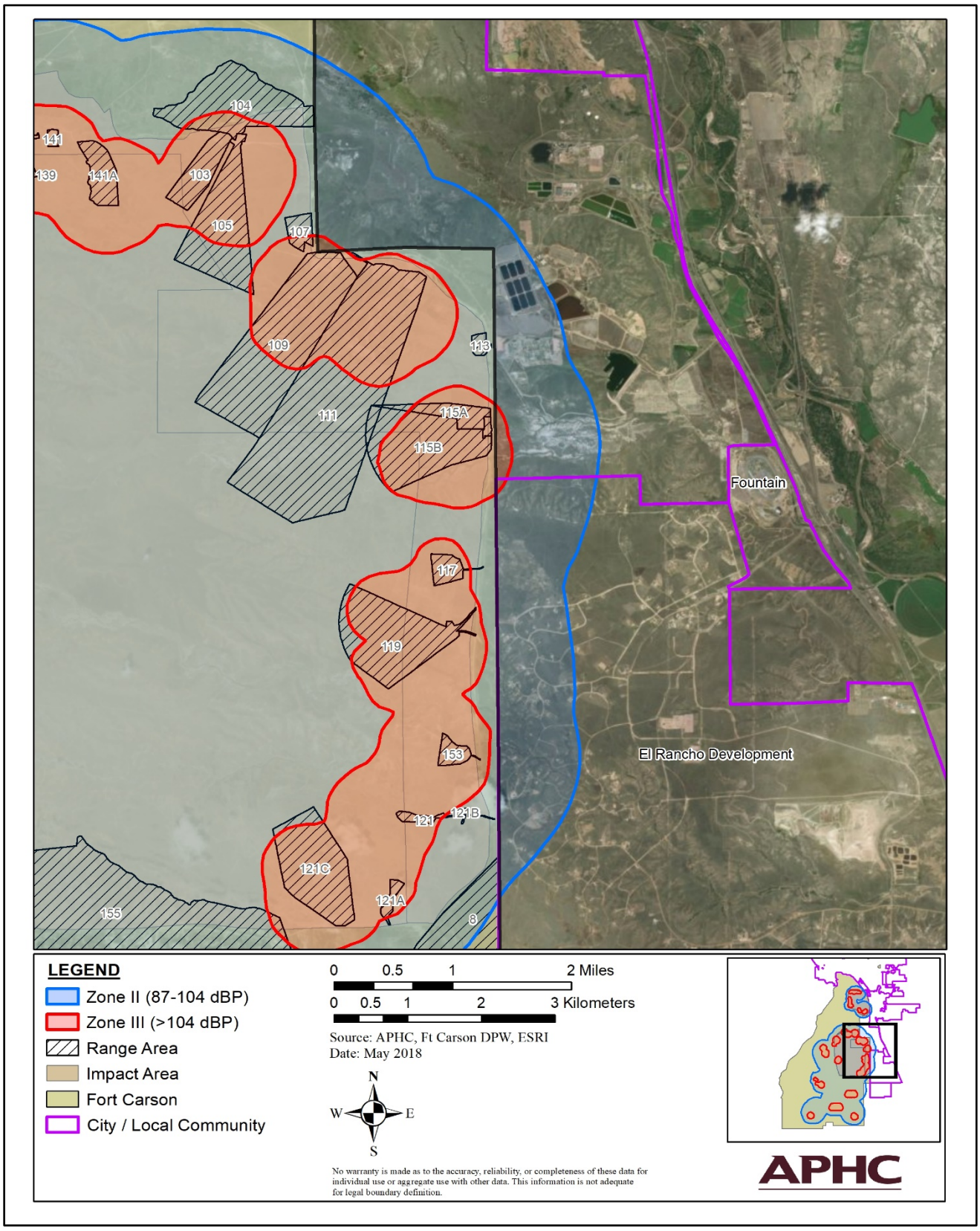


Figure 4-2. Fort Carson Small Arms Noise Zones Extending East

4.1.2 PCMS SMALL ARMS NOISE ZONES

Small arms live fire at PCMS is limited to Range 1 (Combat Pistol Qualification), Range 3 Automated Record Fire), and Range 7 (Multi-Purpose Machine Gun) in the range complex just south of the PCMS cantonment. All other small arms firing on PCMS is done with blank ammunition at Range 9 or within approved TAs. The Noise Zones for live-fire ranges are illustrated in Figure 4-3. The ammunition utilization input table is shown in Appendix C.

Zone II extends approximately 700 m beyond the west boundary into undeveloped open lands. The Zone II also extends approximately 1.1 kilometers (km) north into the cantonment. There are no impacts to sensitive land uses on or off post. Zone III is contained to the PCMS boundary and does not extend into the cantonment area. Table 4-3 lists the acreage calculation for the Noise Zones.

Table 4-3. PCMS Small Arms Noise Zones Acreage

Noise Zone	Noise Zone Acreage		
	Total	Cantonment	Off Post
Zone II	9,501	1,032	615
Zone III	1,002	0	0

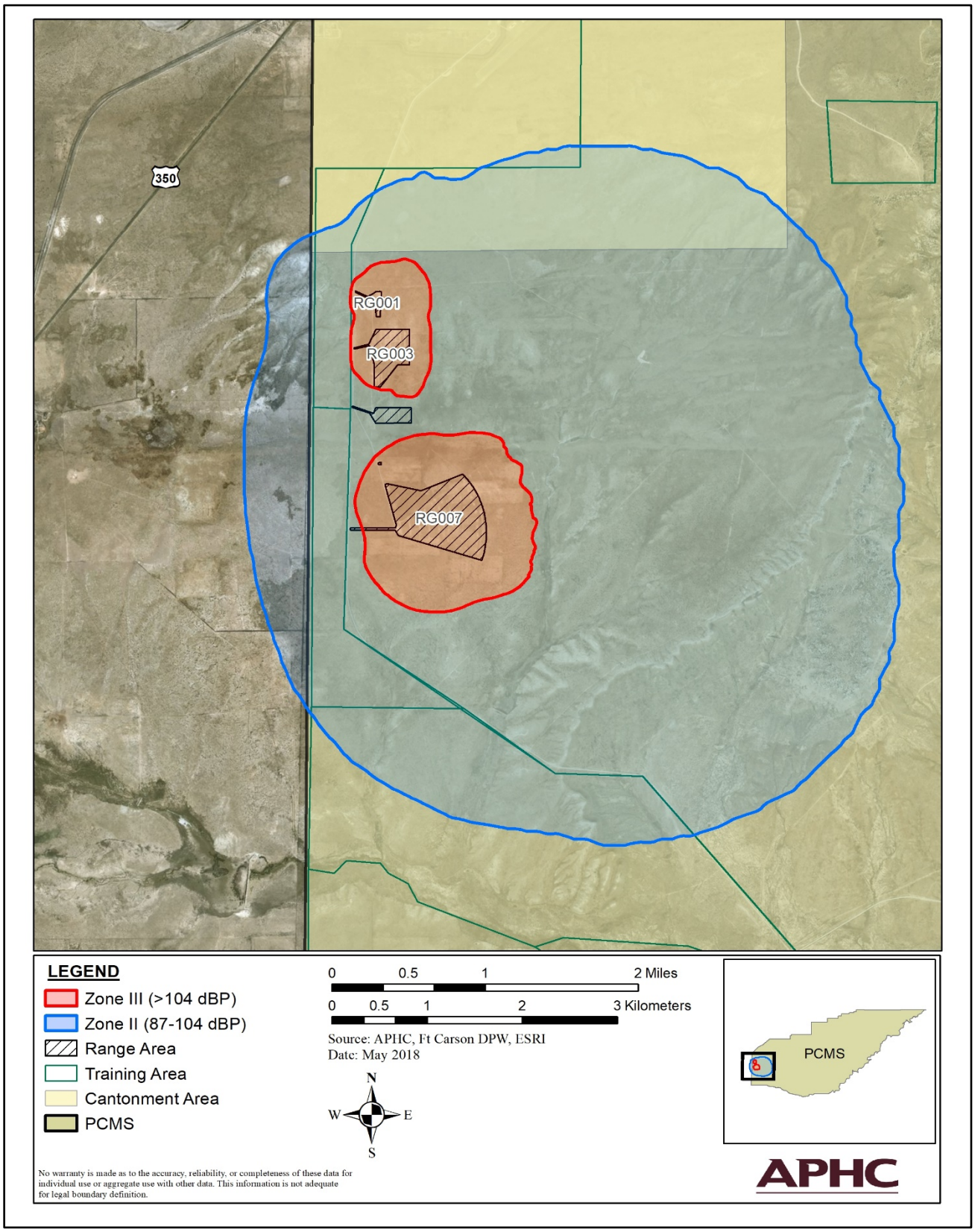


Figure 4-3. PCMS Small Arms Noise Zones

4.1.3 NON-FIXED FIRING POINT AREAS

Units at Fort Carson conduct training at multiple special use, collective training facilities and within the maneuver and training areas at Fort Carson and PCMS using blank ammunition and/or simunitions. These activities produce training which replicates real-world environments and scenarios. With the absence of specific firing and target point locations, noise contours for these activities cannot be modeled. However, by looking at predicted peak levels, we can attempt to assess noise exposure from these training activities.

Tables 4-3 through 4-5 list the predicted peak levels for commonly used rifle and machine gun blank ammunition on Fort Carson. In each column, the upper limit levels would occur under weather conditions that enhance sound propagation (unfavorable), such as the wind blowing toward the receiver. The lower limit levels occur under favorable weather conditions, such as the wind blowing away from the receiver. The azimuth angle can be defined as the direction of fire, i.e. 0 degrees is directly in front of the weapon and 180 degrees is directly behind the weapon.

When combining these variables, the highest peak levels occur when rounds are fired in the direction of the receiver (0 degree azimuth) and under unfavorable weather conditions. As an example, Table 4-3 indicates that under unfavorable weather conditions, a Zone II noise level [87 dBP] extends approximately 200 m for the 5.56 mm blank round at all three given azimuth angles.

Table 4-4. Predicted Peak Levels for 5.56 mm Blank Round

	Predicted Level, dBP Azimuth		
Distance, meters	**0º**	**90º**	**180º**
100	87-97	86-96	87-97
200	80-90	79-89	80-90
400	69-79	68-78	69-79

Note: the 0º is directly in front of the weapon and the 180º azimuth is directly behind the weapon.
Blank is defined as any round that contains propellant but no bullet.

Table 4-5. Predicted Peak for 7.62 mm Blank Round

	Predicted Level, dBP Azimuth		
Distance, meters	**0º**	**90º**	**180º**
100	109-119	106-116	101-111
200	103-113	100-110	94-104
400	92-102	89-99	85-95
800	84-94	81-91	77-87

Note: the 0º is directly in front of the weapon and the 180º azimuth is directly behind the weapon
Blank is defined as any round that contains propellant but no bullet.

Table 4-6. Predicted Peak for .50 Caliber Blank Round

	Predicted Level, dBP Azimuth		
Distance, meters	**0º**	**90º**	**180º**
100	116-126	110-120	111-121
200	109-119	103-113	104-114
400	97-107	92-102	91-101
800	89-99	84-94	84-94
1200	84-94	79-89	84-94
1600	81-91	75-85	75-85

Note: the 0º is directly in front of the weapon and the 180º azimuth is directly behind the weapon
Blank is defined as any round that contains propellant but no bullet.

Based on the distances listed above, in most instances, training operations firing blank ammunition will not produce noise levels at or above the Zone II limit of 87 dBP beyond the Fort Carson or PCMS boundary. However, several training areas located along the boundary are used to fire machine guns up to .50 caliber. These training exercises do possess the potential for higher noise levels beyond the boundary. It should be noted that variables such as actual firing location within the training area, direction of weapon fire, and weather conditions at the time of firing would all determine the degree of noise impact.

4.2 LARGE CALIBER AND DEMOLITION NOISE

The large caliber designation includes weapons 20 mm or greater and any weapon that contains explosive charges. This designation also includes all demolition charges. At Fort Carson, training is conducted with a multitude of large caliber weapons including artillery, mortars, aerial gunnery, mines, rockets, grenade launchers, and explosive demolition charges. Training operations can occur all year round, during daytime or nighttime hours.

In addition to the firing points and ranges assessed in the Noise Zones, training at Fort Carson also includes utilization of simulators (pyrotechnic and non-pyrotechnic). Simulators are used to provide soldiers with the most realistic training experience possible while keeping soldier safety a priority. Simulator noise levels are much lower than noise levels generated by the munitions they replicate. Simulators are not included in the Noise Zones and are addressed separately via peak noise levels in Section 4.2.2.1.

4.2.1 FORT CARSON LARGE CALIBER AND DEMOLITION NOISE ZONES

Figure 4-4 depicts the CDNL Noise Zones for large caliber and demolition operations at Fort Carson. Appendix C lists the large caliber ammunition and explosive detonations expenditures by range and type used to produce the Noise Zones. The Noise Zones were modeled using an assessment period of 250 days and 20 percent night firing (Note: All demolition operations are modeled during daytime hours).

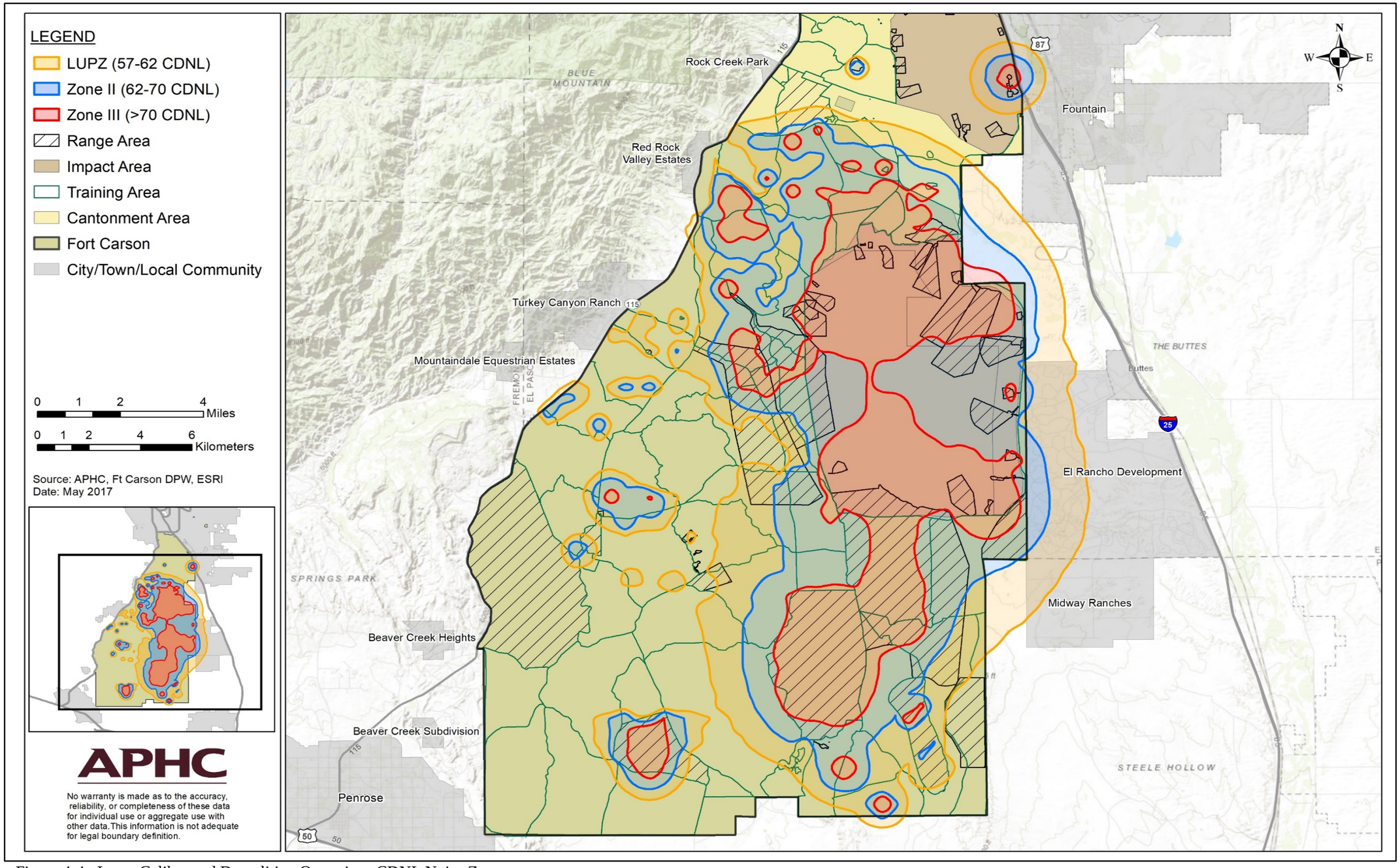


Figure 4-4. Large Caliber and Demolition Operations CDNL Noise Zones

The LUPZ extends beyond the installation boundary east of the small impact area approximately 1.1 km (.6 miles) into the City of Fountain and to a much greater degree outside the large impact area, up to 2.4 km (1.5 miles) into El Paso and Pueblo Counties. The LUPZ also extends beyond the installation boundary west in several small areas (<300 m) and south in one area (480 m) due to Artillery firing. Residential land uses are contained within the LUPZ both east and west of the Fort. Zone II extends beyond the installation boundary in similar fashion east and in one isolated area south, just outside of TA 50. Zone II contains multiple homes in the El Rancho development area, east of the large impact area. Zone III extends beyond the installation boundary in two separate areas, one east of Range 35B (Hand Grenade) in the small impact area and the other northeast of Ranges 109 and 111 in the large impact area (see Figure 4-5). Land use within Zone III consists of Interstate Highway 25, open lands, and gravel pit mining operations, all of which are compatible land uses.

On post, the Noise Zones remain primarily contained to range and TA lands. The LUPZ extends north into the cantonment as far as the airfield property, but does not contain any noise-sensitive land uses. There are no noise-sensitive land uses in Zone II or III within the cantonment area. Table 4-7 lists the total, cantonment area and off post acreages for the CDNL Noise Zones.

Table 4-7. Large Caliber and Demolition Noise Zones Acreage

Noise Zone	Noise Zone Acreage		
	Total	Cantonment	Off Post
LUPZ	29,434	1,880	8,345
Zone II	32,580	966	2,342
Zone III	27,887	87	245

Table 4-6 lists the daytime and nighttime ambient population exposure (LandScan™) totals within the Noise Zones off post and those portions extending into the cantonment areas on post. The largest noise impacts from large caliber weapons occur within the LUPZ east of the Fort during nighttime hours. As evidenced in the Table, population exposure on post is minimal.

Table 4-8. Population Exposure in Large Caliber and Demolition Noise Zones

Population	Noise Zone		
	LUPZ	Zone II	Zone III
Off Post			
Daytime	72	26	0
Nighttime	381	69	0
On Post (Cantonment Area)			
Daytime	0	0	0
Nighttime	0	0	0

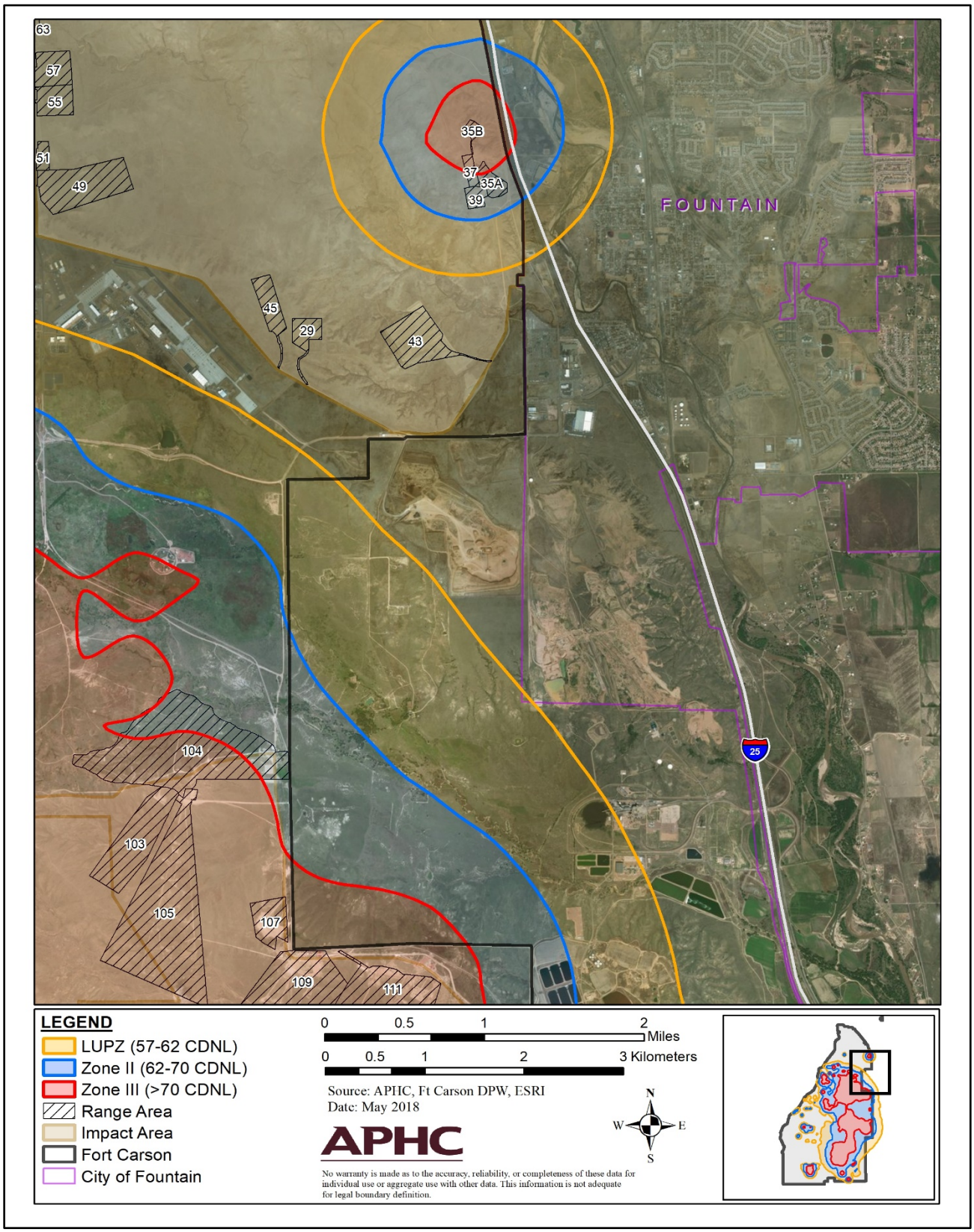


Figure 4-5. Zone III extending beyond the Fort Carson Boundary

4.2.2 FORT CARSON SINGLE EVENT PEAK LEVELS

Annual average noise levels are suitable for long-term land use planning; however, individual training events can be audible outside of a Noise Zone and in some cases objectionable to the surrounding community. Using Peak level assessments can forecast where sound may be audible or loud from singular events. Table 3-2 (Section 3) listed the perceptibility of Peak sound levels. It is worth noting that vibration that often accompanies low-frequency noise from large caliber weapons is almost always air-borne (not ground-borne). Neighbors located near the "loud" area on the map may occasionally notice picture or window rattling from air-borne vibration; however, this rattling does not indicate damage, and usually occurs at levels well below those required to cause structural damage.

Figures 4-6 and 4-7 depict the single event Peak sound level contours for large caliber weapons operations using different weather conditions. Figure 4-6 illustrates weather conditions that enhance sound propagation (unfavorable weather) and Figure 4-7 illustrates more favorable propagation conditions (neutral weather). Both weather scenarios are provided to demonstrate the influence of meteorological conditions on noise propagation. The same range records (Appendix C) used to produce the CDNL Noise Zones were used to create the Peak contours.

Unfavorable Weather – PK15(met)

Under unfavorable weather, peak sound levels between 115 and 130 dB extend beyond the boundary to the east approximately 6.5 km (3.9 miles); south 3.9 km (2.4 miles); and west up to 2.8 km (1.7 miles). The area northeast contains a portion of Fountain, while the area east of the large impact travels as far as Interstate 25, enveloping the El Rancho development and Midway Ranch areas. Sensitive land uses west include homes in Rock Creek Park, the developments of Red Rock Valley, Turkey Canyon Ranch and Mountaindale Equestrian Estates, and several other scattered residences just west of State Highway 110. An area southwest includes several homes near the Beaver Creek subdivision. The areas south are comprised primarily of open grazing lands, which are protected under conservation easements which restrict residential development.

Peak sound levels above 130 dB extend beyond the boundary in several areas east and west of the fort, along with one area south. The area east outside of the large impact area extends up to 1.3 km (.8 miles) into the El Rancho development, containing single-family homes. Artillery firing points near the west boundary extend the 130 dB and above contour out approximately 1 km (.6 miles). Sensitive land uses west include a trailer home park adjacent to TA 9 and homes in the Red Rock Valley Estates and Turkey Canyon Ranch developments.

On post, peak sound levels between 115 and 130 dB extend north into the cantonment from small demolition charge operations at Range 60/Military Operations in Urban Terrain (MOUT) Site. The contour contains family housing areas, enlisted barracks, and the Evans Army Community Hospital. Peak sound levels above 130 dB are primarily contained to the TA boundaries. There are no noise-sensitive land uses in the 130 dB and above contour. It should be noted that range records indicate that demolition charge operations are relatively infrequent (16 per year) at Range 60.

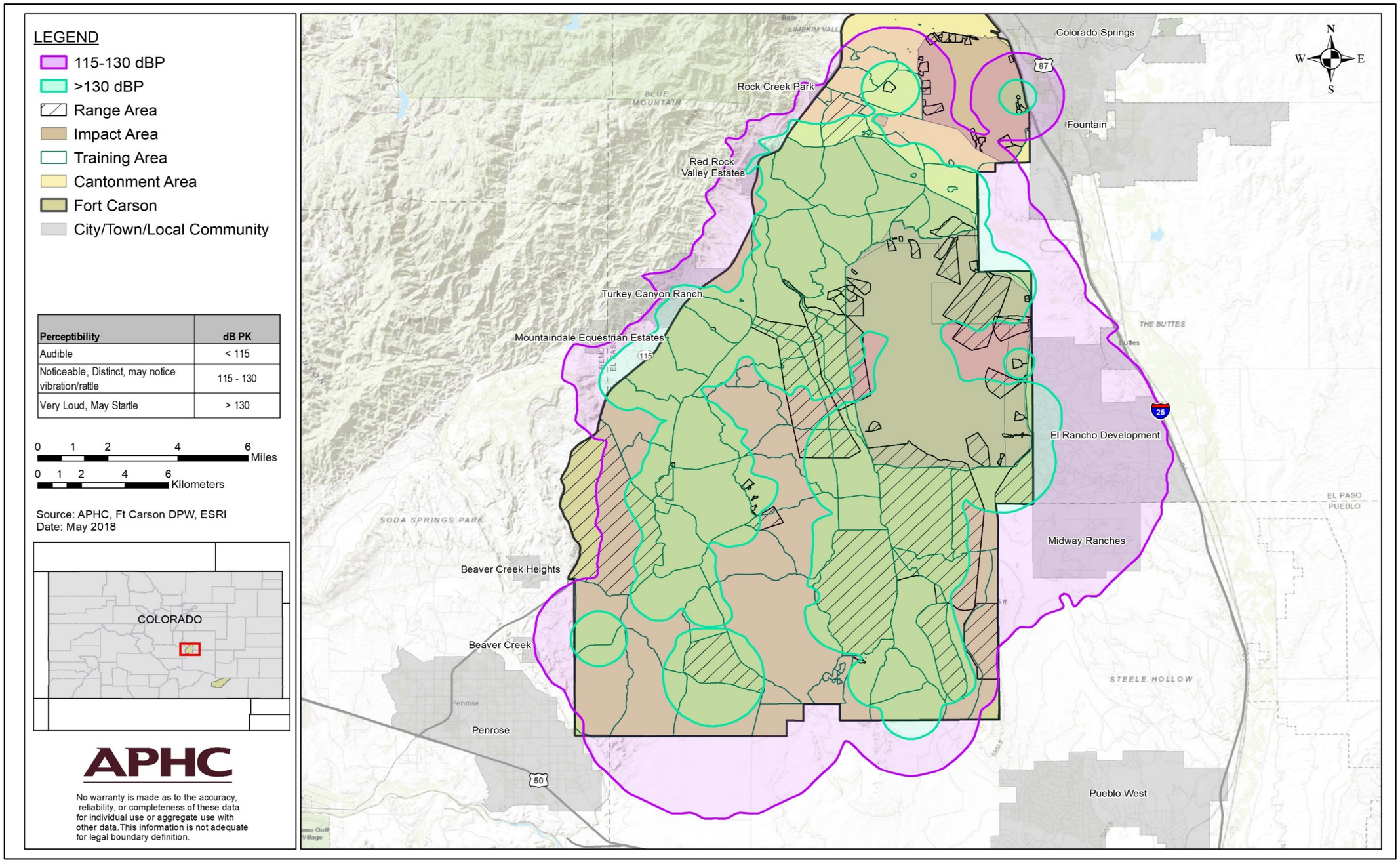


Figure 4-6. Large Caliber and Demolition Operations PK15(met) Sound Levels

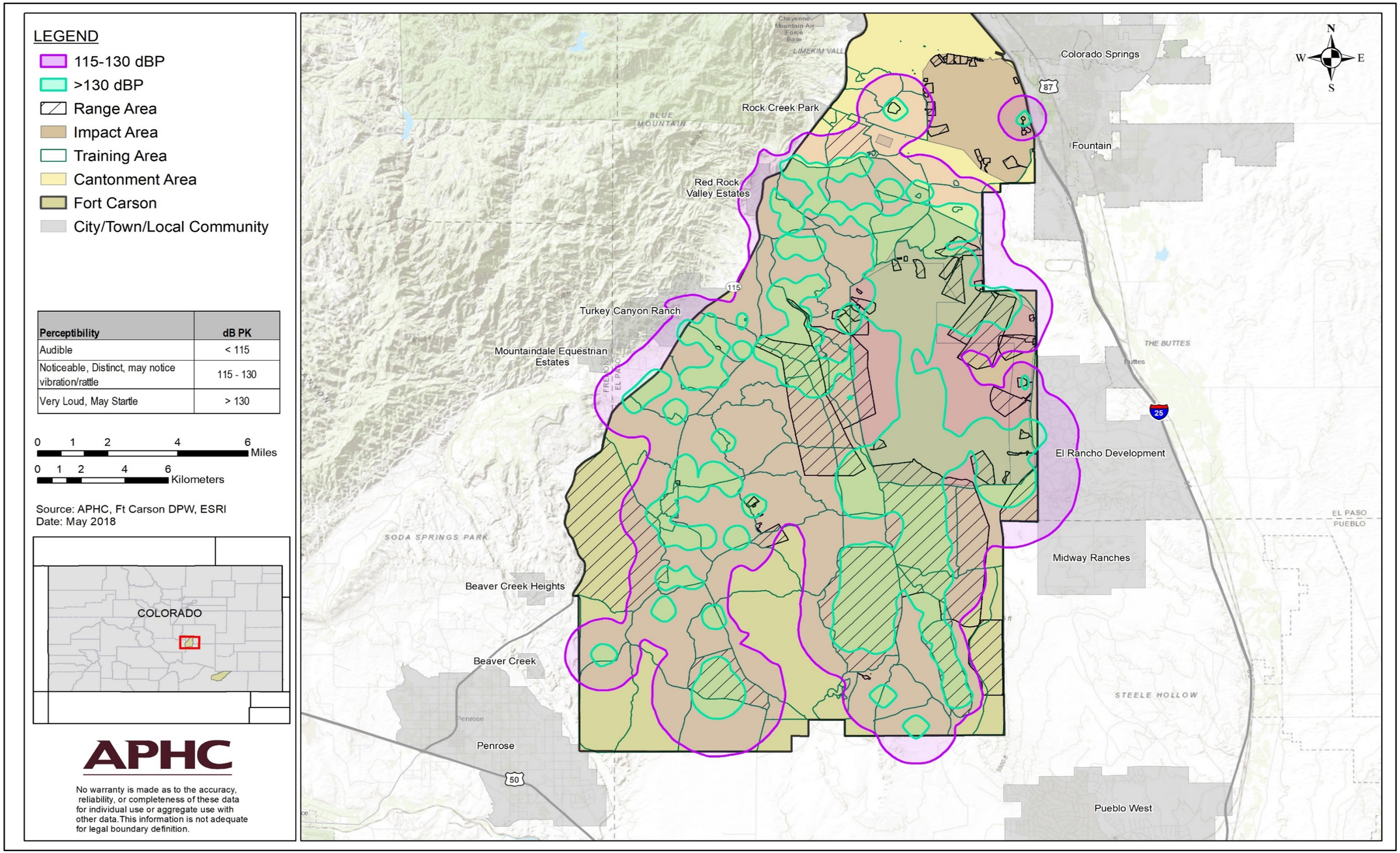


Figure 4-7. Large Caliber and Demolition Operations PK50(met) Sound Levels

Neutral Weather – PK50(met)

Under neutral weather conditions, peak sound levels between 115 and 130 dB extend beyond the boundary east, west and south; however, in more localized fashion. The contour contracts considerably, extending east approximately 1.9 km (1.1 miles), south 1.3 km (.8 miles), and west up to 1.5 km (.9 miles). Residential land use remains common within the noise contour along the eastern and western boundary. As previously mentioned, the areas south are primarily undeveloped ranch lands.

Peak sound levels above 130 dB also extend beyond the installation boundary in several small areas east and west, along with one small area south. Although these areas are significantly reduced under neutral weather, several homes in the El Rancho (east) and Turkey Canyon Ranch (west) neighborhoods are contained within these high noise areas.

On post, sound levels between 115 and 130 dB once again extend north from MOUT Site operations, but do not encompass any sensitive land use. Several enlisted barracks buildings south of the MOUT and north of the airfield remain just outside the contour. On occasion these buildings may be subjected to loud noise levels. Peak sound levels above 130 dB remain confined to range and TA lands and do not contain any sensitive land use within the cantonment.

4.2.3 PCMS LARGE CALIBER AND DEMOLITION NOISE

Large caliber and demolition operations include explosive charges at six breach facility sites (Site 3 is Convoy Live-Fire Range) located within training areas 7 and 10 in the central portion of PCMS. Grenade launcher rounds (40 mm) are fired at Range 5; however, these operations use inert practice rounds only. The maximum Net Explosive Weight (NEW) allowed at five of the breach sites (Sites 1-4 and Site 6) is 25 pounds, while Site 7 has a 5-pound limit. Range records indicate demolition operations are primarily 1.25-pound C4 charges, and less frequently 10-pound charges from individual sections of Bangalore Torpedo. Table 4-9 lists the radius distances from a detonation point for a 2-pound and a 10-pound (TNT Equivalent) charge under unfavorable and neutral weather conditions. All six demolition areas on PCMS are greater than 5 km to the nearest boundary. Given this distance and the frequency of demolition operations, noise exposure is considered negligible.

Table 4-9. Radius Distance from Detonation Point for PCMS Demolition Charges

		Distance from Detonation Site (Meters)	
TNT Equivalent Weight (lbs)	**Risk of Complaints (Noise Level)**	Under **UNFAVORABLE** Weather Conditions	Under **NEUTRAL** Weather Conditions
2 lbs.	Low (< 115 dB)	> 3,000	> 1,800
	Moderate (115 – 130 dB)	1,300 – 3,000	550 – 1,800
	High (> 130 dB)	< 1,300	< 550
10 lbs.	Low (< 115 dB)	> 4,700	> 2,400
	Moderate (115 – 130 dB)	1,900 – 4,700	850 – 2,400
	High (> 130 dB)	< 1,900	< 850

4.3 FUTURE LARGE CALIBER AND DEMOLITION NOISE

The future large caliber weapons and demolition noise discussion in this ICUZ is limited to Fort Carson. There are no anticipated changes to operations at PCMS. In 2017, the Department of the Army proposed the conversion of an Active Component (AC) Infantry Brigade Combat Team (IBCT) at Fort Carson, into an AC Armored Brigade Combat Team (ABCT) and stationing the newly converted ABCT at one of five Army installations, including Fort Carson. The purpose of this action is to increase the Army's ABCT capacity by one brigade (from 10 to 11) in order to increase the total Army's number of ABCTs from 15 to 16 (including Army National Guard units). The effective date of conversion is scheduled for June 2019 (US Army 2017).

The final stationing decision is unknown at the time of this study; however, given the current proposed actions, a likely scenario for stationing would be Fort Carson. Thus, the action would effectively convert and/or replace the 4th IDs, 2nd IBCT for an ABCT. Although the end strength at Fort Carson would remain roughly the same, the conversion of the IBCT to ABCT would alter the make-up of combat maneuver and reconnaissance capabilities. This change in force structure essentially replaces Infantry Companies with Tank and Mechanized Companies. With regards to environmental noise, these changes would bring an increase in the number of large caliber rounds fired to satisfy qualification on M1A2 Tanks and Bradley Fighting Vehicles.

4.3.1 FUTURE LARGE CALIBER AND DEMOLITION NOISE ZONES

The future large caliber and demolition Noise Zones were created using a combination of the ammunition and explosive detonations expenditures used in the current CDNL Noise Zones, and Standards in Training Commission (STRAC) totals for an ABCT. Artillery rounds for the IBCT were subtracted out of the expenditure data. Appendix C lists the outgoing, incoming and new (future) annual expenditure totals to major noise generating sources. A distribution of rounds by range was calculated for the existing ammunition expenditure and then applied to the future expenditure in the same configuration. Although Fort Carson currently has an ABCT, using the STRAC numbers for the incoming ABCT essentially provides a worst case scenario.

Figure 4-8 depicts the CDNL Noise Zones for future large caliber and demolition operations at Fort Carson. The Noise Zones were modeled using an assessment period of 250 days and 20 percent night firing (Note: All demolition operations are modeled during daytime hours).

As expected, the future Noise Zones increase in total size; however, the majority of this increase occurs on range and TAs within the installation boundary. The influence of mechanized large caliber weapons creates a shift in cumulative noise away from static Artillery firing areas and more towards shoot-and-move Multi-Purpose Ranges Complex (MPRC) facilities. Table 4-10 lists the total, cantonment area and off post acreages for the future CDNL Noise Zones.

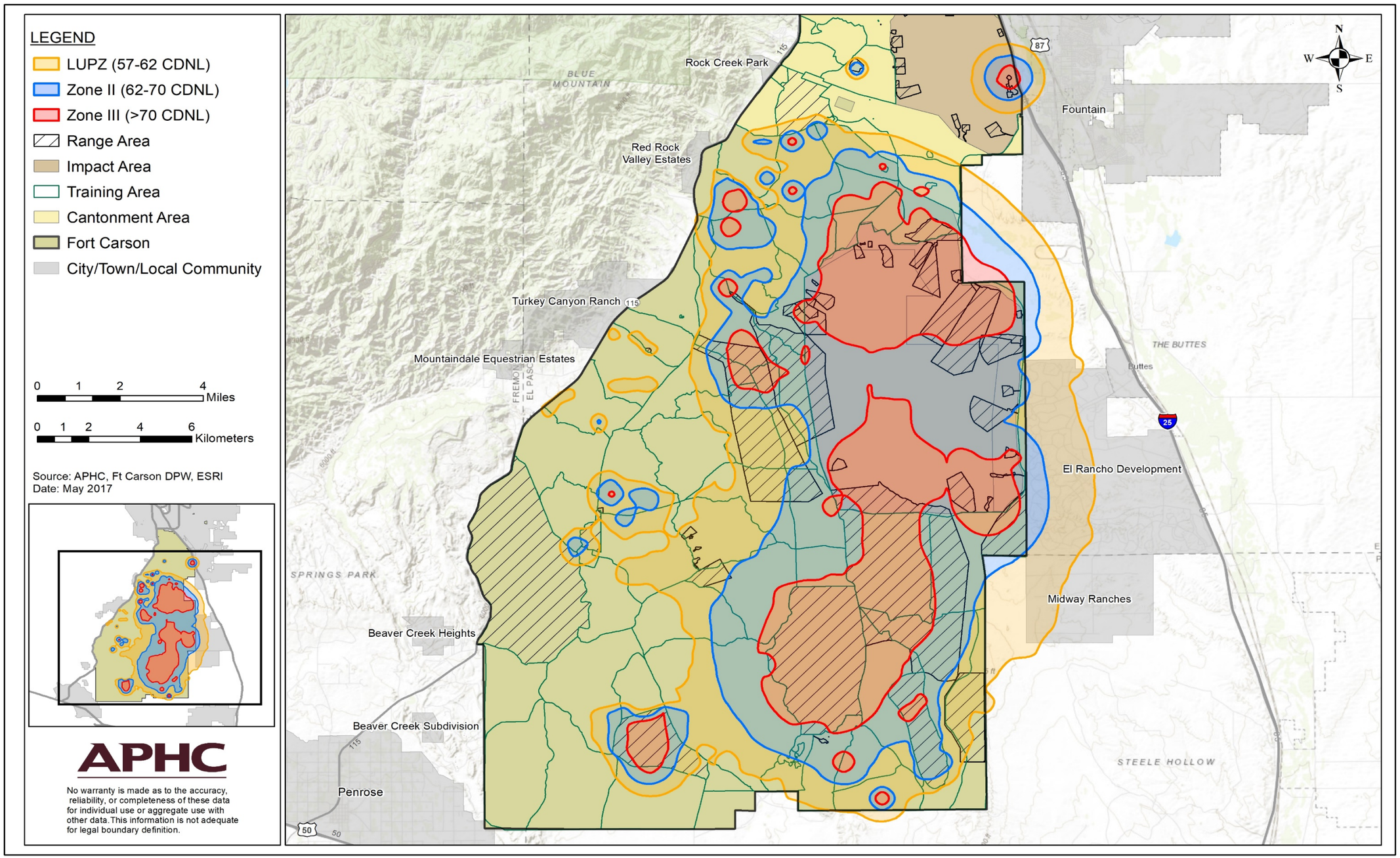


Figure 4-8. Future Large Caliber and Demolition Operations CDNL Noise Zones

Table 4-10. Future Large Caliber and Demolition Noise Zones Acreage

Noise Zone	Noise Zone Acreage		
	Total	Cantonment	Off Post
LUPZ	33,532	1,281	10,012
Zone II	35,214	664	2,455
Zone III	27,450	34	382

The LUPZ extends along a large portion of the installation boundary east, up to 2.6 km (1.6 miles); and one small area south approximately 470 m. The LUPZ remains contained within the western boundary in the future scenario. The LUPZ contains residential land uses in the El Rancho and Midway communities. Zone II extends beyond the installation boundary in similar fashion east and in one area south, just outside of TA 50. Zone II also contains multiple homes in the El Rancho development area.

Zone III extends beyond the installation boundary in two separate areas, one east of Range 35B in the small impact area and the other northeast of Ranges 109 and 111 in the large impact area. Land uses consists of Highway and open lands south of the gravel pit mining operations. There are no sensitive land uses within Zone III. On post, the Noise Zones do not extend far enough to contain any sensitive land uses.

Table 4-11 lists the daytime and nighttime ambient population exposure (LandScan™) totals within the future Noise Zones off post and those portions extending into the cantonment areas on post. As was the case with current operations, population exposure is greatest within the LUPZ. This is almost exclusively the areas east of the large impact area mentioned above. There are no impacts to the population residing on post.

Table 4-11. Population Exposure in Large Caliber and Demolition Noise Zones

Population	Noise Zone		
	LUPZ	Zone II	Zone III
Off Post			
Daytime	91	18	0
Nighttime	406	65	0
On Post (Cantonment Area)			
Daytime	0	0	0
Nighttime	0	0	0

4.4 SIMULATOR NOISE

Simulator noise levels vary depending on the type (i.e., artillery, ground burst, grenade, Improvised Explosive Device) but typically, the variation will be limited to a few decibels. Table 4-7 gives an approximation of anticipated noise levels under neutral and unfavorable weather conditions. The levels were generated using the BNOISE2 computer program, and then verified by comparing the levels with results from noise monitoring studies (U.S. Army 1983, U.S. Army 1984, U.S. Army 1989). Based on Table 4-7, under neutral weather conditions, the risk of complaints will be low beyond 500 m as the Peak level would not exceed 115 dBP. Under unfavorable weather conditions, such as during a temperature inversion, or when there is a steady wind blowing in the direction of the receiver, the distance to a 115 dBP level increases to approximately 800 m.

Table 4-12. Predicted Peak Noise Levels for Typical Army Simulators

Distance from source (Meters)	Neutral Weather Conditions PK50(met) dBP	Unfavorable Weather Conditions PK15(met) dBP
100	134	136
200	125	130
300	120	127
400	117	123
500	114	121
600	111	118
700	109	116
800	107	114

Simulators on Fort Carson are used at multiple collective training facilities, training areas and ranges. As was the case with non-fixed small arms training, simulators may be deployed during exercises in locations near the installation boundary. However, when compared to the high explosive large arms and demolition activities that take place at Fort Carson, in most cases, the noise from simulator training is not expected to create a high risk of complaints.

5 AIRCRAFT NOISE

5.1 GENERAL

Fort Carson accommodates a broad spectrum of aviation training and maintenance activities for both permanently stationed 4th CAB (Iron Eagles) aircraft, including Unmanned Aerial System (UAS) aircraft, and transient rotary- and fixed-wing aircraft. The Colorado Army National Guard, Air National Guard, and Reserve aviation units routinely utilize the airspace and training areas at Fort Carson.

The Fort Carson Local Flying Area (LFA) is defined as a 250 nautical mile radius centered on Butts Army Airfield (BAAF). The LFA is subdivided into Area "L" (local airspace), Area "P" (PCMS airspace), Test Flight Areas (TFA) 1 through 4, and Mountain Training Areas (MTA) 1 through 3 (MTA is divided into two sections) (Fort Carson 2017c). Local regulated airspace on Fort Carson consists of the BAAF airspace, defined by a five statute mile radius centered on the airfield, and the Restricted Area, R-2601. These two areas essentially delineate Fort Carson into North and South. Regulated airspace is managed by the Fort Carson Air Traffic &Airspace (AT&A) Office and controlled by the BAAF tower, DPTMS, and Airfield Operations.

R-2601 is divided into seven aviation training areas (Air 1 - Air 7) within the Fort Carson boundary. Military aircraft utilize R-2601 for a multitude of training activities, including Nap-of-the-Earth, terrain and tactical navigation, and aerial gunnery operations. The Red Devil Complex located in the southwestern portion of the installation features a 5,000 foot tactical dirt airstrip and an adjacent 1,400 foot UAS airstrip. There are nine drop zones on Fort Carson for fixed-wing parachute/paradrop operations and Range 123, a U.S. Air Force range located in the southwestern corner of R-2601, is used for fixed-wing bombing and strafing operations.

The MTAs are established in support of High Altitude Environmental Mountain Training (HAMET). Helicopter landing zones are available by a special permit from the U.S. Forest Service and Bureau of Land Management in these areas (Fort Carson 2017c). Rotary-wing maintenance test flights are conducted in four designated TFAs, located east of the Fort boundary. There is one established off-reservation low-level tactical flight corridor designated Route Hawk, located in the airspace between Fort Carson and PCMS. Helicopter aircraft use Route Hawk for low-level navigation training during day and Night Vision Device operations. Figure 5-1 illustrates the MTA, TFA, and Route Hawk locations.

PCMS airspace is designated as a Military Operations Area, and is considered special use airspace. Aviation operations at PCMS are divided into either normal operations or major exercise. Major exercise is defined as an exclusive use period in support of Brigade training exercises. Normal Operations are defined as any period outside of a major exercise. PCMS airspace is divided into eight aviation training areas (Air A through Air H). Separate air routes allow access to each training area (Fort Carson 2017c).

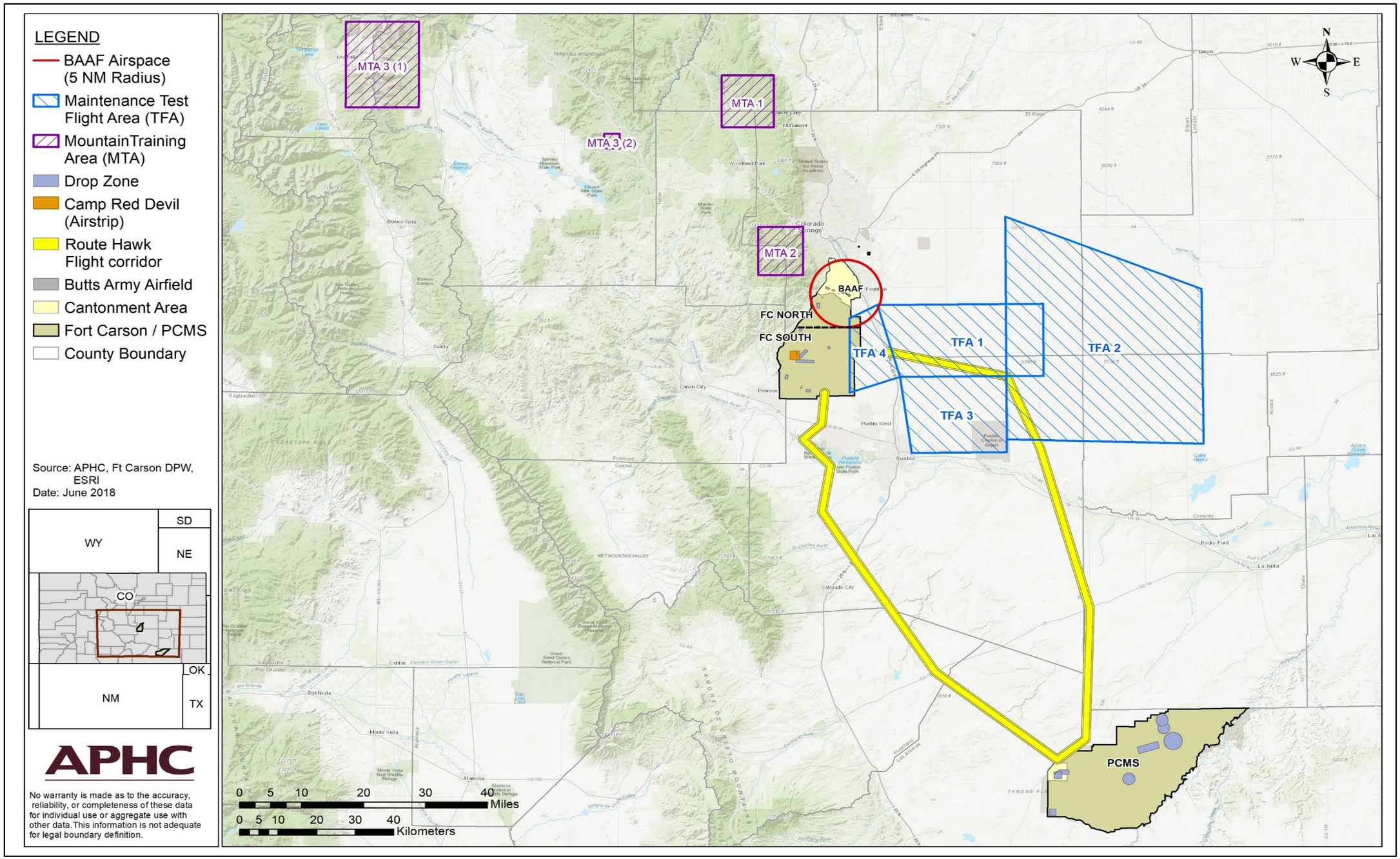


Figure 5-1. Fort Carson Aviation Areas

5.2 BUTTS ARMY AIRFIELD

BAAF is located in the southeast corner of the cantonment area, just south of the small impact area and east of the Wilderness Road Complex. The airfield has one main runway designated 13/31, which orients northwest to southeast and is approximately 4,522 feet in length. The former runway 4/22 is closed, but is used as two separate heliports, designated Eagle East and Eagle West. The airfield elevation is approximately 5,874 feet above mean sea level (MSL). BAAF is home to the 4th CAB, who are the primary users of the airfield.

5.2.1 BUTTS ARMY AIRFIELD NOISE ZONES

The number of military aircraft operations at an airfield varies from day to day. However, the NOISEMAP modeling software requires input of a specific number of daily aircraft flights and aircraft maintenance engine run-up operations. Thus, operations are calculated for an average annual day (AAD), meaning that operations are averaged across all 365 days of the year. The AAD was used in this assessment to generate A-Weighted Day-Night Level (ADNL) Noise Zones for BAAF. Fort Carson AT&A personnel provided aircraft tower counts for FY 2017. Appendix C contains the traffic count summary inputs for the Noise Zones.

Figure 5-2 illustrates the Noise Zones for BAAF aircraft operations. Table 5-1 lists the acreage calculations for each Noise Zone. The LUPZ extends off post east-southeast along the flight track approximately 4 km (2.4 miles), as far as Interstate 25 and west in one small area as far as State Highway 115 (~60 m). Land use in the area east is primarily industrial gravel pit operations, while the area west is residential. Zone II extends beyond the boundary in one area east approximately 415 m into undeveloped industrial land. Zone III is contained to the runway and heliport areas.

Table 5-1. BAAF Noise Zones Acreage

Noise Zone	Noise Zone Acreage		
	Total	Cantonment	Off Post
LUPZ	8,035	4,516	988
Zone II	1,117	668	13
Zone III	156	146	0

On post, the LUPZ contains 4th CAB facilities just west of the airfield, including multiple enlisted barracks and Company Head Quarters facilities. Zone II is primarily contained to the airfield property and impact area north. The barracks facilities are not contained within the Zone II; however, the closed pattern south of the runway flies directly overhead. It should be noted that the majority of all BAAF flights (~80 percent) occur during daytime hours. As evidenced in Table 5-2 the affected population numbers within the Noise Zones are low, as the majority of land use is considered compatible.

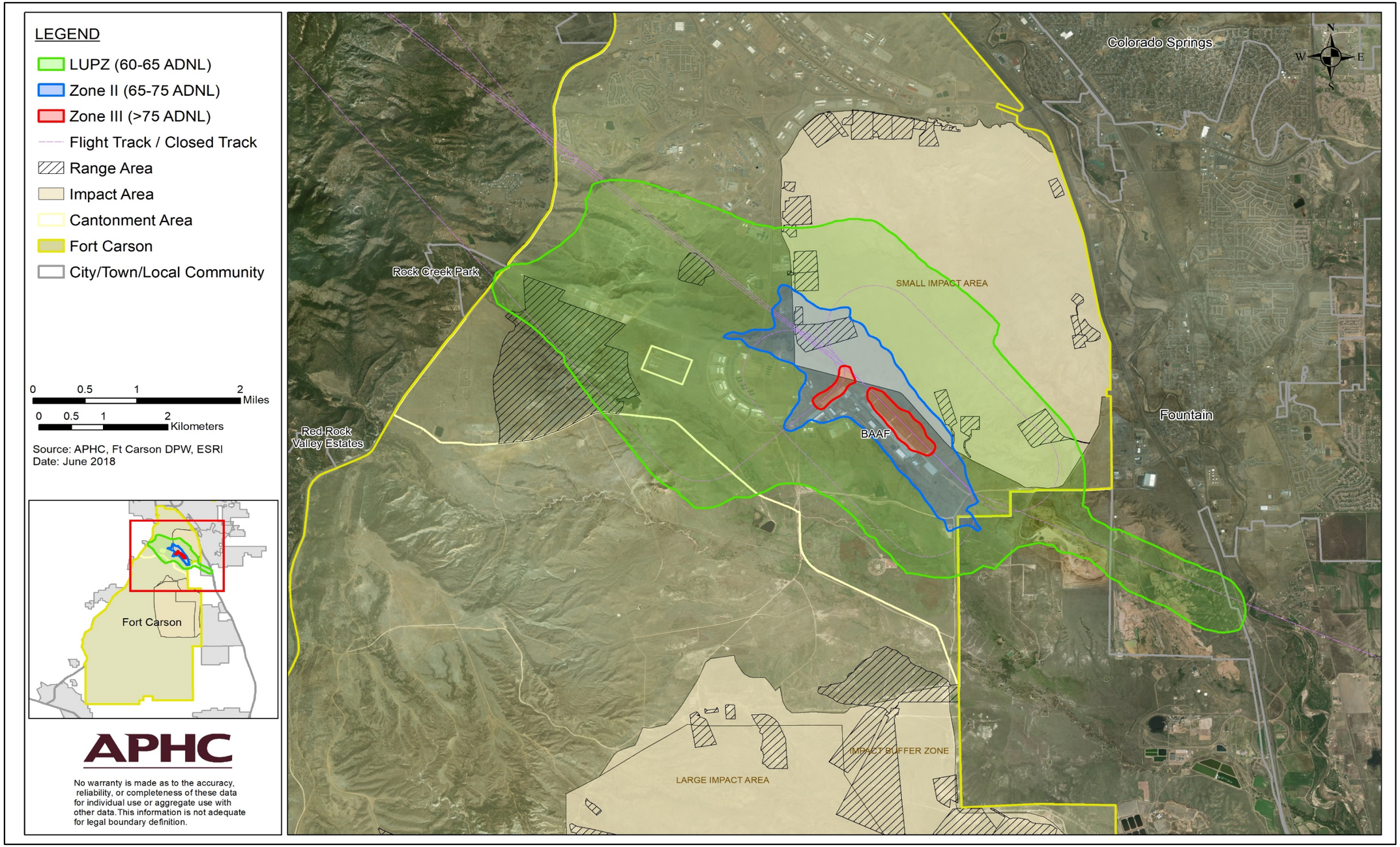


Figure 5-2. Butts Army Airfield ADNL Noise Zone

Table 5-2. Population Exposure in BAAF Noise Zones

Population	Noise Zone		
	LUPZ	Zone II	Zone III
Off Post			
Daytime	0	0	0
Nighttime	0	0	0
On Post (Cantonment Area)			
Daytime	8	34	2
Nighttime	17	0	0

5.3 ANNOYANCE POTENTIAL FROM SINGULAR OVERFLIGHT

Although the Noise Zones show that annual impacts of noise in and around BAAF are relatively minimal, individual aircraft overflights beyond the airfield, transitioning to or training within the LFA, generate noise levels that some individuals might find disruptive and/or annoying. This can be particularly true for military aircraft which tend to perform training activities which are repetitive and at low altitude. Rotary-wing aircraft flying along the installation boundary and C-130 fixed-wing aircraft utilizing the drop zones or the Camp Red Devil airstrip are just a few examples of these activities. As with range noise, singular aircraft overflight is often the culprit of noise complaints received by an installation. In fact, the preponderance of noise complaints received annually by the Fort Carson PAO involve helicopter operations beyond the Fort boundary.

Scandinavian Studies (Rylander 1974) found that a good predictor of annoyance at airfields with 50 to 200 operations per day is the maximum level of the 3 loudest events. While annoyance levels may be lower along less-frequented aviation routes and flight corridors, the Rylander study serves as an indicator for annoyance potential from intermittent overflights, and provides a measure of the intrusiveness of an individual event. Maximum sounds levels from military rotary-wing and fixed-wing aircraft which commonly use the airspace and facilities at Fort Carson and PCMS are listed in Tables 5-3 and 5-4. The 140th Wing of the Colorado Air National Guard (COANG) are the primary users of the bombing and strafing or Airburst range (Range 123) at Fort Carson. The 140th Wing, 120th Tactical Fighter Squadron operates the F-16 Falcon out of Buckley Air Force Base in Aurora, Colorado. Table 5-5 lists the maximum sound levels for the F-16 Falcon. These levels are compared against the levels listed in Table 5-6 to determine the percent of the population that may consider itself highly annoyed from a singular overflight.

Minimum altitudes within the LFA vary based on location; however, as a general rule aircraft operating off post not within a restricted overflight area and not within a designated low-level training route, maintain a minimum altitude of 500 feet AGL. Aircraft operating in Route Hawk maintain a minimum of 1,000 feet AGL from the Fort's southern boundary until the route passes east of Interstate 25, approximately 29 miles due south of Fort Carson. Once beyond this point aircraft conduct low-level (100-300 feet AGL) training, staying within one-mile to one-half mile either side of the centerline (Fort Carson 2017c).

Table 5-3. Maximum A-Weighted Sound Levels for Rotary-Wing Aircraft

Slant Distance (feet)	Maximum Sound Level, dBA[1]				
	AH-64[2] 70 KIAS	**CH-47[2]** **Light** ^130 KIAS	**CH-47[2]** **Heavy*** ^120 KIAS	**UH-60[2]** 70 KIAS	**UH-72[2]** ^123 KIAS
200	90	101	98	86	87
500	82	93	89	77	78
1,000	75	87	83	71	72
1,500	71	83	79	67	68
2,000	68	80	76	64	65
2,500	65	78	74	61	62

[1] During flyover at constant airspeed.
[2] Obtained via AAM Program (Wyle 2013)
^ Only KIAS available in single track mode
* Heavy = sling load
KIAS = Knots Indicated Air Speed

Table 5-4. Maximum A-Weighted Sound Levels for Fixed-Wing Aircraft

Slant Distance (Feet)	Maximum Sound Level , dBA[1]					
	C-130 970 C TIT 170 kts	**C-17** 90% NC 250 kts	**C-12** 90% RPM 160 kts	**C-21** 1500 lbs 160 kts	**C-5** 2.5 EPR 250 kts	**C-23** 99% RPM 160 kts
500	92	97	79	84	114	79
1,000	85	89	73	77	108	73
1,500	80	84	69	73	101	69
2,000	77	79	67	69	97	67
2,500	75	76	65	67	89	65
5,000	66	73	57	58	77	57

[1] Obtained via SelCalc Program (U.S. Air Force 2005)

Table 5-5. Maximum A-Weighted Sound Levels for F-16 Falcon Aircraft

Slant Distance (Feet)	Maximum Sound Level , dBA[1]
	F-16 89% NC, 200 kts
500	117
1,000	106
1,500	102
2,000	98
2,500	92
5,000	65

[1] Obtained via SelCalc Program (U.S. Air Force 2005)

Table 5-6. Percentage of Population Highly Annoyed from Aircraft Noise

Maximum Sound Level , dBA	Highly Annoyed
90	35%
85	28%
80	20%
75	13%
70	5%

Source: Rylander 1974

Taking the Rylander correlation one step further, the SelCalc Program (U.S. Air Force 2005) was used to calculate the distance in ground track from zero to where the maximum A-weighted noise level would decay to 70 dBA or below (threshold for annoyance). This takes into account not only those directly under a flight path but those to the side of a passing aircraft, where noise levels may remain high enough to cause annoyance up to one-half mile away.

Tables 5-7 and 5-8 are based on typical AGL altitudes for stationed rotary-wing aircraft and transient fixed-wing cargo aircraft. All of these aircraft have the potential to operate at relatively low altitudes at or near the Fort Carson boundary, or just beyond in the local airspace depending on the type of training mission.

The tables list the ground track distance, maximum sound level, and subsequent annoyance potential, and represent the best strategy for predicting areas that may be impacted based on annoyance potential from singular overflight. Current flight routes can be amended or future routes can be delineated based on the distances in the Tables, to further avoid the overflight of noise-sensitive areas.

Table 5-7. Rotary-Wing Overflight Annoyance Potential[1]

Source	Ground Track Distance[2]	dBA Maximum[3]	Population Highly Annoyed[4]
AH-64 – 500' AGL 70 KIAS	0'	82	23%
	1,320' (1/4 mile)	73	10%
	1,760' (1/3 mile)	69	4%
	2,640' (1/2 mile)	65	<1%
AH-64 – 1,000'AGL 70 KIAS	0'	75	13%
	1,320' (1/4 mile)	71	7%
	1,760' (1/3 mile)	69	4%
	2,640' (1/2 mile)	65	<1%
CH-47 Light – 500' AGL 130 KIAS	0'	93	+35%
	1,320' (1/4 mile)	94	+35%
	1,760' (1/3 mile)	93	+35%
	2,640' (1/2 mile)	90	+35%
	5,280' (1 mile)	70	5%
CH-47 Light – 1,000' AGL 130 KIAS	0'	87	31%
	1,320' (1/4 mile)	85	28%
	1,760' (1/3 mile)	84	26%
	2,640' (1/2 mile)	83	25%
	5,280' (1 mile)	81	22%
CH-47 Heavy* – 500' AGL 120 KIAS	0'	89	34%
	1,320' (1/4 mile)	77	16%
	1,760' (1/3 mile)	74	11%
	2,640' (1/2 mile)	70	5%
	5,280' (1 mile)	63	<1%
CH-47 Heavy* – 1,000' AGL 120 KIAS	0'	83	25%
	1,320' (1/4 mile)	77	16%
	1,760' (1/3 mile)	75	13%
	2,640' (1/2 mile)	70	5%
	5,280' (1 mile)	63	<1%
UH-60 – 500' AGL 70 KIAS	0'	77	16%
	1,320' (1/4 mile)	68	2%
	1,760' (1/3 mile)	64	<1%
UH-60 – 1,000' AGL 70 KIAS	0'	71	7%
	1,320' (1/4 mile)	67	1%
	1,760' (1/3 mile)	65	<1%

[1] Percent annoyance shown is based upon 50 to 200 overflights per day. (Rylander 1974)
[2] Distance between receiver and the point on Earth at which the aircraft is directly overhead.
[3] Obtained via AAM Program (Wyle 2013)
[4] Calculated percentage based upon regression using the known values in Table 5-8.
+35% The Rylander studies did not include sampling in excess of 90 dBA.
* Heavy = sling load

Table 5-8. Fixed-Wing Overflight Annoyance Potential[1]

Source	Ground Track Distance[2]	dBA Maximum[3]	Population Highly Annoyed[4]
C-130 – 500’ AGL	0’	92	+35%
	1,320' (1/4 mile)	80	20%
	1,760’ (1/3 mile)	77	16%
	2,640' (1/2 mile)	72	8%
	5,280' (1 mile)	62	<1%
C-130 – 1,000’ AGL	0’	85	28%
	1,320' (1/4 mile)	79	19%
	1,760’ (1/3 mile)	77	16%
	2,640' (1/2 mile)	72	8%
	5,280' (1 mile)	64	<1%
C-130 – 2,000’ AGL	0’	77	16%
	1,320' (1/4 mile)	75	13%
	1,760’ (1/3 mile)	74	11%
	2,640' (1/2 mile)	71	7%
	5,280' (1 mile)	64	<1%
C-17 – 500’ AGL	0’	97	+35%
	1,320' (1/4 mile)	84	26%
	1,760’ (1/3 mile)	80	20%
	2,640' (1/2 mile)	73	10%
	5,280' (1 mile)	62	<1%
C-17 – 1,000’ AGL	0’	89	34%
	1,320' (1/4 mile)	82	23%
	1,760’ (1/3 mile)	79	19%
	2,640' (1/2 mile)	74	11%
	5,280' (1 mile)	63	<1%
C-17 – 2,000’ AGL	0’	79	19%
	1,320' (1/4 mile)	77	16%
	1,760’ (1/3 mile)	75	13%
	2,640' (1/2 mile)	72	8%
	5,280' (1 mile)	64	<1%

[1] Percent annoyance shown is based upon 50 to 200 overflights per day. (Rylander 1974)
[2] Distance between receiver and the point on Earth at which the aircraft is directly overhead.
[3] Obtained via SelCalc Program (U.S. Air Force 2005)
[4] Calculated percentage based upon regression using the known values in Table 5-8.
+35% The Rylander studies did not include sampling in excess of 90 dBA.

5.3.1 UNMANNED AERIAL SYSTEM AIRCRAFT

UAS operations at Fort Carson consist of the MQ-1 Gray Eagle medium altitude, long endurance UAS or the smaller RQ-7 Shadow, RQ-11 Raven, RQ-20 Puma, and the Silver Fox tactical reconnaissance aircraft, as well as AAI Aerosonde weather data UAS. Launch and recovery of UAS on Fort Carson takes place at BAAF, the UAS Airstrip at the Red Devil Complex, and the temporary airstrip at the future UAS Training Complex in TA-17. This will become a permanent facility/permanent airstrip when construction is complete. Smaller UAS launch and recovery can also occur at approved Restricted Operating Zones (ROZ) within the R-2601. Launch and recovery on PCMS takes place at the PCMS airfield or within approved TAs.

UAS mission activities are conducted within the R-2601 airspace or within the PCMS boundary. However, future Gray Eagle operations from the 4th CAB are expected to occur in the airspace between R-2601 and PCMS to provide a greater breadth of training capability. The Gray Eagle is currently the loudest UAS operating in Fort Carson airspace. Mission operating altitude for the Gray Eagle averages 12,000-15,000 feet MSL (~6,000-9,000 feet AGL).

Given the specifications of the Gray Eagle model, such as the engine type and size, noise levels are comparable to a heavy-fuel single-engine piston aircraft with variable pitch. Table 5-9 lists the maximum noise overflight levels for the single engine at various power settings. Based on these levels, once the aircraft reaches approximately 2,000 feet AGL, the annoyance potential from overflight (below 70 dBA) is low. Thus, noise impacts from Gray Eagle aircraft operating above 6,000 feet AGL would be minimal, particularly when compared to current rotary- and fixed-wing aircraft operating in the same airspace.

Table 5-9. Maximum A-Weighted Sound Levels for Single-Engine Variable Pitch Aircraft

Slant Distance (Feet)	Maximum Sound Level, dBA		
	100% Power	75% Power	30% Power
200	92	86	75
500	84	78	67
1,000	78	71	60
2,000	71	65	55
5,000	61	55	44

6 NOISE RELATED LAND USE POLICY AND CONTROL

6.1 INTRODUCTION

Implementation of the ICUZ program is intended be a joint effort between Fort Carson and the adjacent communities. The role of Fort Carson is to minimize operational noise impacts on the surrounding local communities The role of the communities is to ensure that development in the surrounding area is compatible with accepted planning, zoning, and development principles and practices to protect the installation's mission.

6.2 ACHIEVING LAND USE COMPATIBILITY

Achieving land use compatibility requires both flexibility and creativity from land use planners, installation commanders, and the citizenry. The previous sections of this document detailed the environmental noise impacts. The following sections detail land use planning tools which are available to both the installation and local communities.

6.3 REGIONAL LAND USE PLANNING

The state of Colorado is divided into 14 separate planning and management regions, each with a Council of Government for the purpose of regional planning. Councils of Governments are voluntary associations of local governments formed under Colorado law. These councils serve as a forum for local governments to identify regional issues, develop strategies and provide a more consolidated system to provide oversight of various regional programs (www.coloradoregions.org). Regional services offered by councils of governments are varied. Services are undertaken in cooperation with member governments, the private sector, and state and federal partners.

Fort Carson lies in three separate planning and management Regions, but is primarily a part of Region 4 (El Paso County), serviced by the Pikes Peak Area Council of Governments (PPACG), which is also one of five Metropolitan Planning Organizations in the State of Colorado. PPACG is a voluntary organization of 16 counties and municipalities, which aims to provide a forum for local governments to discuss issues that cross their political boundaries, identify shared opportunities and challenges, and develop collaborative strategies for action.

The PPACG offers programs in administration, transportation, aging, environment, and military. The governing body of PPACG, the Board of Directors, is composed of elected officials appointed by the member governments and non-voting members from each of the five military installations and key agencies located within (www.ppacg.org).

6.4 JOINT LAND USE STUDY (JLUS)

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

The JLUS program is sponsored by the Department of Defense Office of Economic Adjustment (OEA) (DODI, 2004), which provides technical and financial assistance to the planning agencies for developing plans that are consistent, when economically feasible, with the noise, accident potential, and safety concerns from an installation's training and operations. The cost of the plan is shared between the OEA and the partners involved.

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

1. Impact Analysis. Impact analysis provides an in-depth review of existing and proposed land use patterns; drainage (as it effects land use designations); mission encroachment; transportation improvements, existing and proposed routes; noise/vibration; and other compatibility issues deemed pertinent to JLUS partners.

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/or recommendations for adoption by local jurisdictions to resolve land use conflicts and move toward a compatible land use plan for the installation, the adjacent counties and municipalities, and the communities therein.

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

Fort Carson is currently part of the ongoing Colorado Springs Regional Joint Land Use Study, started in October 2016 with a grant from OEA and sponsored by PPACG. The JLUS study area spans four counties (El Paso, Fremont, Pueblo, and Teller), with 23 different partners, including five military installations in the Pikes Peak region: the Air Force Academy, Fort Carson, Peterson Air Force Base (including Cheyenne Mountain Air Force Station), and Schriever Air Force Base (www.ppacg.org).

6.5 ARMY COMPATIBLE USE BUFFER (ACUB) PROGRAM

Along with the aforementioned Noise Zones, the Army has a specific program designed to limit the effects of encroachment. The ACUB program was borne out of a 2002 expansion of the Private Lands Initiative (10 USC §2684a) allowing military departments to partner with private organizations to establish conservation easements or buffer areas around active installations. These partnerships are beneficial in a number of ways:

- To Fort Carson:
  - Manages development adjacent to and near Fort Carson
  - Protects effective training space to the installation boundaries
  - Averts training restrictions
  - Mitigates against noise and smoke complaints
- To Fort Carson Community Partners:
  - Protects Fort Carson mission and strength
  - Does not remove lands from tax base
  - Maintains local agricultural and wild lands
- To Landowners:
  - Maintains current, compatible land uses
  - Provides cash in hand
  - Retain rights to ownership and management of land

The primary goal of Fort Carson's ACUB program is to buffer the ranges and training areas along the southern and eastern boundaries, in order to prevent training restrictions due to incompatible development. By using the ACUB program, Fort Carson is mitigating factors that would otherwise have direct negative impacts on frequently used training ranges, including: decreasing civilian safety concerns associated with illegal trespass, mitigating off-installation lighting sources that limit use of night vision devices and other night mission training, and decreasing public complaints regarding dust, smoke, noise, and vibration.

Fort Carson's partners in the ACUB program include The Nature Conservancy (TNC), El Paso County, U.S. Fish and Wildlife Service, Colorado Department of Transportation, Colorado Division of Wildlife, and Great Outdoors Colorado.

The buffer area extends from approximately 1.5 to 2.5 miles from the boundary and is separated into two Priority Areas (PA1 and PA2). To date, TNC has established conservation easements totaling 25,661 acres, effectively securing all of PA1 south and southeast of the Fort. These areas consist primarily of undeveloped working ranch lands. Fort Carson is continuing to work with El Paso County to secure an additional ~1,027 acres in PA2, by acquiring individual lots in the planned El Rancho subdivision directly adjacent to the eastern boundary.

6.6 LAND USE PLANNING OPTIONS

The following land use planning tools are available to help local governments create areas of compatible use around military installations. Many on the list are already in use; however, Fort Carson and local governments are strongly encouraged to revisit and/or update any of these options to find the equitable solutions that best work for their situation. These planning tools may be used individually or in combination.

Zoning. The most common method of land use control is *zoning*, or the partitioning of areas into sections reserved for different purposes. This method is an exercise of the police powers of state and local governments that designates the uses permitted in each parcel of land. It normally consists of a zoning ordinance that delineates the various use districts and a zoning map based on the land use element of the community's comprehensive general plan.

Easements. Easements can be an effective and permanent form of land use control; in many instances, better than zoning when trying to resolve an installation's compatibility issues. Easements are permanent (with the title held by the purchaser until sold or released), work equally well within different jurisdictions, are enforceable through civil courts, and may be acquired often at a fraction of the cost of the land value.

Subdivision Regulations. Subdivision regulations are a means by which local governments can ensure that proper lot layout, design, and improvements are included in new residential or commercial developments. These requirements may be anything from dictating the width of the roads to placement of the water and/or sewer systems. Since most local governments require some type of public dedication of open space when approving development plans, the installation may lobby to have a provision added to the subdivision regulations that requires this open space to be located nearest the installation boundary to create a buffer.

Disclosure of Noise Levels. Since noise levels in a community can be effectively modeled, as well as measured and recorded, making noise level information readily available can sometimes be all it takes to discourage incompatible land uses. These noise levels can be disclosed in several ways, including ordinances (or amendments to existing ordinances), deeds, posting noise levels on any sale/lease/rent sign, and initiating voluntary programs among local realtors to provide potential buyers with installation-provided information and noise level/contour mapping.

Deed Restrictions/Covenants. A deed is a document conveying ownership of land from one party to another, and restrictions called *covenants* can be added to the deed to specify restrictions on the use of the land. These covenants are on top of the restrictions already imposed by the current zoning of the property and in many instances may supersede zoning by prohibiting specified uses that would otherwise be allowed. Restrictive covenants "run with the land;" that is, no matter how often the land is resold, these covenants remain in effect until the specified length of the covenant has expired. In order to utilize this option, the installation must already own or must acquire the property. Then, when reselling the property, the installation specifies which uses are permitted on the land thereby preventing incompatible uses (such as residential housing) for as long as the restrictions remain in effect.

7 SUMMARY

The primary focus of the ICUZ study is to quantify the noise environment from military training sources and define the most appropriate uses of noise-impacted areas. The principle noise sources at Fort Carson and PCMS are small and large caliber weapons firing, including demolitions, and aircraft training.

7.1 SMALL ARMS WEAPONS

Fort Carson Small Arms Ranges

Small arms operations at Fort Carson take place at both dedicated small arms ranges in the small arms impact area in the north, and within the larger multi-purpose training complexes in the central and southern portions of the Fort. Small arms firing activities at these ranges occurs frequently throughout the year. Multiple ranges concurrently firing can be a common daily occurrence on the installation.

The Noise Zones from small arms firing are generally contained to training lands on post, with the exception of several areas beyond the eastern boundary. Zone II extends beyond the boundary east into the City of Fountain and El Paso County lands. Several homes within the El Rancho subdivision are contained within the Zone II. Other land uses within Zone II are considered compatible. Zone III extends beyond the eastern boundary outside the northeast corner of the large impact area. Land use in this area is considered compatible.

On post, Zone II and Zone III extend into the cantonment area from firing at the small impact area range complex. Zone II contains multiple enlisted barracks buildings north and west of the small impact area. Zone III mostly contains storage facilities and vehicle maintenance shops. Zone III does not contain any noise-sensitive land uses.

PCMS Small Arms Ranges

Live-fire small arms at PCMS are limited to a several ranges in the range complex just south of the PCMS cantonment. Zone II extends beyond the west boundary into undeveloped open lands. Zone III is contained to the PCMS boundary. There are no impacts to sensitive land uses on or off post.

Non-Fixed Firing Ranges

Training activities which require the firing of small arms weapons using blank ammunition occur in multiple special use and collective training facilities throughout the Fort. A large majority of the training areas also support these operations at Fort Carson and PCMS. In most cases, weapons fire takes place far enough from the installation and/or maneuver site boundary that noise impacts would be minimal.

7.2 LARGE CALIBER WEAPONS AND EXPLOSIVES

Fort Carson Land Use Compatibility

The cumulative large caliber and demolition operations Noise Zones show impacts to sensitive land uses are generally limited to the areas beyond Fort Carson's eastern boundary. Zones II and III extending beyond the boundary are primarily concentrated outside the ranges in the large impact area. Noise-sensitive land use within Zone II includes homes in the El Rancho subdivision, adjacent to the installation boundary. Zone II also extends just beyond the boundary south into undeveloped ranch land. There are no noise-sensitive land uses contained within Zone III. The Land use Planning Zone (LUPZ) extends further east, encompassing a larger portion of Fountain in the northeast and more homes in the El Rancho subdivision. The LUPZ also extends beyond the western boundary in several localized areas, containing scattered residences. Noise-sensitive land use within the LUPZ is considered compatible per Army guidelines; however, the LUPZ is delineated to indicate areas of emphasis for land use planners. These areas, although below Zone II limits, represent noise levels which some communities may still find unacceptable.

On post, the Noise Zones remain primarily contained to range and training area lands. The LUPZ extends north into the cantonment as far as the airfield property, but does not contain any noise-sensitive land uses. There are no noise-sensitive land uses in Zone II or III within the cantonment area.

Fort Carson Single Event Levels

Peak levels correlate with the receiver's perception of noise levels and can be a good predictor of complaints. Peak sound levels are included in this study as a supplement to land use compatibility Noise Zones. People in an area experiencing peak sound pressure levels between 115 and 130 dB may describe events as noticeable and distinct. Peak sound pressure levels above 130 dB are generally objectionable, and are often described as very loud and startling. Peak levels can vary significantly for the same activity based upon weather conditions. Peak sound levels in this study were modeled with two meteorological conditions (unfavorable and neutral weather) applied.

Under unfavorable weather, peak sound levels between 115 and 130 dB extend well beyond the boundary east, west, and south. Noise exposure is spread across the smaller communities and subdivisions east and west of the Fort. The areas south are comprised primarily of open grazing lands, which are protected under conservation easements restricting residential development. Peak sound levels above 130 dB extend beyond the boundary in similar fashion east, west and one area south. The area east outside of the large impact area extends up to into the El Rancho development, containing single family homes. Sensitive land uses west include a trailer home park adjacent to TA 9 and homes in the Red Rock Valley Estates and Turkey Canyon Ranch developments.

On post, peak sound levels between 115 and 130 dB extend north from limited training activities at Range 60. The contour contains family housing areas, enlisted barracks, and the Evans Army Community Hospital. Peak sound levels above 130 dB do not contain are primarily contained any noise-sensitive land uses in the cantonment.

Under neutral weather conditions, peak sound levels diminish considerably, particularly along the eastern and southern boundaries. However, noise impacts remain greatest in the areas east and west, where residential land uses are in close proximity to the installation boundary. Peak sound levels above 130 dB also extend beyond the installation boundary in several small areas east and west, along with one small area south. Although these areas are significantly reduced under neutral weather, several homes in the El Rancho (east) and Turkey Canyon Ranch (west) neighborhoods are contained within these high noise areas.

On post, the peak sound level contours do not encompass any sensitive land use. Although, a cluster of enlisted barracks buildings remain just outside the 115-130 dB contour. On occasion, these buildings may be subjected to loud-than-normal noise levels.

PCMS Single Event Levels

Live-fire large caliber and demolition operations at PCMS are limited to C4 and Bangalore torpedo demolition charges at Range 9. These operations do not occur frequently enough to generate CDNL Noise Zones which extend beyond the boundary. In addition, the detonation site for these activities is located far enough inside the PCMS boundary that single event peak sound levels would diminish below the threshold for complaints, according to Army guidelines. Given this distance and the frequency of demolition operations, noise exposure from demolition operations at PCMS is considered negligible.

7.3 AVIATION ACTIVITY

Butts Army Airfield

The cumulative Noise Zones from operations at Butts Army Airfield (BAAF) show minimal impacts beyond the installation boundary. Zone III is contained to the runway and heliport areas. Zone II extends beyond the boundary east into undeveloped industrial land. The LUPZ extends off post east-southeast as far as Interstate 25 and west in one small area just beyond the boundary. Land use in the area east is primarily industrial gravel pit operations, while the area west is residential. On post, Zone II is primarily contained to the airfield property and impact area north. The LUPZ contains multiple enlisted barracks facilities just west of the airfield.

Unmanned Aerial Systems

Unmanned Aerial System (UAS) launch and recovery operations take place at several different facilities throughout the Fort, using several different types of UAS aircraft. Training flights with UAS take place within the restricted airspace R-2601 at Fort Carson or within approved training areas on PCMS. Generally, the noise produced from UAS activities within the shared airspace is considerably quieter than other larger aircraft activities. Once UAS aircraft reach mission altitudes the annoyance potential from overflight is low. Future flight training missions with the Gray Eagle UAS are expected in the airspace between Fort Carson and PCMS, pending a certificate of authorization from the Federal Aviation Administration. Again, based on mission altitudes and known overflight levels, noise impacts from Gray Eagle flights to land use in these areas would be minimal.

Single Overflight

Aircraft operating outside of Fort Carson restricted airspace either in or out of designated flight corridor, aviation training area, maintenance test flight area, or within the Local Flying Area all have the potential to cause annoyance and possibly generate noise complaints from single overflight. Measures are currently in place to help mitigate the effects of aircraft noise, including minimum flight altitudes and avoidance procedures. However, helicopter overflight still generates the majority of all noise complaints received by Fort Carson.

7.4 RECOMMENDATIONS

The ICUZ is a proactive planning tool, which can help guide future development in surrounding communities. At a minimum, local municipal governments are encouraged to support public disclosure of all Noise Zones and supplemental metrics which may convey how military training operations affect the noise environment. The current Joint Land Use Study (JLUS) effort demonstrates the strong relationship Fort Carson has with the surrounding local government partners. It is recommended that all parties involved continue to pursue the recommendations made within the JLUS, contributing to the program's success.

The ICUZ study describes the noise characteristics of a specific operational environment, and as such, will change if a significant operational change is made. Therefore, if Fort Carson's mission, training, or training facilities undergo changes, the ICUZ should be reviewed to determine if the current noise assessment is sufficient. At a minimum, it is recommended that every five years the ICUZ and/or Noise Zones be updated to incorporate pertinent changes to the noise environment.

A GLOSSARY OF TERMS

A-Weighted Sound Level – a sound level (in decibels) that has been weighted to correspond with the non-linear sensitivity of the human ear. A-weighting discriminates against the lower frequencies and is used to measure most common military sounds such as transportation and small-arms fire.

Ambient Noise – the background noise that is usually present at a particular location; anything from cars on a highway, to insects in the woods.

Atmospheric Refraction – the bending and/or focusing of sound waves by the varying layers and densities of the earth's atmosphere.

C-Weighted Sound Level – like A-weighting, this is another sound level weighting technique that is used to normalize the low, impulsive sounds to the range of human hearing. It is used when measuring low frequency sound such as those from large arms, demolitions, and sonic booms.

Day-Night Average Sound Level (DNL) – the 24-hour average frequency-weighted sound level, in decibels, from midnight to midnight, obtained after the addition of 10 decibel "penalties" to sound levels between midnight and 7 a.m. and 10 p.m. to midnight (0000 to 0700 hours and 2200 to 2400 hours). A-weighting (ADNL) is understood unless otherwise specified, but C-weighting (CDNL) is also common.

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

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 them over the appropriate time period.

Frequency – the number of complete oscillation cycles per unit of time. The unit of frequency is the Hertz.

Frequency Weighting – the process of factoring in certain frequencies more or less heavily in order to bring the sound measurement more in line with the characteristics of the receiver (and thus make the numbers more meaningful to the task at hand). Example: A- or C-weighting to specifically parallel the sensitivity of the human ear.

Hertz – the unit of frequency equal to once cycle per second.

Impulse (or Impulsive) Noise – noise of short duration (typically less than one second), high intensity, abrupt onset and rapid decay, and often rapidly changing spectral composition. Impulsive noise is characteristically associated with such sources as explosions, impacts, the

discharge of forearms, the passage of supersonic aircraft (creating sonic booms), and many industrial processes.

Land Use Planning Zone (LUPZ) – The Land Use Planning Zone (LUPZ) is a subdivision of Zone I. The LUPZ is 5 dB lower than the Zone II.

Large Caliber/Arms – conventional military weapons over 20 millimeters in diameter.

Noise – any sound without value or unwanted sound.

Noise Level Reduction – the difference, in decibels, between the sound level outside a building and the sound level inside a designated room in the building (usually A-weighted). 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 if the designated room in the building.

Noise Zone III – the area around a noise source in which the C-weighted day-night sound level (CDNL) is greater than 70 dB (demolition and large caliber weapons), the A-weighted day-night level (ADNL) is greater than 75 dB (aviation), or the dB Peak is greater than 104 (small caliber weapons).

Noise Zone II – the area around a noise source in which the CDNL is 62-70 dB (demolition and large caliber weapons), the ADNL is 65-75 dB (aviation), or the dB Peak is 87-104 (small caliber weapons).

Noise Zone I – included all areas around a noise source in which the CDNL is less than 62 dB (demolition and large caliber weapons), the ADNL is less than 65 dB (aviation), or the dB Peak is less than 87 (small caliber weapons). This area is usually suited for all types of land use activities.

Peak – Peak is a single-event sound level without weighting.

PK15(Met) – PK15(met) is a computer modeled single-event peak level that is exceeded only 15 percent of the time by the loudest munitions type detonation. This metric accounts for variations caused by weather conditions and favors noise propagation. The PK15(met) metric does not communicate any information about how often the loudest munitions type is detonated.

PK50(Met) - is similar to the PK15(met) except that it represents the peak noise level that is exceeded 50 percent of the time. This metric also accounts for weather but assumes conditions which are not favorable for noise propagation.

Propagation – the process by which sound travels through space or material; may be affected by such things as weather, terrain, and barriers.

Slant Distance – the straight-line distance between two points not at the same elevation as contrasted with ground distance. Also known as slant range.

Small Arms – conventional military weapons .50 caliber and below in diameter.

Sound Exposure Level (SEL) – the total energy of a sound event normalized to a specific amount of time (e.g., one second) so that sounds of different durations may be compared directly.

Unweighted Peak Sound Level – the peak, single event sound level without weighting, without taking into account berms or other attenuation, and without any particular certainty.

B LAND USE GUIDELINES

Land use recommendations vary based on the type of noise source. The Federal Interagency Committee on Urban Noise (FICUN, 1980) guidelines in Table B-1 are applicable to A-weighted noise sources such as aircraft and traffic. Using the FICUN guidelines, the Army in conjunction with recommendations of the National Academy of Sciences Committee on Hearing, Bioacoustics and Biomechanics (CHABA 1981), developed Noise Zone limits for weapons and explosive noise. Tables B-2 and B-3 contain land use recommendations for land within the weapons and explosive Noise Zones.

TABLE B-1. FICUN GUIDELINES

SLUCM No.	LAND USE	NOISE ZONES AND ADNL LEVELS (dBA)						
		Noise Zone I		Noise Zone II		Noise Zone III		
		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 Products	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 - Manufacturing	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
32	Stone, Clay & Glass Products Manufacturing	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
33	Primary Metal Industries	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
34	Fabricated Metal Products - Manufacturing	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
25	Professional, Scientific & Controls	Yes	Yes	Yes	25	30	No	No
39	Miscellaneous Manufacturing	Yes	Yes	Yes	Yes[2]	Yes[3]	Yes[4]	No
40	**Transportation Communication & Utilities**							
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, Communication & Utilities	Yes	Yes	Yes	25[5]	30[5]	No	No

TABLE B-1. FICUN GUIDELINES, cont'd

SLUCM No.	LAND USE	NOISE ZONES AND ADNL LEVELS (dBA)						
		Noise Zone I		Noise Zone II		Noise Zone III		
		0-55	55-65	65-70	70-75	75-80	80-85	85+
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
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	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 & Recreational**							
71	Cultural Activities, Including Churches	Yes	Yes[*]	25[*]	30[*]	No	No	No
71.2	Nature Exhibits	Yes	Yes[*]	Yes[*]	No	No	No	No
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

TABLE B-1. FICUN GUIDELINES, cont'd

SLUCM No.	LAND USE	NOISE ZONES AND ADNL LEVELS (dBA)						
		Noise Zone I		Noise Zone II		Noise Zone III		
		0-55	55-65	65-70	70-75	75-80	80-85	85+
80	**Resource Product & Extract**							
81	Agriculture (Except Livestock)[11]	Yes	Yes	Yes[8]	Yes[9]	Yes[10]	Yes[10]	Yes[10]
81.5 to 81.7	Livestock Framing & Animal Breeding	Yes	Yes	Yes[8]	Yes[9]	No	No	No
82	Agricultural Related Activities	Yes	Yes	Yes[8]	Yes[9]	Yes[10]	Yes[10]	Yes[10]
83	Forestry Activities & Related Services	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

Notes:

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
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 approval.

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.

x^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.

x^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.

x^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.

x^5 If noise-sensitive, use indicated NLR; if not, use is compatible.

x^6 No buildings.

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

x^8 Residential buildings require a NLR of 25.

x^9 Residential buildings require a NLR of 30.

x^{10} Residential buildings not permitted.

x^{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.

TABLE B-2. LAND USE COMPATIBILITY FOR SMALL ARMS NOISE

LAND USE		SUGGESTED LAND USE COMPATIBILITY	
SLUCM NO.	LAND USE NAME	Noise Zone II 87-104 dBP	Noise Zone III >104 dBP
10	Residential		
11	Household units	N[1]	N
11.11	Single units: detached	N[1]	N
11.12	Single units: semidetached	N[1]	N
11.13	Single units: attached row	N[1]	N
11.21	Two units: side-by-side	N[1]	N
11.22	Two units: one above the other	N[1]	N
11.31	Apartments: walk-up	N[1]	N
11.32	Apartment: elevator	N[1]	N
12	Group quarters	N[1]	N
13	Residential hotels	N[1]	N
14	Mobile home parks or courts	N[1]	N
15	Transient lodgings	25	N
16	Other residential	N[1]	N
20	Manufacturing		
21	Food and kindred products; manufacturing	Y[2]	Y[3]
22	Textile mill products; manufacturing	Y[2]	Y[3]
23	Apparel and other finished products; products made from fabrics, leather, and similar materials; manufacturing	Y[2]	Y[3]
24	Lumber and wood products (except furniture); manufacturing	Y[2]	Y[3]
25	Furniture and fixtures; manufacturing	Y[2]	Y[3]
26	Paper and allied products; manufacturing	Y[2]	Y[3]
27	Printing, publishing, and allied industries	Y[2]	Y[3]
28	Chemicals and allied products; manufacturing	Y[2]	Y[3]
29	Petroleum refining and related industries	Y[2]	Y[3]
30	Manufacturing (continued)		
31	Rubber and misc. plastic products; manufacturing	Y[2]	Y[3]
32	Stone, clay and glass products; manufacturing	Y[2]	Y[3]
33	Primary metal products; manufacturing	Y[2]	Y[3]
34	Fabricated metal products; manufacturing	Y[2]	Y[3]
35	Professional scientific, and controlling instruments; photographic and optical goods; watches and clocks	25	35
39	Miscellaneous manufacturing	Y[2]	Y[3]
40	Transportation, communication and utilities		
41	Railroad, rapid rail transit, and street railway transportation	Y[2]	Y[3]
42	Motor vehicle transportation	Y[2]	Y[3]
43	Aircraft transportation	Y[2]	Y[3]
44	Marine craft transportation	Y[2]	Y[3]
45	Highway and street right-of-way	Y[2]	Y[3]
46	Automobile parking	Y[2]	Y[3]
47	Communication	25	35
48	Utilities	Y[2]	Y
49	Other transportation, communication and utilities	25	35

TABLE B-2. LAND USE COMPATIBILITY FOR SMALL ARMS NOISE, cont'd

LAND USE		SUGGESTED LAND USE COMPATIBILITY	
SLUCM NO.	LAND USE NAME	Noise Zone II 87-104 dBP	Noise Zone III >104 dBP
50	Trade		
51	Wholesale trade	Y[2]	Y[3]
52	Retail trade – building materials, hardware and farm equipment	25	35
53	Retail trade – including shopping centers, discount clubs, home improvement stores, electronics superstores, etc.	25	35
54	Retail trade – food	25	35
55	Retail trade – automotive, marine craft, aircraft and accessories	25	35
56	Retail trade – apparel and accessories	25	35
57	Retail trade – furniture, home, furnishings and equipment	25	35
58	Retail trade – eating and drinking establishments	25	35
59	Other retail trade	25	35
60	Services		
61	Finance, insurance and real estate services	25	35
62	Personal services	25	35
62.4	Cemeteries	Y[2]	Y[3]
63	Business services	25	35
63.7	Warehousing and storage	Y[2]	Y[3]
64	Repair services	Y[2]	Y[3]
65	Professional services	25	N
65.1	Hospitals, other medical facilities	N	N
65.16	Nursing homes	N	N
66	Contract construction services	25	35
67	Government services	25	35
68	Educational services	35	N
68.1	Child care services, child development centers, and nurseries	35	N
69	Miscellaneous		
69.1	Religious activities	35	N
70	Cultural, entertainment and recreational		
71	Cultural activities (& churches)	35	N
71.2	Nature exhibits	N	N
72	Public assembly	N	N
72.1	Auditoriums, concert halls	35	N
72.11	Outdoor music shells, amphitheaters	N	N
72.2	Outdoor sports arenas, spectator sports	N	N
73	Amusements	Y	N
74	Recreational activities (including golf courses, riding stables, water recreation)	N	N
75	Resorts and group camps	N	N
76	Parks	N	N
79	Other cultural, entertainment and recreation	N	N

TABLE B-2. LAND USE COMPATIBILITY FOR SMALL ARMS NOISE, cont'd

LAND USE		SUGGESTED LAND USE COMPATIBILITY	
SLUCM NO.	LAND USE NAME	Noise Zone II 87-104 dBP	Noise Zone III >104 dBP
80	Resource production and extraction		
81	Agriculture (except live- stock)	Y[4]	Y[5]
81.5	Livestock farming	Y[4]	N
81.7	Animal breeding	Y[4]	N
82	Agriculture related activities	Y[4]	Y[5]
83	Forestry activities	Y[4]	Y[5]
84	Fishing activities	Y	Y
85	Mining activities	Y	Y
89	Other resource production or extraction	Y	Y

Notes:
SLUCM – Standard Land Use Coding Manual, U.S. Department of Transportation
dBP- unweighted Peak decibel level
Y (Yes) – Land use and related structures compatible without restrictions.
N (No) – Land use and related structures are not compatible and should be prohibited.
Y^x – Yes with restrictions. The land use and related structures generally are compatible. However, see note(s) indicated by the superscript.
N^x – No with exceptions. The land use and related structures are generally incompatible. However, see note(s) indicated by the superscript.
25, 30, or 35 – The numbers refer to noise level reduction (NLR) levels. NLR (outdoor to indoor) is achieved through the incorporation of noise attenuation into the design and construction of a structure. Land use and related

Note 1:

a. Although local requirements for on- or off-base housing may require noise-sensitive land uses within Noise Zone II, such land use is generally not recommended. The absence of viable alternative development options should be determined and an evaluation should be conducted locally prior to local approvals indicating that a demonstrated community need for the residential use would not be met if development were prohibited in these zones. Existing residential development is considered as pre-existing, non-conforming land uses.

b. Where the community determines that these uses must be allowed, measures to achieve outdoor to indoor NLR of at least 30 decibels (dB) in Noise Zone II should be incorporated into building codes and be considered in individual approvals.

c. Normal permanent construction can be expected to provide an NLR of 20 dB, thus the reduction requirements are often stated as 10 dB over standard construction and normally assume mechanical ventilation, upgraded sound transmission class ratings in windows and doors, and closed windows year round.

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

Note 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.

Note 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.

Note 4. Residential buildings require an NLR of 30.

Note 5. Residential buildings are not permitted.

TABLE B-3. LAND USE COMPATIBILITY: DEMOLITION AND LARGE ARMS NOISE

LAND USE		SUGGESTED LAND USE COMPATIBILITY		
SLUCM NO.	LAND USE NAME	LUPZ CDNL or CNEL 57-62	Noise Zone II CDNL or CNEL 62-70	Noise Zone III CDNL or CNEL 70+
10	Residential	Y[1]	N[2,3]	N[3]
11	Household units	Y[1]	N[2,3]	N[3]
11.11	Single units: detached	Y[1]	N[2,3]	N[3]
11.12	Single units: semidetached	Y[1]	N[2,3]	N[3]
11.13	Single units: attached row	Y[1]	N[2,3]	N[3]
11.21	Two units: side-by-side	Y[1]	N[2,3]	N[3]
11.22	Two units: one above the other	Y[1]	N[2,3]	N[3]
11.31	Apartments: walk-up	Y[1]	N[2,3]	N[3]
11.32	Apartment: elevator	Y[1]	N[2,3]	N[3]
12	Group quarters	Y[1]	N[2,3]	N[3]
13	Residential hotels	Y[1]	N[2,3]	N[3]
14	Mobile home parks or courts	Y[1]	N[2,3]	N[3]
15	Transient lodgings	Y	Y	N
16	Other residential	Y[1]	N[2,3]	N[3]
20	Manufacturing			
21	Food and kindred products; manufacturing	Y	Y[4]	Y[4]
22	Textile mill products; manufacturing	Y	Y[4]	Y[4]
23	Apparel and other finished products; products made from fabrics, leather, and similar materials; manufacturing	Y	Y[4]	Y[4]
24	Lumber and wood products (except furniture); manufacturing	Y	Y[4]	Y[4]
25	Furniture and fixtures; manufacturing	Y	Y[4]	Y[4]
26	Paper and allied products; manufacturing	Y	Y[4]	Y[4]
27	Printing, publishing, and allied industries	Y	Y[4]	Y[4]
28	Chemicals and allied products; manufacturing	Y	Y[4]	Y[4]
29	Petroleum refining and related industries	Y	Y[4]	Y[4]
30	Manufacturing (continued)			
31	Rubber and misc. plastic products; manufacturing	Y	Y[4]	Y[4]
32	Stone, clay and glass products; manufacturing	Y	Y[4]	Y[4]
33	Primary metal products; manufacturing	Y	Y[4]	Y[4]
34	Fabricated metal products; manufacturing	Y	Y[4]	Y[4]
35	Professional scientific, and controlling instruments; photographic and optical goods; watches and clocks	Y	N	N
39	Miscellaneous manufacturing	Y	Y[4]	Y[4]

TABLE B-3. LAND USE COMPATIBILITY: DEMOLITION AND LARGE ARMS NOISE, cont'd

LAND USE		SUGGESTED LAND USE COMPATIBILITY		
SLUCM NO.	LAND USE NAME	LUPZ CDNL or CNEL 57-62	Noise Zone II CDNL or CNEL 62-70	Noise Zone III CDNL or CNEL 70+
40	Transportation, communication and utilities			
41	Railroad, rapid rail transit, and street railway transportation	Y	Y	Y
42	Motor vehicle transportation	Y	Y	Y
43	Aircraft transportation	Y	Y	Y
44	Marine craft transportation	Y	Y	Y
45	Highway and street right-of-way	Y	Y	Y
46	Automobile parking	Y	Y	Y
47	Communication	Y	N	N
48	Utilities	Y	Y	Y
49	Other transportation, communication and utilities	Y	Y	N
50	Trade			
51	Wholesale trade	Y	Y	N
52	Retail trade – building materials, hardware and farm equipment	Y	Y	N
53	Retail trade – including shopping centers, discount clubs, home improvement stores, electronics superstores, etc.	Y	Y	N
54	Retail trade – food	Y	Y	N
55	Retail trade – automotive, marine craft, aircraft and accessories	Y	Y	N
56	Retail trade – apparel and accessories	Y	Y	N
57	Retail trade – furniture, home, furnishings and equipment	Y	Y	N
58	Retail trade – eating and drinking establishments	Y	Y	N
59	Other retail trade	Y	Y	N
60	Services			
61	Finance, insurance and real estate services	Y	Y	N
62	Personal services	Y	Y	N
62.4	Cemeteries	Y	Y	Y
63	Business services	Y	Y	N
63.7	Warehousing and storage	Y	Y[4]	Y[4]
64	Repair services	Y	Y	N
65	Professional services	Y	Y	N
65.1	Hospitals, other medical facilities	Y[1]	N	N
65.16	Nursing homes	Y[1]	N	N
66	Contract construction services	Y	Y	N
67	Government services	Y	Y	N
68	Educational services	Y[1]	N	N
68.1	Child care services, child development centers, and nurseries	Y[1]	N	N

TABLE B-3. LAND USE COMPATIBILITY: DEMOLITION AND LARGE ARMS NOISE, cont'd

LAND USE		SUGGESTED LAND USE COMPATIBILITY		
SLUCM NO.	LAND USE NAME	LUPZ CDNL or CNEL 57-62	Noise Zone II CDNL or CNEL 62-70	Noise Zone III CDNL or CNEL 70+
69	Miscellaneous			
69.1	Religious activities	Y[1]	N	N
70	Cultural, entertainment and recreational			
71	Cultural activities (& churches)	Y[1]	N	N
71.2	Nature exhibits	Y[1]	N	N
72	Public assembly	Y[1]	N	N
72.1	Auditoriums, concert halls	Y[1]	N	N
72.11	Outdoor music shells, amphitheaters	Y[1]	N	N
72.2	Outdoor sports arenas, spectator sports	Y	N	N
73	Amusements	Y	Y	N
74	Recreational activities (including golf courses, riding stables, water recreation)	Y	N	N
75	Resorts and group camps	Y	N	N
76	Parks	Y	N	N
79	Other cultural, entertainment and recreation	Y	N	N
80	Resource production and extraction			
81	Agriculture (except live- stock)	Y	Y	Y
81.5	Livestock farming	Y	N	N
81.7	Animal breeding	Y	N	N
82	Agriculture related activities	Y	Y	Y
83	Forestry activities	Y	Y	Y
84	Fishing activities	Y	Y	Y
85	Mining activities	Y	Y	Y
89	Other resource production or extraction	Y	Y	Y

Note 1: LUPZ- Land Use Planning Zone is a subdivision of Land Use Zone I and functions as a buffer for Noise Zone II. Communities and individuals often have different views regarding acceptable or desirable levels of noise. To address this, some local governments have implemented land use planning measures beyond Noise Zone II limits. In addition to mitigating current noise impacts, implementing such controls within the LUPZ can create a buffer to prevent the possibility of future noise conflicts.

Note 2: Although local requirements for on- or off-base housing may require noise-sensitive land uses within Noise Zone II, such land use is generally not compatible within Noise Zone II. Measures to achieve overall noise level reduction inside structures do not solve noise difficulties outside the structure. Barriers are not effective reducing the noise from artillery and armor, the detonation of either large caliber military munitions or a large quantity of explosives. Additionally, noise level reduction inside structures does not mitigate the vibration generated by the low-frequency energy of large caliber weapons firing and detonations.

Note 3: Within Zones, existing "noise sensitive land uses are considered as pre-existing incompatible land uses. In most cases these uses are not a risk to either mission sustainment or a community's quality of life. Most long-term members near Army installations or activities acknowledge hearing military operations and activities but they are usually not alarmed or bothered by the noise.

Note 4: Although noise levels may be compatible, caution should be exercised in siting any activity which may be sensitive to vibration.

C DATA USED TO GENERATE NOISE ZONES

C.1 SMALL ARMS RANGE NOISE ZONES

Source: All small arms range utilization extracted from 01 January 2016 to 31 December 2017 RFMSS ammunition expenditure report. RFMSS provided by Fort Carson Range Control Division.

TABLE C-1. FORT CARSON SMALL ARMS AMMUNITION UTILIZATION MATRIX

Facility	PISTOL, .45 CAL, LIVE	PISTOL, .40 CAL, LIVE	PISTOL, 9 MM, LIVE	RIFLE, .22 CAL, LIVE	RIFLE, 300 MAG, LIVE	RIFLE, 5.56 MM, LIVE	RIFLE, 5.56 MM, BLANK*	RIFLE, 7.62 MM, LIVE	MACHINE GUN, 7.62 MM, LIVE	MACHINE GUN, 7.62 MM, BLANK*	MACHINE GUN, .50 CAL, LIVE	MACHINE GUN, .50 CAL, BLANK*	MACHINE GUN, .50 CAL, PLASTIC	SHOTGUN, 12 GAUGE	SHOTGUN, 12 GAUGE NON-LETHAL
RG001		X	X	X		X									
RG003	X		X			X	X							X	
RG007			X												
RG007A	X		X			X			X					X	
RG009A	X		X			X									
RG009B			X			X	X		X	X		X			
RG009C			X			X									
RG009D			X			X	X								
RG009E			X			X	X								
RG009F			X			X	X								
RG013			X			X	X		X					X	
RG013A			X			X	X		X					X	
RG015			X			X			X					X	
RG017	X		X			X	X		X					X	
RG024						X	X			X		X		X	X
RG029						X	X								
RG037			X			X									
RG043			X		X	X		X	X					X	
RG045			X			X									
RG049A			X			X								X	
RG049B						X									
RG049C			X			X								X	
RG051			X			X								X	
RG055			X			X									
RG057						X									
RG060						X	X	X		X		X		X	X
RG060A							X			X		X			
RG061		X	X			X									
RG063			X												
RG065						X									
RG069						X									

TABLE C-2. FORT CARSON SMALL ARMS AMMUNITION UTILIZATION MATRIX

Facility	PISTOL, .45 CAL, LIVE	PISTOL, .40 CAL, LIVE	PISTOL, 9 MM, LIVE	TRAINER AT4, 9MM TPT	RIFLE, 300 MAG, LIVE	RIFLE, 5.56 MM, LIVE	RIFLE, 5.56 MM, BLANK*	RIFLE, 6.5 MM, LIVE	RIFLE, 7.62 MM, LIVE	MACHINE GUN, 7.62 MM, LIVE	MACHINE GUN, 7.62 MM, BLANK*	MACHINE GUN, .50 CAL, LIVE	MACHINE GUN, .50 CAL, BLANK*	SHOTGUN, 12 GAUGE
RG104							X						X	
RG105			X		X	X				X		X	X	
RG109					X	X	X		X	X	X	X	X	
RG111						X	X			X	X	X	X	
RG115A			X			X								
RG115B					X	X			X	X		X		
RG117						X				X				
RG119			X		X	X	X		X	X	X	X	X	X
RG121						X				X		X		X
RG121A														X
RG121C			X		X	X			X	X	X	X		
RG123			X			X	X		X	X		X		
RG127						X	X			X	X	X	X	
RG127A						X	X		X	X	X	X	X	
RG129										X		X		
RG131B			X		X	X	X		X	X	X			X
RG131C	X	X	X		X	X	X		X	X	X	X		X
RG133			X		X	X			X	X		X		
RG135			X		X	X			X	X		X		
RG137			X			X	X		X					
RG139			X	X										
RG141		X	X		X	X	X		X	X		X		X
RG141A	X		X	X	X	X	X		X	X	X	X	X	X
RG143					X	X			X	X	X	X	X	
RG145						X				X		X	X	
RG147							X				X			
RG147A			X			X	X							X
RG150			X			X	X		X	X	X	X	X	X
RG153			X	X		X	X		X	X	X	X	X	
RG155			X	X	X	X	X		X	X	X	X	X	
RG157						X	X				X			
RG159		X	X			X	X							X
RG161														X
RG163						X	X			X	X			X
RG165			X			X	X			X	X	X	X	

TABLE C-3. PCMS SMALL ARMS AMMUNITION UTILIZATION MATRIX

Range/Facilty	PISTOL, .40 CAL, LIVE	PISTOL, 9 MM, LIVE	RIFLE, 300 MAG, LIVE	RIFLE, 5.56 MM, LIVE	RIFLE, 5.56 MM, BLANK*	RIFLE, 7.62 MM, LIVE	MACHINE GUN, 7.62 MM, LIVE	MACHINE GUN, 7.62 MM, BLANK*	MACHINE GUN, .50 CAL, LIVE	MACHINE GUN, .50 CAL, BLANK*	SHOTGUN, 12 GAUGE
PCRG001		X		X							
PCRG001A		X		X							X
PCRG003		X		X							X
PCRG003A	X	X		X							X
PCRG007			X	X		X	X		X	X	
PCRG009				X	X		X	X	X	X	

C.2 LARGE CALIBER AND DEMOLITION NOISE ZONES (CDNL)

Source: Large caliber ammunition expenditures (RFMSS) from 01 January 2016 to 31 December 2017. RFMSS provided by Fort Carson Range Control Division.

TABLE C-4. LARGE CALIBER AND DEMOLITION AMMUNITION EXPENDITURE

				MODEL INPUTS	
Facility/Airspace	Nomenclature	Quantity Fired FY 16 & FY17	2 Year Average	Daytime (0700-2200)	Nighttime (2200-0700)
MP001	Mortar, 120 MM Inert	310	155	124	31
	Mortar, 60 MM Inert	207	104	83	21
MP003	Mortar, 81 MM Inert	14	7	6	1
MP004	Mortar, 120 MM Inert	40	20	16	4
	Mortar, 120 MM Inert	12	6	5	1
MP015	Mortar, 120 MM HE	56	28	22	6
	Mortar, 120 MM Inert	351	176	140	35
MP016	Mortar, 60 MM HE	531	266	212	53
	Mortar, 60 MM Inert	1095	548	438	110
	Mortar, 81 MM HE	251	126	100	25
	Mortar, 81 MM Inert	440	220	176	44
	Mortar, 120 MM HE	247	124	99	25
	Mortar, 120 MM Inert	1247	624	499	125
MP019	Mortar, 60 MM HE	265	133	106	27
	Mortar, 60 MM Inert	160	80	64	16
	Mortar, 81 MM HE	162	81	65	16
	Mortar, 81 MM Inert	208	104	83	21
	Mortar, 120 MM HE	58	29	23	6
	Mortar, 120 MM Inert	308	154	123	31
MP020	Mortar, 60 MM HE	14	7	6	1
	Mortar, 60 MM Inert	191	96	76	19
	Mortar, 81 MM Inert	57	29	23	6
	Mortar, 120 MM HE	38	19	15	4
	Mortar, 120 MM Inert	300	150	120	30
MP023	Mortar, 81 MM HE	7	4	3	1
	Mortar, 81 MM Inert	91	46	36	9
	Mortar, 120 MM Inert	100	50	40	10
MP024	Mortar, 60 MM HE	68	34	27	7
	Mortar, 60 MM Inert	657	329	263	66
	Mortar, 81 MM HE	94	47	38	9
	Mortar, 81 MM Inert	587	294	235	59
	Mortar, 120 MM HE	192	96	77	19
	Mortar, 120 MM Inert	911	456	364	91
MP025	Mortar, 60 MM HE	332	166	133	33
	Mortar, 60 MM Inert	435	218	174	44
	Mortar, 81 MM HE	78	39	31	8
	Mortar, 81 MM Inert	212	106	85	21
	Mortar, 120 MM HE	346	173	138	35
	Mortar, 120 MM Inert	1827	914	731	183

HE = High Explosive; Inert is defined as any round that does not make noise upon impact (Illum, Smoke, TP, TPT, etc…)

				MODEL INPUTS	
Facility/Airspace	Nomenclature	Quantity Fired FY 16 & FY17	2 Year Average	Daytime (0700-2200)	Nighttime (2200-0700)
MP026	Mortar, 60 MM HE	24	12	10	2
	Mortar, 60 MM Inert	1086	543	434	109
	Mortar, 81 MM HE	71	36	28	7
	Mortar, 81 MM Inert	280	140	112	28
	Mortar, 120 MM HE	214	107	86	21
	Mortar, 120 MM Inert	428	214	171	43
MP027	Mortar, 60 MM HE	260	130	104	26
	Mortar, 60 MM Inert	114	57	46	11
	Mortar, 81 MM HE	100	50	40	10
	Mortar, 81 MM Inert	59	30	24	6
	Mortar, 120 MM HE	295	148	118	30
	Mortar, 120 MM Inert	1207	604	483	121
OP09	Missile, TOW HE	4	2	2	0
RG024	Demolition, Roll H6 1/2 LB p/ft (M060)	10	5	5	0
	Demolition, 1 1/4 LB C4	9	5	5	0
RG035B	Grenade, M67	5598	2799	2799	0
RG060	Demolition, 1 1/4 LB C4	31	16	16	0
RG103	Grenade, 40 MM HE	11560	5780	5780	0
RG105	Gun, 25 MM Inert	4626	2313	1850	463
	Gun, 30 MM Inert	4480	2240	1792	448
	Rocket, 2.75" Inert	440	220	176	44
	Tank Stryker, 105 MM Inert	8	4	3	1
	Tank, 120 MM Inert	176	88	70	18
	Tank, 120 MM SABOT Inert	285	143	114	29
RG109	Gun, 25 MM Inert	7555	3778	3022	756
	Gun, 30 MM Inert	7630	3815	3052	763
	Rocket, 2.75" Inert	512	256	205	51
	Tank, 120 MM Inert	292	146	117	29
	Tank, 120 MM SABOT Inert	153	77	61	15
RG111	Gun, 25 MM Inert	325	163	130	33
	Gun, 30 MM Inert	47706	23853	19082	4771
	Rocket, 2.75" Inert	4566	2283	1826	457
	Tank Stryker, 105 MM Inert	366	183	146	37
	Tank, 120 MM Inert	32	16	13	3
	Tank, 120 MM SABOT Inert	28	14	11	3

HE = High Explosive; Inert is defined as any round that does not make noise upon impact (Illum, Smoke, TP, TPT, etc…)

				MODEL INPUTS	
Facility/Airspace	Nomenclature	Quantity Fired FY 16 & FY17	2 Year Average	Daytime (0700-2200)	Nighttime (2200-0700)
RG117	Mortar, 60 MM Inert	144	72	58	14
	Mortar, 81 MM HE	129	65	52	13
	Mortar, 81 MM Inert	274	137	110	27
	Mortar, 120 MM HE	597	299	239	60
	Mortar, 120 MM Inert	805	403	322	81
RG121	Demolition, Roll H6 1/2 LB p/ft (M060)	675	338	338	0
	Demolition, Roll PETN 1/2 LB p/ft (M980)	236	118	118	0
	Demolition, 1 1/4 LB C4	1714	857	857	0
	Rocket, AT-4, 84 MM HE	8	4	4	0
	Artillery, 155 MM HE	18	9	7	2
RG121A	Demolition, 1/4 LB TNT	185	93	93	0
	Demolition, 1 LB TNT	6	3	3	0
	Demolition, 1 1/4 LB C4	6272	3136	3136	0
	Demolition, Shaped 15 LB	114	57	57	0
	Demolition, Shaped 40 LB	45	23	23	0
	Demolition, Roll PETN 1/2 LB p/ft (M980)	10	5	5	0
	Demolition, 40 LB Cratering Charge	147	74	74	0
	Demolition, Bangalore Torpedo M1A2	247	124	124	0
	Demolition, Military Dynamite M1	87	44	44	0
	Mine, Claymore M18A1	228	114	114	0
RG123	Demolition, 1 1/4 LB C4	205	103	103	0
	Demolition, 2 1/4 LB C4	7	4	4	0
	Demolition, 1/2 LB TNT	4	2	2	0
	Demolition, 1 LB TNT	11	6	6	0
	Demolition, Shaped 40 LB	1	1	1	0
	Demolition, Bangalore Torpedo M1A2	6	3	3	0
	Demolition, Military Dynamite M1	10	5	5	0
	Gun, 20 MM Inert	50922	25461	20369	5092
	Gun, 30 MM Inert	5855	2928	2342	586
	Mortar, 60 MM Inert	10	5	4	1
	Tank Stryker, 105 MM Inert	104	52	42	10
RG125	Bomb, 500 LB Live	2	1	1	0
	Bomb, 250 LB Live	4	2	2	0
	Demolition, Roll PETN 1/2 LB p/ft (M980)	12	6	6	0
	Demolition, 1 1/4 LB C4	44	22	22	0

HE = High Explosive; Inert is defined as any round that does not make noise upon impact (Illum, Smoke, TP, TPT, etc…)

				MODEL INPUTS	
Facility/Airspace	Nomenclature	Quantity Fired FY 16 & FY17	2 Year Average	Daytime (0700-2200)	Nighttime (2200-0700)
RG127	Demolition, Bangalore Torpedo M1A2	24	12	12	0
	Gun, 25 MM Inert	1321	661	528	132
	Mortar, 60 MM Inert	180	90	72	18
	Mortar, 120 MM HE	54	27	22	5
	Mortar, 120 MM Inert	170	85	68	17
	Tank, 120 MM Inert	49	25	20	5
	Tank, 120 MM SABOT Inert	42	21	17	4
RG127A	Demolition, 1 1/4 LB C4	4	2	2	0
	Demolition, Bangalore Torpedo M1A2	12	6	6	0
	Mortar, 60 MM Inert	76	38	30	8
	Mortar, 81 MM Inert	86	43	34	9
	Mortar, 120 MM HE	38	19	15	4
	Mortar, 120 MM Inert	5	3	2	1
RG129	Missile, Javelin HE	3	2	2	0
	Grenade, 40 MM HE	443	222	222	0
	Mortar, 60 MM HE	129	65	52	13
	Mortar, 60 MM Inert	120	60	48	12
	Mortar, 81 MM HE	60	30	24	6
RG131B	Grenade, M67	19	10	10	0
	Rocket, AT-4, 84 MM HE	6	3	3	0
	Rocket, LAW HE	13	7	7	0
RG131C	Demolition, 1/4 LB TNT	36	18	18	0
	CHG, DEMO SHEET .083" THK C-2	36	18	18	0
	Demolition, Roll PETN 1/2 LB p/ft (M980)	10	5	5	0
	Demolition, 1 1/4 LB C4	342	171	171	0
	Demolition, 16 x 1 1/4 LB C4	6	3	3	0
	Grenade, M67	3	2	2	0
RG139	Rocket, AT-4, 84 MM HE	452	226	181	45
	Rocket, LAW HE	60	30	24	6
	Rocket, RAAWS, 84 MM HE	10	5	4	1
	Rocket, RAAWS, 84 MM Inert	204	102	82	20
	Rocket, RPG HE	29	15	12	3
RG141	Grenade, 40 MM HE	264	132	132	0

HE = High Explosive; Inert is defined as any round that does not make noise upon impact (Illum, Smoke, TP, TPT, etc…)

				MODEL INPUTS	
Facility/Airspace	Nomenclature	Quantity Fired FY 16 & FY17	2 Year Average	Daytime (0700-2200)	Nighttime (2200-0700)
RG141A	Mine, Claymore M18A1	44	22	22	0
	Grenade, 40 MM HE	1030	515	515	0
	Missile, Javelin HE	6	3	3	0
	Rocket, AT-4, 84 MM HE	173	87	69	17
	Rocket, LAW HE	4	2	2	0
	Rocket, RAAWS, 84 MM HE	37	19	15	4
	Rocket, RAAWS, 84 MM Inert	13	7	5	1
	Rocket, RPG HE	40	20	16	4
	Gun, 30 MM HE	1500	750	600	150
	Mortar, 60 MM HE	580	290	232	58
	Mortar, 60 MM Inert	1154	577	462	115
	Mortar, 81 MM HE	288	144	115	29
	Mortar, 81 MM Inert	278	139	111	28
	Mortar, 120 MM HE	158	79	63	16
	Mortar, 120 MM Inert	488	244	195	49
	Artillery, 105 MM HE	26	13	10	3
	Artillery, 155 MM HE	31	16	12	3
RG143	Gun, 25 MM Inert	88786	44393	35514	8879
	Gun, 30 MM Inert	10332	5166	4133	1033
	Rocket, 2.75" Inert	1406	703	562	141
	Rocket, RAAWS, 84 MM Inert	26	13	10	3
	Tank Stryker, 105 MM Inert	1012	506	405	101
	Tank, 120 MM Inert	4077	2039	1631	408
	Tank, 120 MM SABOT Inert	1151	576	460	115
RG145	Gun, 25 MM Inert	560	280	224	56
RG149	Missle, Stinger, Inert	1	1	1	0
RG150	Demolition, Roll PETN 1/2 LB p/ft (M980)	1	1	1	0
	Demolition, 1 1/4 LB C4	1	1	1	0
	HG, HC AN-M8	221	111	111	0
RG153	Demolition, 1 1/4 LB C4	60	30	30	0
	Demolition, Bangalore Torpedo M1A2	10	5	5	0
	Missile, Javelin HE	1	1	1	0
	Mortar, 60 MM HE	275	138	110	28
	Mortar, 60 MM Inert	438	219	175	44
	Mortar, 81 MM Inert	24	12	10	2
	Mortar, 120 MM HE	46	23	18	5
	Mortar, 120 MM Inert	126	63	50	13

HE = High Explosive; Inert is defined as any round that does not make noise upon impact (Illum, Smoke, TP, TPT, etc…)

				MODEL INPUTS	
Facility/Airspace	Nomenclature	Quantity Fired FY 16 & FY17	2 Year Average	Daytime (0700-2200)	Nighttime (2200-0700)
RG155	Demolition, 1 1/4 LB C4	692	346	346	0
	Demolition, Bangalore Torpedo M1A2	60	30	30	0
	Mine, Claymore M18A1	8	4	4	0
	Missile, Javelin HE	3	2	2	0
	Missile, TOW HE	26	13	13	0
	Missile, TOW Inert	14	7	7	0
	Rocket, 2.75" Inert	275	138	110	28
	Grenade, M67	19	10	10	0
	Gun, 25 MM Inert	4551	2276	1820	455
	Gun, 25 MM Inert	4364	2182	1746	436
	Gun, 30 MM Inert	2412	1206	965	241
	Gun, 30 MM Inert	50	25	20	5
	Mortar, 60 MM Inert	131	66	52	13
	Mortar, 81 MM HE	105	53	42	11
	Mortar, 81 MM Inert	1016	508	406	102
	Mortar, 120 MM HE	758	379	303	76
	Mortar, 120 MM Inert	1445	723	578	145
	Artillery, 155 MM HE	663	332	265	66
	Tank Stryker, 105 MM Inert	70	35	28	7
	Tank, 120 MM Inert	219	110	88	22
	Tank, 120 MM SABOT Inert	495	248	198	50
RG161	Demolition, 1 1/4 LB C4	12	6	6	0
RG165	Demolition, 1/4 LB TNT	20	10	10	0
	Demolition, 1 1/4 LB C4	137	69	69	0
	Demolition, Bangalore Torpedo M1A2	19	10	10	0
TA09	Artillery, 155 MM HE	38	19	15	4
	Artillery, 155 MM Inert	15	8	6	2
TA10	Artillery, 105 MM HE	324	162	130	32
	Artillery, 105 MM Inert	184	92	74	18
	Artillery, 155 MM HE	258	129	103	26
	Artillery, 155 MM Inert	20	10	8	2
TA11	Artillery, 105 MM HE	257	129	103	26
	Artillery, 105 MM Inert	115	58	46	12
	Artillery, 155 MM HE	780	390	312	78
	Artillery, 155 MM Inert	122	61	49	12

HE = High Explosive; Inert is defined as any round that does not make noise upon impact (Illum, Smoke, TP, TPT, etc…)

				MODEL INPUTS	
Facility/Airspace	Nomenclature	Quantity Fired FY 16 & FY17	2 Year Average	Daytime (0700-2200)	Nighttime (2200-0700)
TA12	Artillery, 105 MM HE	748	374	299	75
	Artillery, 105 MM Inert	162	81	65	16
	Artillery, 155 MM HE	383	192	153	38
	Artillery, 155 MM Inert	113	57	45	11
	Rocket, MRLS RRPR Inert	32	16	13	3
TA13	Artillery, 155 MM HE	291	146	116	29
	Artillery, 155 MM Inert	31	16	12	3
TA14	Artillery, 155 MM HE	1332	666	533	133
	Artillery, 155 MM Inert	103	52	41	10
	Rocket, MRLS RRPR Inert	10	5	4	1
TA16	Artillery, 105 MM Inert	117	59	47	12
	Artillery, 155 MM HE	877	439	351	88
	Artillery, 155 MM Inert	60	30	24	6
TA17	Artillery, 105 MM HE	18	9	7	2
	Artillery, 155 MM HE	788	394	315	79
	Artillery, 155 MM Inert	112	56	45	11
TA18	Artillery, 105 MM HE	18	9	7	2
	Artillery, 105 MM Inert	41	21	16	4
	Artillery, 155 MM HE	276	138	110	28
	Artillery, 155 MM Inert	33	17	13	3
TA20	Artillery, 105 MM HE	215	108	86	22
	Artillery, 105 MM Inert	30	15	12	3
TA24	Artillery, 105 MM HE	97	49	39	10
	Artillery, 155 MM HE	3	2	1	0
	Artillery, 155 MM Inert	2	1	1	0
	Demolition, Roll H6 1/2 LB p/ft (M060)	50	25	25	0
	Demolition, Roll H6 1/2 LB p/ft (M060)	50	25	25	0
	Demolition, Roll PETN 1/2 LB p/ft (M980)	7	4	4	0
	Demolition, 1 1/4 LB C4	38	19	19	0
TA25	Artillery, 105 MM HE	9	5	4	1
	Artillery, 105 MM Inert	27	14	11	3
	Artillery, 155 MM HE	35	18	14	4
TA29	Demolition, Roll H6 1/2 LB p/ft (M060)	50	25	25	0
	Demolition, Roll PETN 1/2 LB p/ft (M980)	1	1	1	0
	Demolition, 1 1/4 LB C4	91	46	46	0

HE = High Explosive; Inert is defined as any round that does not make noise upon impact (Illum, Smoke, TP, TPT, etc…)

				MODEL INPUTS	
Facility/Airspace	Nomenclature	Quantity Fired FY 16 & FY17	2 Year Average	Daytime (0700-2200)	Nighttime (2200-0700)
TA30	Artillery, 105 MM HE	163	82	65	16
	Artillery, 105 MM Inert	18	9	7	2
	Artillery, 155 MM HE	264	132	106	26
	Artillery, 155 MM Inert	37	19	15	4
	Demolition, 1 1/4 LB C4	20	10	10	0
TA31	Demolition, 1 1/4 LB C4	95	48	48	0
TA34	Artillery, 155 MM HE	172	86	69	17
TA40	Demolition, Roll PETN 1/2 LB p/ft (M980)	1	1	1	0
	Demolition, 1 1/4 LB C4	1	1	1	0
TA42	Demolition, 1 1/4 LB C4	1	1	1	0
TA43	Demolition, 1 1/4 LB C4	1	1	1	0
TA44	Demolition, 1 1/4 LB C4	1	1	1	0
TA49	Artillery, 155 MM HE	350	175	140	35
	Artillery, 155 MM Inert	24	12	10	2
	Artillery, 155 MM Inert	24	12	10	2
TA50	Artillery, 155 MM HE	80	40	32	8
	Artillery, 155 MM Inert	19	10	8	2

HE = High Explosive; Inert is defined as any round that does not make noise upon impact (Illum, Smoke, TP, TPT, etc…)

C.3 FUTURE LARGE CALIBER AND DEMOLITION NOISE ZONES (CDNL)

Source: Future Noise Zones were created using a combination of the ammunition and explosive detonations expenditures used in the current CDNL Noise Zones (01 January 2016 to 31 December 2017 RFMSS report) and STRAC totals for an ABCT. A distribution of rounds by range was calculated for the existing ammunition expenditure and then applied to the future expenditure in the same configuration.

TABLE C-5. PROJETCED FUTURE LARGE CALIBER AMMUNITION EXPENDITURE

Nomenclature	Existing Annual Expenditure	Changes to Existing Activity (IBCT leaving)	Additonal ABCT STRAC FY18 Expenditure	Future Annual Expenditure
Artillery, 105 MM HE	938	-938	--	--
Artillery, 105 MM Inert	347	-347	--	--
Artillery, 155 MM HE	3,320	-768	2,228	4,780
Artillery, 155 MM Inert	358	-120	394	632
Gun, 25 MM Inert	56,044	--	84,084	140,128
Mortar, 120 MM HE	1,549	-186	868	2,231
Mortar, 120 MM Inert	5,040	-753	3,514	7,801
Tank, 120 MM Inert	2,423	--	4,005	6,428
Tank, 120 MM SABOT Inert	1,077	--	5,568	6,645

C.4 AIRCRAFT NOISE ZONES

Source: Airfield traffic counts from 01 October 2016 to 30 September 2017. Airfield operations data provided by Fort Carson Air Traffic and Airspace Division. Traffic counts do not separate by aircraft type and/or model. Therefore AT&A personnel were asked to estimate percentages by aircraft type.

TABLE C-6. BUTTS AAF ANNUAL AIRCRAFT OPERATIONS

Aircraft Type	Day (0700-2200)	Night (200-0700)
UH-60	29,174	7,293
AH-64	29,174	7,293
CH-47	10,211	2,553
Other Aircraft	4,376	1,094
Total	**72,935**	**18,233**

D REFERENCES

DOD, 2015, Department of Defense Instruction 4165.57, Air Installations Compatible Use Zones (AICUZ), May 2011, as amended March 2015.

DODI, 2004, Department of Defense Instruction 3030.3, Joint Land Use Study (JLUS) Program.

FICUN, 1980, Guidelines for Considering Noise in Land Use Planning and Control.

Fort Carson, 2015, Piñon Canyon Maneuver Site (PCMS) Training and Operations, Final Environmental Impact Statement, US Army Environmental Command and Fort Carson, March 2015.

Fort Carson, 2016, Environmental Assessment for the Construction and Operation of an Unmanned Aerial Systems Training Complex at Training Area 17 North, Fort Carson Directorate of Public Works, Environmental Division, June 2016.

Fort Carson, 2017a, Integrated Cultural Resources Management Plan for U.S. Army Garrison Fort Carson, Colorado, Fiscal Years 2017-2021, NEPA & Cultural Resources Branch, Directorate of Public Works, Environmental Division, March 2017.

Fort Carson, 2017b, US Army Garrison Fort Carson Fact Sheet (February 2017), Fort Carson Garrison Public Affairs Office.

Fort Carson, 2017c, Fort Carson Aviation Procedures Guide, Headquarters Fort Carson Colorado, 22 June 2017.

Fort Carson, 2018, Noise and Environmental Complaint Standard Operating Procedures, Fort Carson Garrison Public Affairs Office, February 2018.

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

PPACG, 2018, Pikes Peak Area Council of Governments Homepage URL: http://www.ppacg.org

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

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

REPI, 2017, Department of Defense, Readiness and Environmental Protection Integration (REPI) Program, Project Profile, Fort Carson Colorado, 2017.

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.

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

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. Air Force, 2005, SELcalc2 Noise Model, Wright-Patterson Air Force Base, OH.

U.S. Air Force, 2013, Noisemap – BaseOps 7.357 - AAM, Wright-Patterson Air Force Base, OH.

U.S. Army 1983, USAEHA Environmental Noise Assessment No. 52-34-0415-83, Noise Levels from Machine Guns, Grenade and Artillery simulators from Training at Sudbury Annex, Fort Devens, MA, 23-24 March 1983.

U.S. Army, 1984, Army Environmental Hygiene Agency, Environmental Noise Assessment No. 52-34-0442-84, Noise Measurement Study, Camp Bullis, Texas, 27 February – 2 March 1984.

U.S. Army 1989, USAEHA Environmental Noise Assessment No. 52-34-0447-89, Results of Monitoring Edgewood Area Field Training Exercise Site, Aberdeen Proving Ground, MD, June 1989.

U.S. Army, 1999, Center for Health Promotion and Preventive Medicine, Health Hazard Assessment Report on the 40mm XM1001 Canister Cartridge for the MK-19 Mod 3 Grenade Machine Gun, No. 69-37-2735-00, November 1999.

U.S. Army, 2007, Army Regulation 200-1, Environmental Protection and Enhancement, Chapter 14 Operational Noise.

U.S. Army, 2009, U.S. Army Construction Engineering Research Laboratories, BNOISE2 Computer Model, Version 1.3 2009-11. 30.

U.S. Army, 2012, U.S. Army Public Health Command, Operational Noise Program, U.S. Army Fort Carson Installation Operational Noise Plan, July 2012.

U.S. Army, 2015, U.S. Army Engineer Research and Development Center (ERDC), SARNAM Computer Model, Version 2015-07-27

U.S. Army, 2017, U.S. Army Environmental Center, IBCT to ABCT Conversion and Stationing Programmatic Environmental Assessment, November 2017.

U.S. Army, 2018, Fort Carson Homepage, URL: http://www.carson.army.mil

U.S. Census Bureau, 2018. Homepage, URL: http://www. census.gov