UTAH ARMY NATIONAL GUARD INSTALLATION COMPATIBLE USE ZONE STUDY

OCTOBER 2023

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EXECUTIVE SUMMARY

OVERVIEW

The Department of the Army is required 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 this Army policy. The ICUZ study quantifies the noise environment from military training sources and recommends the most appropriate uses of noise-impacted areas. This study reflects the weapons activities from Fiscal Years 2019 through 2022 and aviation operations for Calendar Year 2022.

Army Regulation (AR) 200-1 lists housing, schools, and medical facilities as examples of noise-sensitive land uses. The regulation states for land use planning purposes, noise-sensitive land uses are acceptable within the Land Use Planning Zone (LUPZ) and 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 primary training facilities used by the Utah Army National Guard (UTARNG) are Camp W.G. Williams Military Reservation, the Army Aviation Support Facility (AASF) in West Jordan Utah, and an AASF Satellite Location at Roland Wright Air National Guard Base.

CONCLUSIONS

The operational noise sources assessed in the ICUZ include small arms weapons firing, demolition and large arms weapons firing, and rotary-wing aircraft training. The principal noise source at Camp Williams is demolition and large caliber weapons training. Population centers around Camp Williams are located outside the eastern half, with the Cities of Herriman and Bluffdale to the north and northeast and the Cities of Eagle Mountain, Lehi, and Saratoga Springs south and southeast. County lands to the west of Camp Williams are primarily rural in nature, consisting of open land and agricultural land uses.

SMALL ARMS WEAPONS:

According to Army guidelines, the surrounding land use is compatible with the noise from small arms weapons operations. Noise Zone III extends beyond the boundary in several areas, encompassing undeveloped scrub lands. Zone II extends beyond the boundary southwest and northwest from firing at the main range complex, as well as to the east from firing at the Post ranges. Currently there are two single-family residences within Zone II (one along South 1825 West (northeast of the Post pistol ranges) and one on Step Mountain Road (north of the impact

area). However, the Step Mountain Road area is undergoing increased development, which could increase the number of noise-sensitive land uses within Zone II. The remaining Zone II areas contain undeveloped scrub land.

DEMOLITION AND LARGE CALIBER WEAPONS:

The Noise Zones do not extend beyond the boundary indicating noise from demolition and large caliber weapons activity is compatible with the surrounding land use. Although the Noise Zones remain within Camp Williams, individual training events can be audible outside of a Noise Zone and in some cases objectionable to the surrounding community. Peak level assessments can forecast where sound may be audible or loud from singular events.

Under unfavorable weather Peak levels above 115 dB extend beyond the northern and southern boundaries. The areas inside the contours north do not contain any sensitive land uses (undeveloped scrub lands). To the southeast Peak levels between 115 and 130 dB encompass residential land use concentrated in medium to high density subdivisions (Arrival, Cedar Pass Ranch, Meadow Ranch, North Ranch, Spring Run, Valley View, Valley View Foothills, Valley View South, Westview Heights) in the city of Eagle Mountain. Peak sound levels above 130 dB extend beyond the southern boundary, encompassing multiple residences in the Hidden Hills Road area and Vande Way area (northern area of the North Ranch and Arrival Subdivisions). Residences in these neighborhoods would be expected to occasionally experience high noise levels from artillery firing activity, particularly given the right meteorological conditions. These noise contours, like others in this study, establish the most common or concentrated areas of noise generated by the various training and operational activities at Camp Williams. On occasion, noise from a particular event may extend into an area not covered by a depicted noise contour.

Although the contours contract considerably under neutral conditions, Peak levels between 115 and 130 dB still extend beyond the northern and southern boundaries, but to a much lesser degree. Peak levels between 115 and 130 dB encompass several single-family homes south of the boundary.

AVIATION ACTIVITY

Although aircraft operations occur on a regular basis, there are not enough flights at Camp Williams or the AASF to generate cumulative aircraft Noise Zones. Nevertheless, noise from individual overflights arriving and departing, and transitioning between training areas have the potential to be disruptive and/or annoying. Sufficient measures to mitigate the effects of aircraft noise are currently in place, including no-fly and avoidance areas, as well as minimum flight altitudes over noise-sensitive land use. However, there is always the possibility that an individual overflight could lead to a complaint. Pilots should remain vigilant in adhering to noise abatement procedures and fly-neighborly programs.

RECOMMENDATIONS

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

The completion of West Traverse Mountain (WTM) Compatibility Area Study demonstrates the strong relationship the UTARNG has with the surrounding local communities. It is recommended that all parties involved continue to pursue the recommendations made within the WTM Study, contributing to the program's success. As well as monitoring any changes in current land use around Camp Williams to avoid future incompatibilities and sustain its viability. Key remaining recommendations from the WTM Study to focus effort on are:

- Create Zoning Overlay District Titled Military Compatibility Area Overlay District, Comprised of Land Use Military Compatibility Areas (MCA), Impulse Noise MCA, Aviation Safety MCA, and a Light MCA.
- Continue to pursue real estate disclosure at the local and/or state legislative level. Disclosure provides information on possible impacts (noise/vibration, air safety zones) to prospective buyers or renters as part of real estate transactions for properties close to military installations. Real estate disclosure enhances the ability to promote compatible land use around military installations that will protect both the military's mission and potential homeowners from unnecessary conflicts.
- Encourage the pursuit of a comprehensive plan and zoning regulation in Utah to help create and maintain compatible uses. Legislation can require that a planning entity, when drafting a comprehensive plan, shall include provisions for accommodating military installations located partially, within or "abutting" the planning entity's boundaries.

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 the UTARNG mission, training, or training facilities undergo changes, the ICUZ should be reviewed to determine if the current noise assessment is sufficient. The Army recommends ICUZ Studies be reviewed every 5-years or updated if mission changes occur which are substantial, and/or permanently alter the noise environment.

SECTION

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

AAM	Advanced Acoustical Model
AASF	Army Aviation Support Facility
ACUB	Army Compatible Use Buffer
ADNL	A-Weighted Day-Night Average Sound Level
AFP	Artillery Firing Points
AGL	Above Ground Level
AR	Army Regulation
ARNG	Army National Guard
ATC	Air Traffic Control
CAS	Compatible Area Study
CDNL	C-Weighted Day-Night Average Sound Level
dB	Decibel(s)
dBA	Decibels, A-Weighted
DNL	Day-Night Average Sound Level
DoD	Department of Defense
DODI	Department of Defense Instruction
DZ	Drop Zone
FY	Fiscal Year
ICUZ	Installation Compatible Use Zone
JLUS	Joint Land Use Study
lb	Pound(s)
LUPZ	Land Use Planning Zone
MCA	Military Compatibility Area
MCAOD	Military Compatibility Area Overlay District
mm	Millimeter
MOUT	Military Operations in Urban Terrain
NEW	Net Explosive Weight
NLR	Noise Level Reduction
OEA	Office of Economic Adjustment
OLDCC	Office of the Local Defense Community Cooperation
OSD	Office of the Secretary of Defense
PAO	Public Affairs Office
PK	Peak
RFMSS	Range Facility Management Support System
REPI	Readiness and Environmental Protection Integration Program
RWANGB	Roland Wright Air National Guard Base
SARNAM	Small Arms Range Noise Assessment Model
SEL	Sound Exposure Level
TP	Target Practice

UAS	Unmanned Aerial Systems
µPa	Micropascals
UTARNG	Utah Army National Guard
WTM	West Traverse Mountain
WTSL	West Traverse Sentinel Landscape

1 INTRODUCTION

1.1 GENERAL

This Installation Compatible Use Zone (ICUZ) study provides a strategy for environmental noise management in the areas surrounding Utah Army National Guard (UTARNG) training facilities. Environmental noise is defined as unwanted outdoor sound created by human activity, such as noise generated by transportation, industrial, and recreational sources. The Army further categorizes environmental noise as sound levels which remain below hearing conservation thresholds (hearing impairment and loss) but are high enough to produce other negative effects and/or interfere with quality of life. The most common type of environmental noise (e.g., operational noise) at Army installations is directly produced by military training and testing activities such as military weapons firing or weapons systems operations and aircraft. Environmental noise management strives to promote compatibility both on-post, and in the surrounding communities off-post.

The primary effect of environmental/operational noise on exposed communities is short-and long-term annoyance, defined by the US Environmental Protection Agency[1] as any negative subjective reaction on the part of an individual or group. Other negative effects of noise include classroom learning disruption, sleep disturbance, speech interference, and productivity loss. In addition, studies have been conducted to examine the non-auditory health effects of aircraft and weapons (impulsive) noise exposure, focusing primarily on stress response, blood pressure, birth weight, mortality rates, and cardiovascular health. To date, direct results have been inconclusive; however, more research is needed in this field.

The ICUZ focuses on two key areas of concern from environmental/operational noise: land use compatibility and annoyance/complaint risk. Elements of the ICUZ include military noise analysis, education about noise and noise metrics, complaint management, and when necessary, noise abatement procedures. The ICUZ study examines noise exposure associated with military training operations and provides land use guidelines for achieving compatibility with the surrounding communities. The report is provided to assist both UTARNG personnel and local government officials. As stakeholders prepare and update comprehensive development plans, it is recommended that the information in this ICUZ study is utilized to help achieve compatible land use. This study reflects the weapons activities from Fiscal Years (FY) 2019 through 2022 and aviation operations for Calendar Year 2022.

1.2 REGULATORY REQUIREMENTS

This assessment has been conducted in accordance with the Department of Defense Instruction (DoDI) 4715.13, DoD Operational Noise Program (DoD 2020) and Army Regulation (AR) 200-1, Environmental Protection and Enhancement, Chapter 14, *Operational Noise* (U.S. Army 2007).

[1] US Environmental Protection Agency

1.3 PROCESS AND PROCEDURE

The Army has an obligation 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 recommends land uses that are compatible with military operations, while allowing maximum beneficial use of adjacent properties. DoD and component Services have published guidelines that reflect these land use recommendations.

Army Regulation (AR) 200-1 translates noise exposure on communities 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. The guidelines are not intended to alter existing noise-sensitive land uses within the Noise Zones, but they can be used to see where further noise-sensitive development should be discouraged. 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.

1.4 NOISE METRICS

Noise descriptors or metrics appropriate for the determination of compatible land use are based on the best available scientific information. When measuring sound, the levels are often filtered (i.e., frequency weighted) to accommodate how the human ear functions. This network is known as "A-weighting" and is used to assess continuous noise sources, such as ground vehicles and aircraft. Military impulsive sounds (e.g., explosions and weapons firing rounds greater than

20mm), which can often be felt as well as heard, utilize a "C-weighting" network. This weighting includes more of the low-frequency components of the sound, meaning these frequencies are not de-emphasized to the same extent as in A-weighting. Explanations of the noise metrics applicable to this ICUZ 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 and accounts for human sensitivity to nighttime noise levels. A 10 dB adjustment is applied to operations that happen during nighttime 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.
- **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 (PK).** Peak is the highest instantaneous sound pressure level produced during a measurement or noise event. There is no frequency weighting or time component (assessment period) applied with Peak such as with DNL or Lmax. Note: Additional PK metrics utilizing statistical variations (PK15 and PK50) based on meteorological conditions are employed as supplements within this ICUZ. A discussion of these metrics is in Section 3.

1.5 NOISE EXPOSURE MODELS

Within DoD, the primary means of assessing environmental noise is through computer simulation models, since direct measurements of noise levels are often impractical, expensive, and inconclusive. Operations data needed for simulation inputs will vary based on the type of training and/or testing activity. Some examples of operations data include the type of weapon and ammunition fired at a range, the location of firing areas and targets, aircraft traffic counts at an airfield, and flight track information for runways. These data are input into the appropriate software model, which then calculates noise exposure levels associated with the multiple types of military operations ongoing at UTARNG facilities. A summary of the computer models is provided on the next page:

- The Small Arms Range Noise Assessment Model (SARNAM) program was developed by the Army to assess small arms (.50 caliber and below) live-fire ranges. SARNAM incorporates information on projectile spectrum, directivity, sound propagation, and the effects of noise mitigation and safety structures when necessary. Small caliber Noise Zones are addressed using Peak sound levels (single-event metric), and therefore have no assessment period.
- The BNOISE2 modeling program developed by the Army calculates noise levels generated by firing large caliber weapons (20mm and greater) and high-explosive charges. Noise Zones for large caliber weapons are addressed using the C-weighted Day-Night average sound Level (CDNL) with an assessment period of 104 days. This is the

Army standard assessment period for all ARNG training installations and ranges per AR 200-1 guidance.

- NoiseMap/Advanced Acoustical Model (AAM) is a suite of computer programs and components developed by the DoD and National Aeronautics and Space Administration to predict noise exposure in the vicinity of airfields due to aircraft flights, maintenance, and ground run-up operations. Aircraft flight data are obtained to derive average daily operations by runway and type of aircraft. Noise Zones for aircraft operations are addressed using the A-weighted Day-Night average sound Level (ADNL), with an assessment period of 365 days.

1.6 NOISE IMPACTS ON DOMESTIC ANIMALS AND WILDLIFE

Section 14-4 c of AR 200-1 states "Address noise impacts on domestic animals and wildlife, as required, through the study of each species' response or a surrogate response to noise." At Camp Williams the only species of concern is the golden eagle. Potential impacts are addressed through Best Management Practices restricting dismounted movements within 0.5 mile of an active nest site. At Camp Williams, potential nesting sites vary from year to year. During the 2023 nesting season one active Eagle nest was identified, prompting temporary restrictions in the Beef Hollow area, which were later lifted. The information presented or referenced as a "noise-sensitive" land use in this study is based solely upon human response to noise.

1.7 NOISE BASICS

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that is typically associated with human activity and that interferes with or disrupts normal activities. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to environmental noise is annoyance. The response of individuals to similar noise events is diverse and influenced by the type of noise; the perceived importance of the noise, and its appropriateness in the setting; the time of day and the type of activity during which the noise occurs; and the sensitivity of the individual.

In general, human sound perception is such that a change in sound pressure level of 3 dB is barely noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling or halving the sound level. Because the decibel scale is logarithmic and not linear, the combined noise level of two sounds occurring at the same time cannot simply be added together. For example, a garbage truck with a noise level of 100 dB combined with a lawn mower with a noise level of 95 dB results in a noise level of 101.2 dB, not 195 dB.

1.8 EFFECTS ON SOUND PROPAGATION

Outdoor sound propagation is affected by a multitude of factors including spreading, absorption, ground configuration, terrain profile, obstacles, atmospheric pressure, wind, turbulence, temperature, and humidity. The subjects covered in this section are spreading losses, attenuation by atmospheric absorption, attenuation over the ground, diffraction, and refraction. These factors, either individually or in combination, can all substantially influence how loud or intense military training noise may be at a particular location.

1.8.1 SPREADING LOSSES

Spreading loss refers to the decrease of sound energy (i.e., sound level) as it travels away from the source. Sound from a point source, such as a generator, spreads in all directions like an expanding sphere. A rule of thumb in acoustics is that a spherically spreading sound decreases by 6 dB for every doubling of distance. For example, the distance from 100 to 200 feet, or from 200 to 400 feet, or from 400 to 800 feet would expect the same 6 dB drop in sound level.

An exception to the 6 dB per doubling rule involves a line source (such as a busy freeway) rather than a point source. Near a line source, the listener receives noise from the continuous line of cars traveling on the freeway. The sound spreading from a line source can be pictured as an expanding cylinder. For a long, straight-line source, the sound level drops by 3 dB for every doubling of distance from the source.

1.8.2 ATMOSPHERIC EFFECTS

One of the principal factors on sound propagation are atmospheric effects, or day-to-day weather conditions. Wind and temperature significantly influence how far sound may travel 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 to move or push the sound to the downwind receiver.

Sound traveling in the direction of the wind (downwind) has a higher speed than sound traveling through calm air. Likewise, sound traveling against the direction of the wind (upwind) has a lower speed than sound traveling through calm air. Wind speed typically increases with the height above the ground. This gradient in wind speeds, and sound speeds, causes the sound to refract. Sound refracts downward in the downwind direction and upward in the upwind direction. In general, receivers that are downwind of a source will experience higher sound levels, and those that are upwind will experience lower sound levels. As with a temperature inversion, the downward curving paths reduce or eliminate the effectiveness of barriers in the downwind direction. Wind that is perpendicular to the sound path has no significant effect.

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. Under normal conditions, air temperature decreases with an increase in altitude. This results in a *temperature lapse* where sound waves are bent upward and away from receptors resulting in lower sound levels on the ground. However, when the temperature increases with altitude the result is a *temperature inversion* which bends sound downward and toward receptors resulting in louder events. It may be possible to detonate 10 lbs of explosives without disturbing a community (neutral "lapse" weather conditions), while on another day with a temperature inversion, the detonation of 1 lb at the same location may be disruptive (unfavorable weather conditions).

Figure 1-1 illustrates how temperature inversions bend (refract) the sound created by a typical explosion. The sound waves from the explosion initially travel upward, but the inversion bends 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. Predicting sound travel can be very difficult; however, the Explosives Research Group 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.

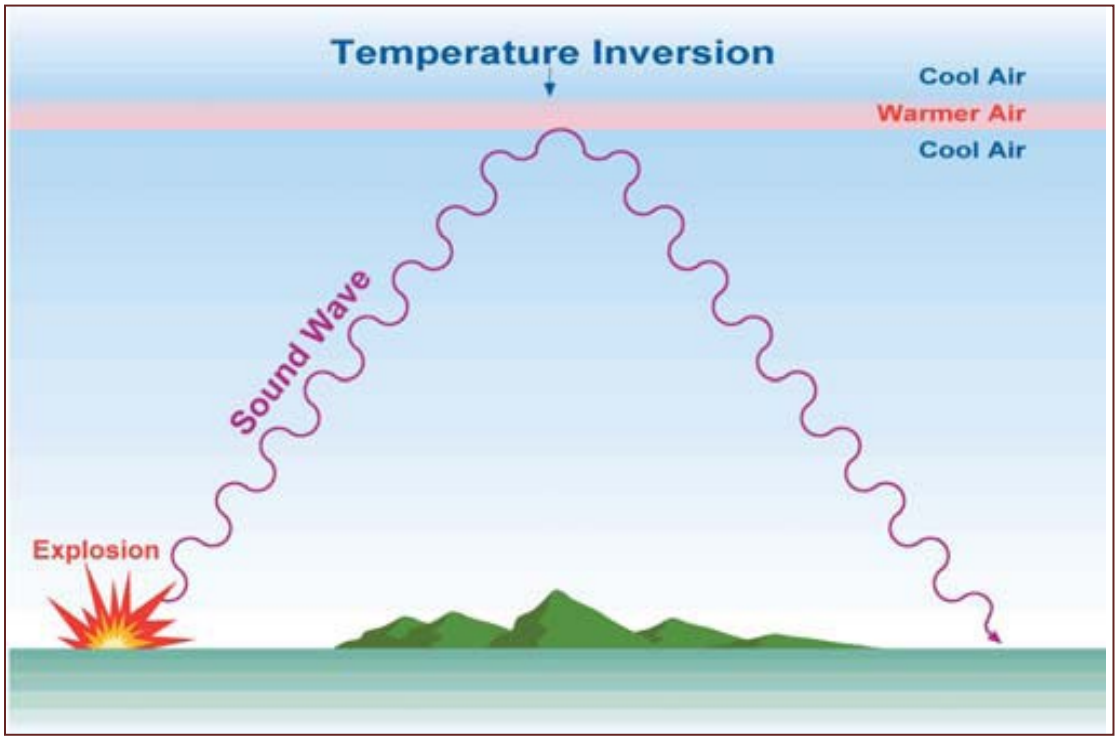

Figure 1-1. Example of a Temperature Inversion

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

1.8.3 GROUND EFFECT

When sound propagates along the surface of the earth from a source to a receiver, it follows two paths. The first is a direct path from the source to the receiver, and the second is a path that starts at the source, reflects off the ground, and then travels to the receiver. If the ground is hard, such as pavement or water, the sound reflects off of the surface and adds to the sound from the direct path, resulting in higher levels than the direct path alone. When sound reflects off of soft ground, such as grass, or loose snow, some frequencies of the reflected sound experience a phase reversal, whereby the areas of high and low pressure become reversed. Adding this phase-reversed sound with the sound from the direct path results in a reduction in the total sound at the receiver. Thus, sound levels are generally higher when the sound propagates over hard ground rather than soft ground.

1.8.4 ATTENUATION FROM VEGETATION

Wide areas of dense foliage provide some attenuation for higher-frequency sound (small arms, aircraft run-up) when they are located between a source and receiver. However, the vegetation **must** be dense enough to block the line of sight, even over short distances, and **must** extend well beyond the line of sight (both horizontally and vertically). The attenuation is negligible for low-frequency sound sources such as explosions but increases with frequency.

For areas of dense vegetation less than 10 meters (33 feet) across, no attenuation is assumed, and for areas 10 to 20 meters (33 to 66 feet) across, the first row of values is used. For areas from 20 to 200 meters (66 to 656 feet) across, the distance through the thick vegetation is multiplied by the dB attenuation per meter value in the last row of the table to compute the attenuation. For example, at 250 Hz, approximately 120 meters (400 feet) of dense foliage would be required to produce a noticeable 5 dB of attenuation for a sound source such as an aircraft run-up (120 meters multiplied by 0.04 equals 5 dB). At 500 Hz, approximately 100 meters (325 feet) of dense foliage would be required to produce 5 dB of attenuation for a sound source such as roadway traffic. Table 1-2 provides dense foliage noise attenuation (ISO 1996).

Table 1-2. Dense Foliage Noise Attenuation

Propagation Distance (meters)	**Nominal Midband Frequency (Hz)**							
	63	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**
10 to 20 (dB Attenuation)	0	0	1	1	1	1	2	3
20 to 200 (dB Attenuation)	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.12

Source: ISO 9613-2.1996. Table A.1[2]
Legend: dB = decibel, Hz = Hertz

1.8.5 ATTENUATION DUE TO BARRIERS AND NATURAL TERRAIN

Barriers, earth berms, and natural terrain can attenuate sound when they are located in the line of sight between the source and the receiver. This attenuation increases with height, width, and proximity to either the source or the receiver. If there are gaps in a barrier, the potential benefits will be substantially reduced.

Studies have shown that properly designed and located highway type barriers can be used to reduce the impact of generators, vehicle test tracks and some small arms ranges at Army installations. For demolition and larger caliber weapons, the dimensions of the barrier required for a noticeable reduction in the noise level make them impractical. However, natural barriers, such as hills, can be used if the range is properly sited. (Lewis 1991). Naturally occurring landforms can influence blast noise sound waves (air-blast) through both reflection and diffraction. Reflection can be defined as the redirection of a sound wave as it bounces off a surface. Diffraction can be loosely defined as the bending of acoustic waves around corners (i.e., hills, earth berms, mountains). It should be noted that the attenuation on blast noise (i.e., large caliber weapons and demolitions) are highly dependent upon the terrain feature's location and size.

[2] https://www.iso.org/standard/20649.html

Figure 1-2 illustrates the barrier concept. The sound from the helicopter has a direct path to the person on the right side of the diagram. The direct path to the person on the left side of the diagram is blocked by the hill. The sound must travel over the hill to the person on the left. The greater the change in direction of the sound path at the top of the barrier, the greater the reduction in sound. The change in direction can be increased by increasing the height of the barrier or moving the source or receiver closer to the barrier (if the source or receiver is below the top of the barrier). As the figure illustrates, barriers are most effective for sound sources on the ground. If the helicopter in the figure were to climb upward, there would be a direct path to both people (left and right) on the ground.

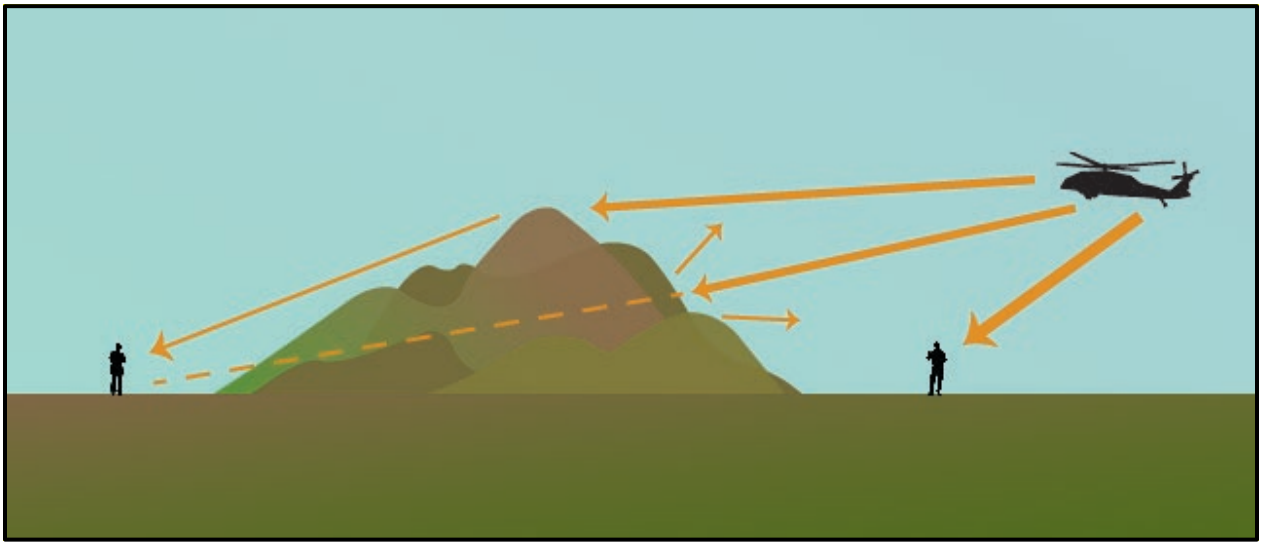

Figure 1-2. Barrier Example

1.8.6 NOISE SOURCE DIRECTIVITY

The directional pattern of noise emission around a noise source is called directivity. Almost all sources create unique directional patterns of noise. A 1981 Navy Report described the directivity of guns mathematically which predicts that for a gun fired horizontally, sound levels will be noticeably higher to the front and rear of the weapon, and lower to the sides. This general rule applies to both small arms weapons and large gun tubes, such as artillery weapons. (Luz 1990).

1.9 VIBRATION

Vibration in the context of military training is caused by the impact of low frequency sound waves on unsecured objects. In fact, there are situations where vibration can be the primary irritant to the public, because the sound making the vibration is too low for the human ear to hear. Thus, a citizen inside their home may not realize that training operations are occurring until a disturbance is felt such as a window rattle. The following discussion provides explanations to common inquiries related to structural vibration from military training (why does my home shake, will it damage my home, is the vibration ground-borne, why does my home crack).

Two of the most common questions asked are why does my home shake and will the vibrations damage my home. Vibration is caused by any force acting on a surface of a structure that causes it to move back and forth from its normal resting position. The low-frequency content of artillery firing, or explosives are most effective at producing vibrations. Helicopter operations may also produce vibrations of buildings and rattling of windows, ceiling tiles and objects in buildings. Effects noticed, if any, are vibrations of structure surfaces that either can be felt, or that induce audible rattle. In general, the components of conventional structures that are most sensitive to induced vibration are windows, followed by doors, and finally floors. Low levels of house vibration may result in “nuisance effects” such as dishes clattering on a shelf, chandelier glass rattling, or picture frames shifting on the wall. Occupants will notice vibrations at levels far below the intensity needed for structural damage. It is very unlikely that vibration from normal Army activities will result in structural damage to residential homes. Army installations set firing limits, based on various studies, that include data on the amount of vibration that would damage a house. These studies are very conservative to reduce the risk of damage to nearby structures.

Citizens often express concern that the vibration is ground-borne. While some Army activities may seem to shake the ground, the vibration felt in a home is typically caused by airborne sound waves that act on external surfaces of a home, causing it to vibrate. Although it is true that certain military training (such as the use of cratering charges by military engineers) will cause ground vibrations, the explosive weight is generally not large enough and the distance between civilian homes and the explosion too great to result in ground-borne-induced house vibrations. Studies of vibration caused by coalmine detonations indicate that ground-borne vibration dominates house vibration at scaled distances of less than 50 (Northwestern University 1981). At scaled distances greater than 50, airborne vibration dominates. Scaled distance is equal to the distance from the source to the receiver, in feet, divided by the square root of the explosive weight in pounds. For a 100-pound charge, a distance of 500 feet is required for the scaled distance to equal 50. That is, for a 100-pound charge, the ground-borne vibration is the dominant cause of house vibration if the house is located within 500 feet from the detonation point. At distances greater than 500 feet, the airborne sound wave is the dominant cause of vibration.

An additional question may be if the military activity did not cause cracks what could have? Structures crack for a variety of reasons which have nothing to do with noise and vibration. Portions of all houses will eventually crack due to a variety of environmental and construction factors including:

- Temperature and humidity are major sources of cracking of interior surfaces. The range of inside and outside humidity and the ratio of inside to outside surface and air temperatures (cold verses hot) can shrink and expand wood framing in homes.
- Intensity, duration, and direction of wind; snow loads.
- Frost action – when saturated earth freezes it expands one-seventh greater than its original size, and thus exerts tremendous pressure in all directions.
- Orientation and partial shading of walls from sunlight – uneven heating causes uneven expansion of walls.
- Uneven settling of building foundation.
- Inadequate foundation design – foundation was not designed with sufficient strength to withstand the lateral pressures of the soil on the exterior.
- Incorrect partition (wall) load construction.
- Room volume (wall and ceiling area) – the larger the surface area of a wall or ceiling (high walls and cathedral ceilings), the more likely it is to crack from expansion or shrinkage.
- Type of skin, frame, exterior materials, and interior finish.
- History of patching.
- Presence of water leaking into building structure from external sources or condensing on interior pipes.

2 UTAH ARMY NATIONAL GUARD

2.1 GENERAL

The Utah National Guard consists of the UTARNG and the Utah Air National Guard (UTANG). These entities are directed and supported by the Utah Department of Veterans and Military Affairs. Personnel include part-time citizen soldiers and airmen and full-time, active-duty soldiers and airmen, as well as state and federal civilian employees. The headquarters of the Utah National Guard is on the southern end of Salt Lake Valley in Draper, Utah. This large facility is home to several major commands and separate units.

The UTARNG mission is two-pronged, having both federal and state functions. UTARNG assists the federal government in defending the sovereign interests of the United States while protecting the lives and property of Utah citizens during times of natural disaster to preserve peace, order, and public safety. UTARNG units can be mobilized at any time by Presidential order to supplement regular armed forces or upon declaration of a state of emergency at the direction of the Governor. The UTARNG maintains training facilities and Readiness Centers throughout the state. The major commands/units of the UTARNG are as follows:

- 97th Troop Command
- 97th Aviation Troop Command
- 65th Fires Brigade
- 19th Special Forces Group (Airborne)
- 300th Military Intelligence Brigade
- 204th Maneuver Enhancement Brigade
- 640th Regiment (Regional Training Institute)

Figure 2-1 depicts the locations of the UTARNG facilities that generate noise levels that could impact land use, which are as follows:

- Camp W.G. Williams Military Reservation (Camp Williams)
- Grant Smith Farms Drop Zone
- Army Aviation Support Facility (AASF) – West Jordan (South Valley Regional Airport)
- Hanger 10 – AASF Satellite Location (Roland Wright Air National Guard Base)
- Unmanned Aerial System (UAS) Facility (Wendover Airport)

These facilities are the focus of the ICUZ study. Additional maintenance facilities and Readiness Centers within the state are excluded from the ICUZ noise analysis.

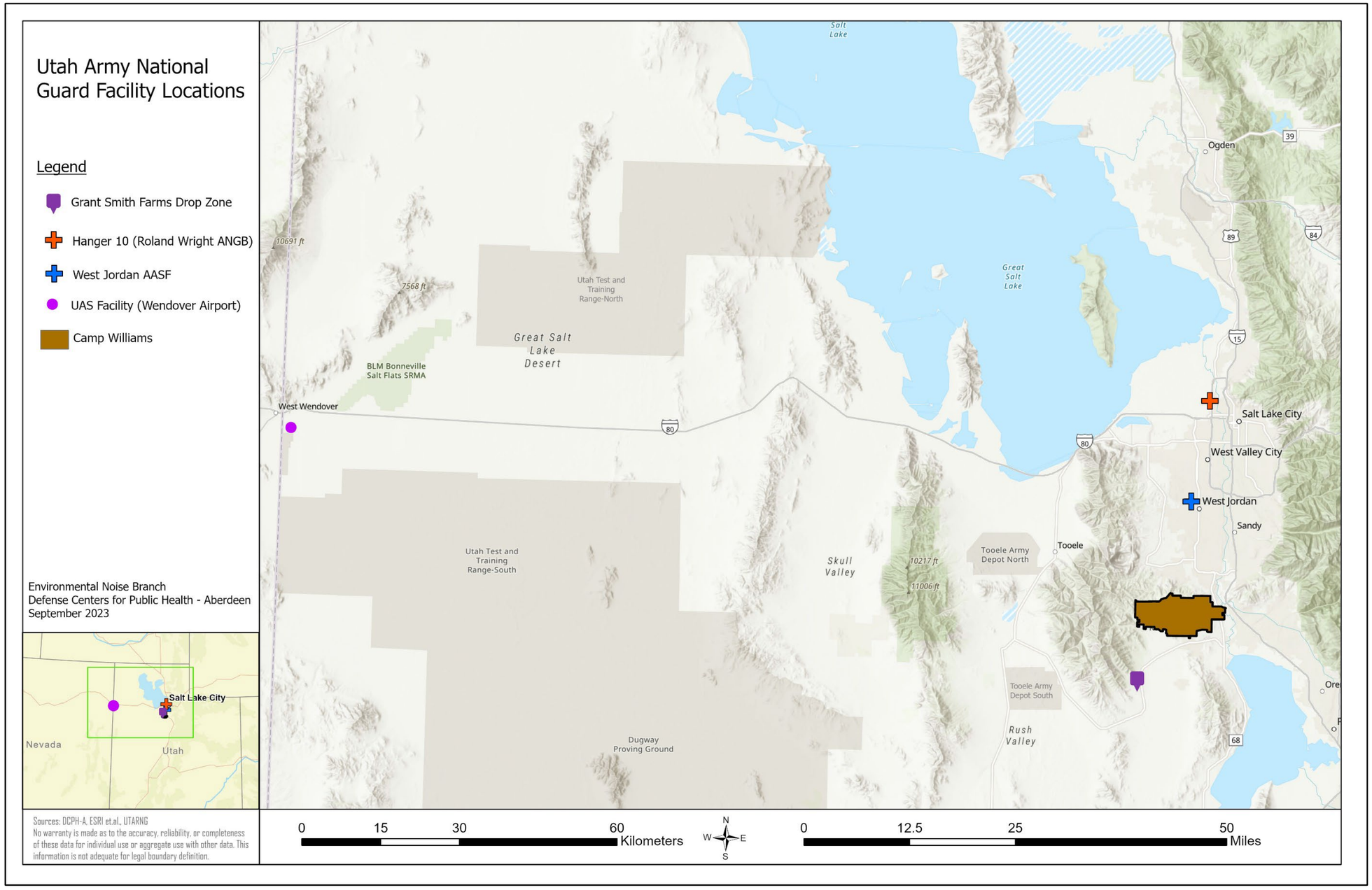

Figure 2-1. UTARNG Training Centers Location

2.2 NOISE MANAGEMENT PROGRAM

Noise generated from military operations and long-term noise exposure on surrounding communities are the most persistent and costly encroachment challenges for DoD. The presence of noise can extend far beyond the fence line and tends to be more apparent to the public than other visual or environmental factors. As a result, training noise can generate complaints from communities and is often the most prominent discussion point and decision-making factor in land use planning surrounding military installations.

In accordance with AR 200-1, Army and ARNG installations/facilities are responsible for maintaining a Noise Management Program. Two of the main program components are:

> *(1) Evaluate and document the impact of noise produced by ongoing and proposed actions/activities.*
> *(2) Monitor, record, archive and address operational noise complaints.*

A noise management program is intended to reduce noise impacts and avoid potential conflicts. Along with the ICUZ study, an effective noise complaint procedure will help reduce the potential for complaints to escalate and prevent the degradation of the training mission due to controversy over noise. Another important element of the program, which helps reduce noise inquires and/or complaints, is conducting routine public outreach to keep communities informed about the training mission, and aware of any changes to mission(s) or operations tempo. Together these program tenants can help installations address complaints, advise local planning commissions, cooperatively develop action plans which limit future encroachment, and protect the health and safety of local communities.

2.2.1 NOISE MANAGEMENT

The Army Aviation Support Facility (AASF) and the Camp Williams Range Control receive, and address noise complaints related to aviation and training taking place on Camp Williams respectively. The Utah National Guard Public Affairs Office (PAO) assists in mitigation efforts by advising the public and surrounding communities of training events known to produce higher than usual noise levels. The following page provides contact information for noise inquires. The diagram illustrates the basic complaint process in the event a noise complaint is received (Figure 2-2).

The PAO maintains public websites, along with multiple social media feeds (Facebook, Twitter, and Instagram) to provide news releases and information to the local surrounding communities. Training exercises or special training events which are expected to generate higher-than-normal noise levels off post, are posted to social media sites. Additionally, some of the local communities repost the social media feeds to their own accounts.

Camp Williams
Range Control
(801) 878-5421

Helicopter Activity
(801) 816-3490

Utah National Guard
Public Affairs Office
801-432-4407
https://ut.ng.mil/News-and-Media/
email: mailto:ng.utngpao@army.mil

2.2.2 AWARENESS/EDUCATION

The DoD Community and Environmental Noise Primer is a resource for involvement and education of the public, as well as installation personnel. The Primer is found at http://dodnoise.org/

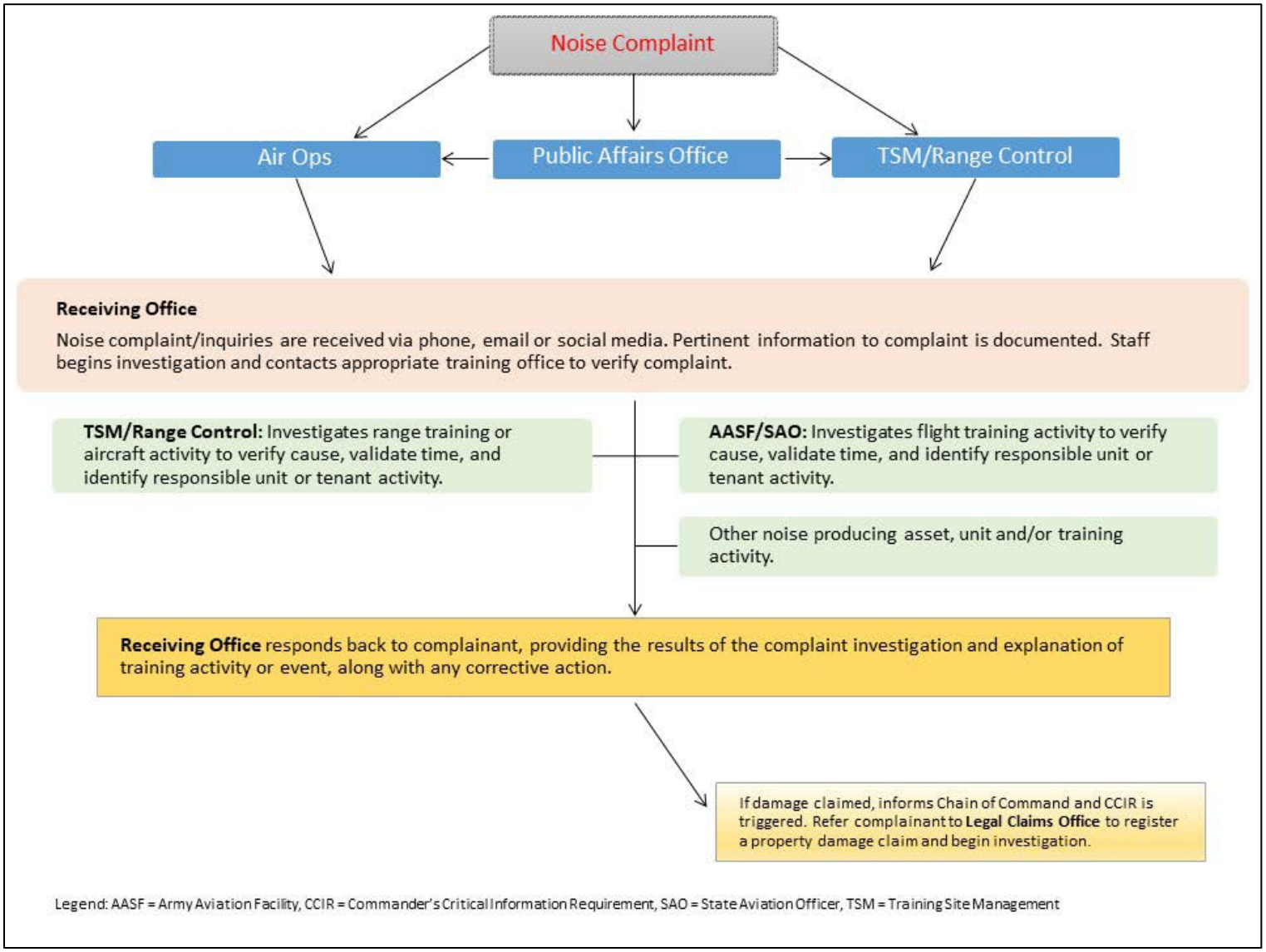

Figure 2-2. UTARNG Noise Complaint Process

3 NOISE ASSESSMENT GUIDELINES

The Army recommends land use options based on the type of noise source. Table 3-1 lists the noise limits as shown in 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 dB Peak	
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
Legend: dB = decibel, ADNL = A-weighted Day-Night Level, CDNL = C-weighted Day-Night Level

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, since long term neighbors often acknowledge that they hear frequent training but are not disturbed by it. However, this is not necessarily the case for individuals new to the area, who are less habituated to training activities, and may not be as willing to tolerate the noise it produces.

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 for Impulsive (Blast) Noise

Perceptibility	dB Peak	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 the time of day the 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 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 approaching 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): 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). PK15(met) levels would occur under unfavorable weather conditions that enhance sound propagation. The PK15(met) metric does not communicate any information about how often the loudest munitions type is detonated.
- Neutral Weather Conditions - PK50(met): 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). 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. 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 even lower. The PK50(met) metric also does not communicate any information about how often the loudest munitions type is detonated.

The 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 Compatible Use Plan (formerly the Joint Land Use Study (JLUS)) or the Army Compatible Use Buffer (ACUB) are implemented, the PK15(met) areas 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 CAMP WILLIAMS

4.1 LOCATION

Camp Williams is in north-central Utah approximately 26 miles south of Salt Lake City. The Camp is situated to the west of Interstate 15 (I-15) and straddles the boundaries of Salt Lake and Utah Counties. The cities of Bluffdale, Herriman, Eagle Mountain, Lehi, and Saratoga Springs surround Camp Williams to the north, east, and south-southeast (Figure 4-1). Figure 4-2 depicts the land use surrounding Camp Williams. Currently, the 2019 National Land Cover Data set is the best data available. Apart from the western area, over the past 4-years general growth pressure has occurred around Camp Williams. The area west is mountainous terrain which remains undeveloped. The most notable land use change is in the south, where additional high density residential development has occurred west of Tickville Gulch Road (City of Eagle Mountain). Low density development (scattered single family homes) has increased in the areas north, particularly along Step Mountain Road (south of the City of Herriman).

The 2020 census shows significant population growth has occurred in the cities near Camp Williams since 2010, with most cities recording a doubling of population (Table 4-1). These growth trends are expected to continue into the foreseeable future. In fact, 2022 population estimates show growth in the cities of Bluffdale, Herriman, Eagle Mountain, Lehi, and Saratoga Springs have continued at or approaching double-digit rates.

As shown in Figure 4-3 most of the area surrounding Camp Williams is densely populated (> 4,000 people per square mile). The areas north have seen continuous growth (Cities of Herriman, Bluffdale, Riverton, and Draper). The area between Eagle Mountain, Saratoga Springs, and Lehi is not continuously built-up however the population density is also high (> 1,000 people per square mile). The population density is low to the northwest, west and southwest (< 100 people per square mile).

Table 4-1. Population Surrounding Camp Williams

Location	2010 Census	2020 Census	% Change (2010 to 2020)	V2022 Estimate	% Change (2020 to V2022)
Bluffdale City	7,598	17,014	+ 124	19,080	+ 12.1
City of Herriman	21,785	55,144	+ 153	59,179	+ 7.3
Salt Lake County	1,029,655	1,185,238	+ 15	1,186,257	+ 0.1
City of Eagle Mountain	21,415	43,623	+ 104	54,149	+ 24.1
City of Lehi	47,407	75,907	+60	84,373	+ 11.1
City of Saratoga Springs	17,781	37,696	+ 112	49,354	+ 30.9
Utah County	516,564	659,399	+ 28	702,434	+ 6.5
Utah (State)	2,763,885	3,271,616	+ 18	3,380,800	+ 3.3

Source: U.S. Census Bureau

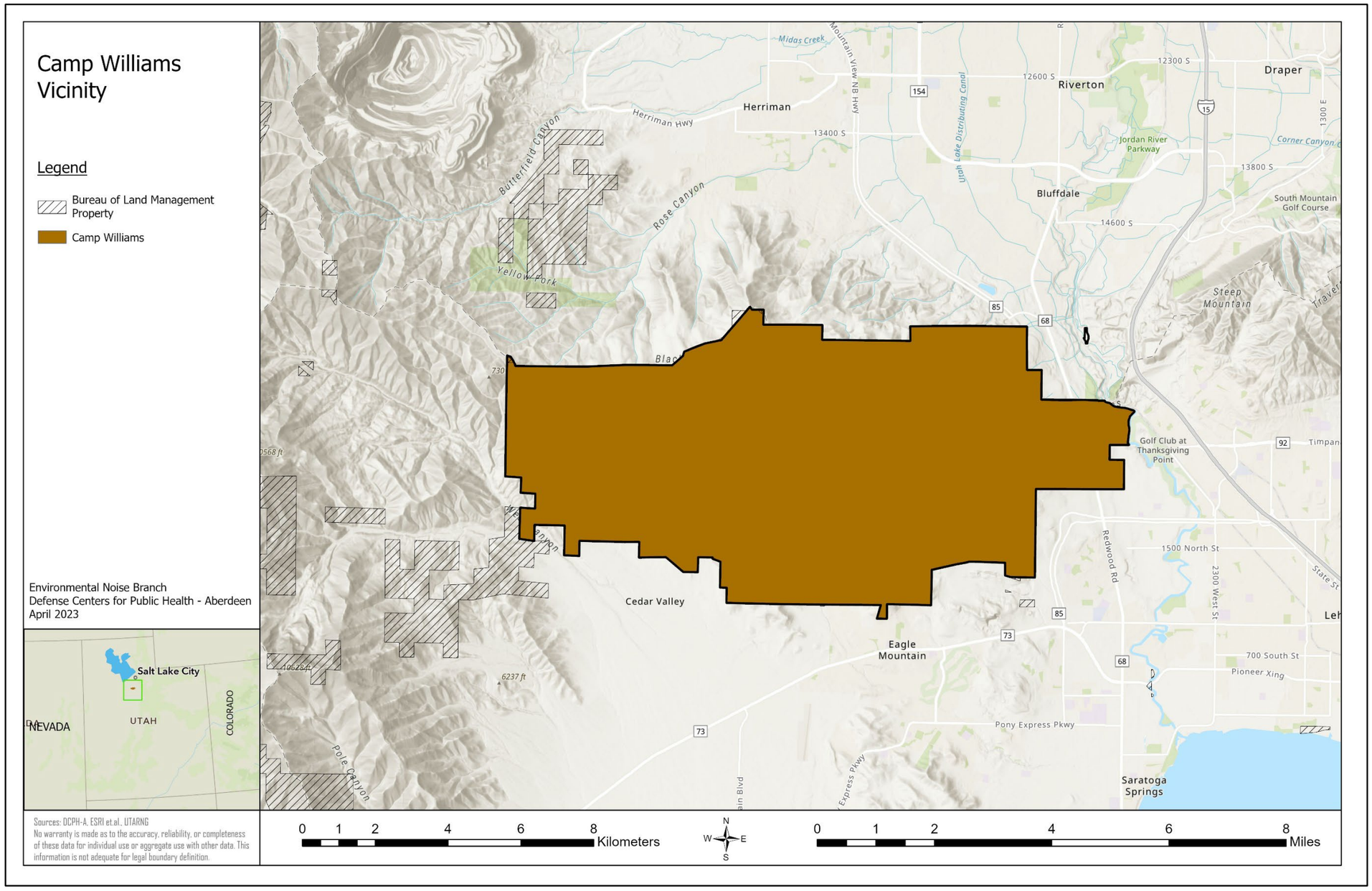

Figure 4-1. Camp Williams General Location

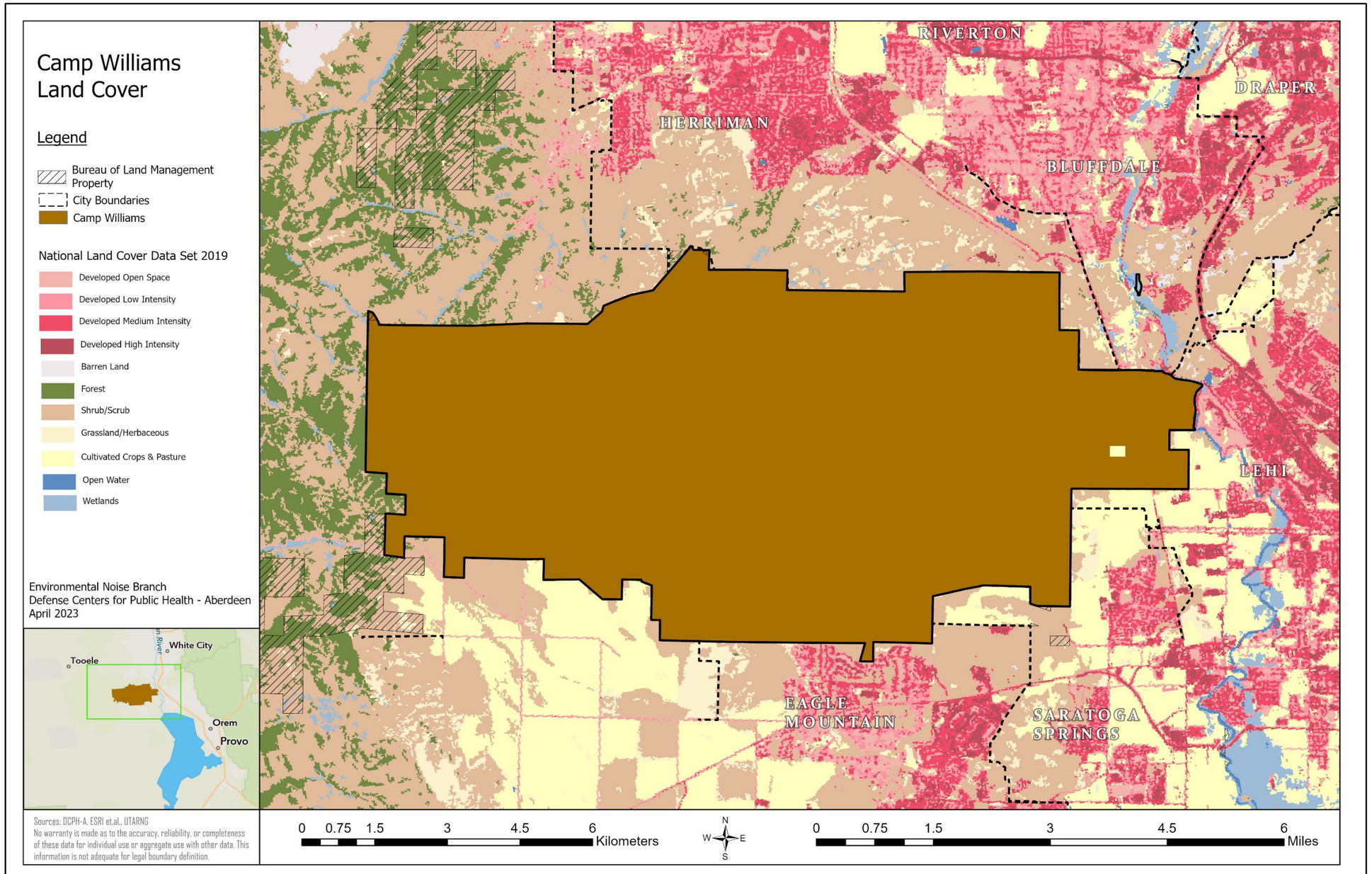

Figure 4-2. Land Cover in Camp Williams Vicinity

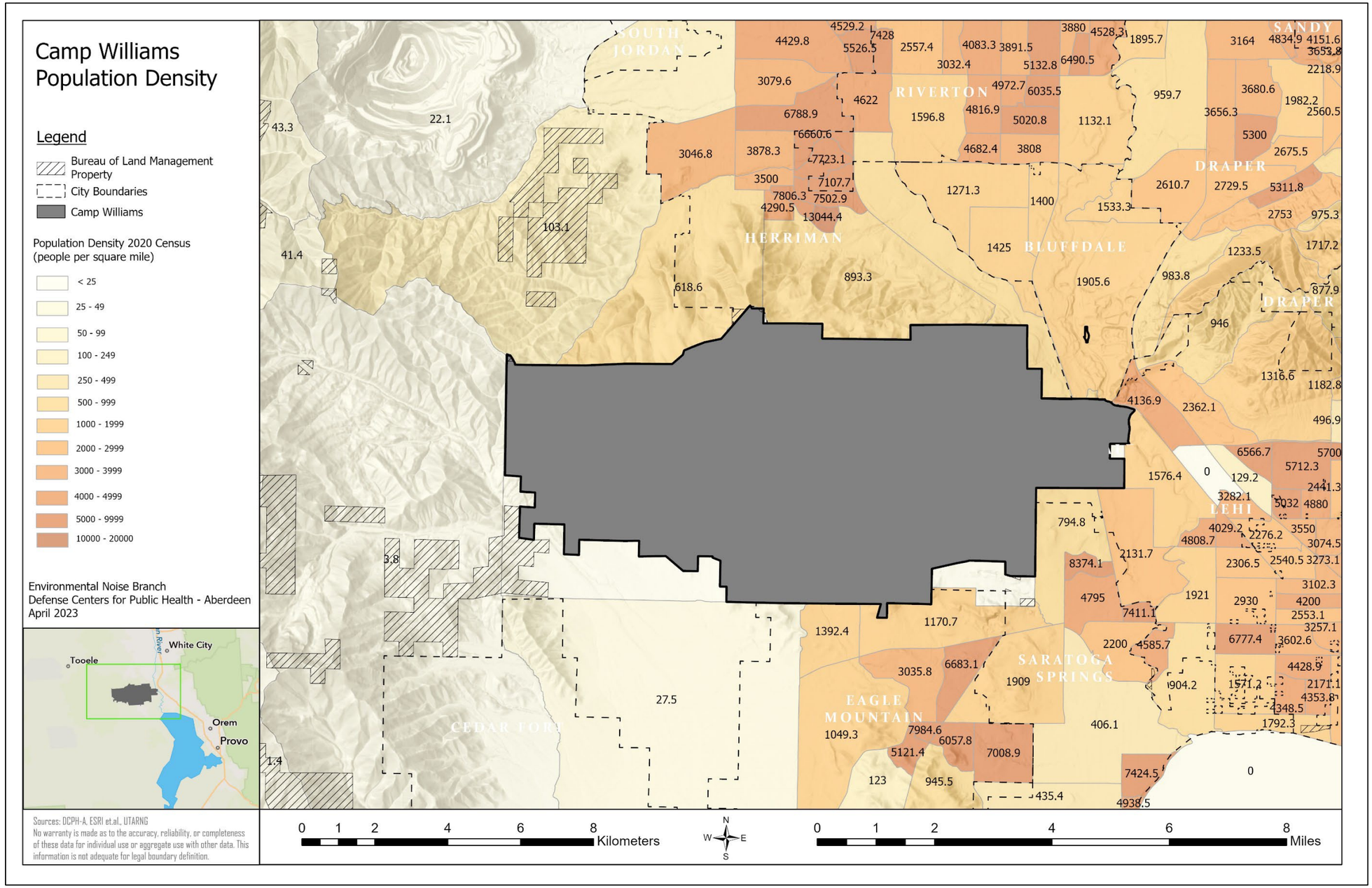

Figure 4-3. Population Density near Camp Williams

4.2 TRAINING FACILITIES AND RANGES

Camp Williams is one of the largest training facilities for the National Guard in the western U.S. with over 24,000 acres. The Camp also provides training for the U.S. Army and Army Reserve, U.S. Marine Corps and Marine Corps Reserve, U.S. Air Force and U.S. Air Force Reserve, and the Reserve Officers Training Corps. In addition, it is also an important training site for local law enforcement agencies.

Camp Williams offers a wide variety of training environments to soldiers, airmen, and marines, such as small arms live-fire familiarization and qualification training, artillery firing and maneuvering, demolitions training, helicopter maneuvering, land navigation, and military academic courses (including field exercises). Additional training includes basic airborne and jump master refresher courses at Grant Smith Farms Drop Zone (DZ) (a leased property 7 miles south of Camp Williams).

Camp Williams is considered a premier training facility because of the wide array of live-fire and ground maneuver capabilities, which allow for battalion-sized field training exercises, urban assault and defense training, mobilization, and artillery battalion live-fire exercises. The reservation has 44 designated training areas, which encompass a total of 17,603 acres. Training occurs year-round, approximately 50 weekends per year and 10 to 12 annual training periods (up to 14 days each).

Most range facilities are in the southwest portion of installation along with the main impact area (Figure 4-4 and Table 4-2). There are multiple Artillery Firing Points (AFP) at Camp Williams, most are in the eastern half of the reservation. In the northeast corner there are seven small caliber ranges.

Additionally, Camp Williams has several Collective Training Facilities (CTF). These facilities recreate a typical urban environment for the purpose of providing realistic training scenarios for soldiers. The CTF’s at Camp Williams include a Military Operations in Urban Terrain (MOUT) Training Area, a Combat in Cities Facility, an Improvised Explosive Device (IED) Defeat-Home Station Training Complex, and an Afghan Village. Individual training areas throughout the reservation are also utilized for similar collective training operations.

Table 4-2. Camp Williams Live-Fire Ranges

General Location with Camp Williams	Range Facility	Weapons / Ammunition
North Central	Engineering Qualification Area (EQA 1, 2, 3) Heavy Demolition Range	Three pads with 40-lb, 320-lb, 105-lb limits
Northeast	Alternate Pistol (AP) Range	Pistol (9mm, .22 cal, .38 cal, .40 cal, .45 cal)
	Auxiliary Pistol (AU) Range	
	Bobber (BO) Pistol Range	
	10 Turner (20T) Pistol Range	
	20 Turner (20T) Pistol Range	
	Biathlon (BI) Range	Rifle .22 Caliber
	300 Meter Zero (300Z) Range	Pistol (9mm), Rifle and Machine Gun (5.56mm and 7.62mm)
South Central	25 Meter Zero Range Alpha (25M A)	Pistol (9mm, .45 cal), Rifle (5.56mm), Shotgun (12 Gauge)
	Combat Pistol (CP) Qualification Range	Pistol (9mm, .38 cal, .40 cal, .45 cal)
	Grenade Launcher Range (GLR)	M203 (40mm TP)
	Hand Grenade (HG) Range	M67 Fragmentation Grenade
	Light Demolition Range	One pit with 40-lb limit
	Live-Fire Shoothouse (SH)	Pistol (9mm, .40 cal, .45 cal), Rifle (5.56mm Short Range Training Ammunition)
	Military Operation in Urban Terrain (MOUT) Assault Course	Rifle (5.56mm), M203 (40mm TP)
	Modified Record Fire (MRF) Range	Pistol (9mm), Rifle (5.56mm)
	Mortar (MTR) Range	M224 (60mm -M769 Full Range Training Round), M252 (81mm-M879 Full Range Training Round)
	Scaled Mortar (SMTR) Range	M224 (60mm-M766 Short Range), M52 (81m-M880 Short Range)
	USOC Live-Fire Shoot House Complex	Pistol (9mm, .40 cal, .45 cal), Rifle (5.56mm Short Range Training Ammunition)
Southwest	10 Meter (10M) Machine Gun Range	Rifle and Machine Gun (5.56mm, 7.62mm)
	25 Meter Zero Range Bravo (25M B)	Pistol (9mm, .45 cal), Rifle and Machine Gun (5.56mm, 7.62mm), Shotgun (12 Gauge)
	25 Meter Zero Range Charlie (25M C)	Pistol (9mm, .38 cal, .45 cal), Rifle (5.56mm)
	Aerial Gunnery Range	Machine Gun (7.62mm), Cannon (20mm, 30mm)
	Infantry Squad Battle Course (ISBC)	Rifle and Machine Gun (5.56mm, 7.62mm)
	Known Distance (KD) Range	Rifle and Machine Gun (5.56mm, 7.62mm)
	Multipurpose Machine Gun (MPMG) Range	Pistol (9mm), Rifle and Machine Gun (5.56mm, 7.62mm, .50 cal)

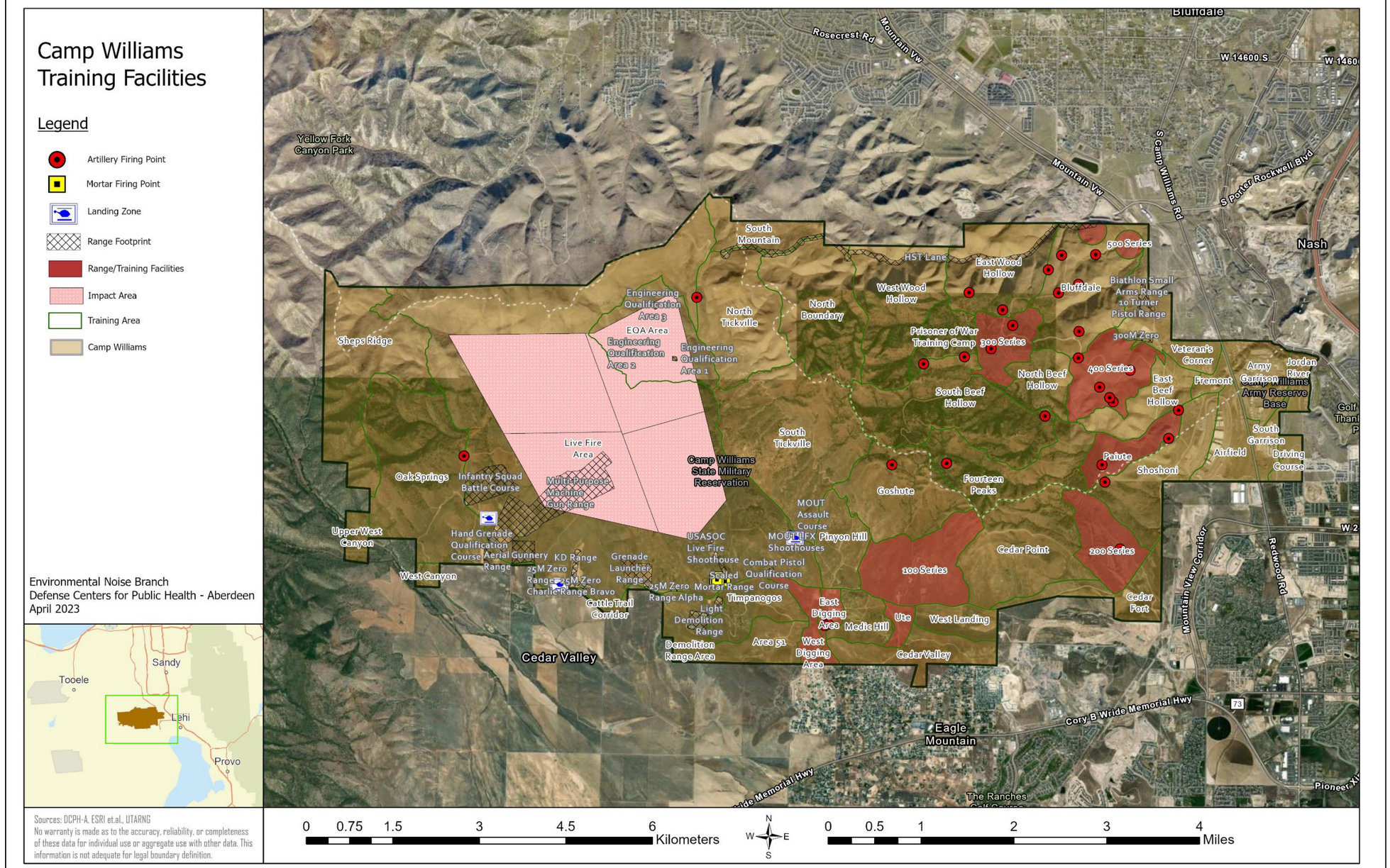

Figure 4-4. Camp Williams Training Facilities

4.3 RANGE NOISE ASSESSMENT

4.3.1 GENERAL

The range noise assessment is based on weapons and explosive activities from FY 2019 through FY 2022. The 2022 training levels are more representative of what is expected for future utilization. During a typical year 300,000 personnel complete training at Camp Williams.

4.3.2 SMALL ARMS NOISE

The small arms designation includes weapons of .50 caliber or less. Small arms weapons utilized at Camp Williams include a multitude of rifles, machine guns, pistols, and shotguns with various ammunition. The SARNAM computer model was used to calculate and plot peak noise levels based on the loudest weapon at each small arms range from the operations data described in Appendix C. SARNAM requires specific firing point and target point locations entered into the program to generate noise contours. 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 Areas subsection (4.3.2.2).

4.3.2.1 SMALL ARMS NOISE ZONES

The live-fire small arms ranges at Camp Williams are utilized year-round depending upon training mission requirements, such as the type of training to be completed; the unit being trained; and deployment status. The Noise Zones for small arms activity represent a maximum training scenario (all ranges actively firing) for live-fire ammunition operations. As previously mentioned, there is no assessment period with the Peak noise metric. (Note: Zone I includes all areas outside the Zone II noise limit of 87 dB Peak).

The Noise Zones are split into two separate areas: the main range area in the southwest (dedicated impact area) and multiple ranges in the northeast corner of the reservation. As shown in Table 4-3 and Figure 4-5, the Noise Zones extend beyond the boundary. At the time of this study, there are two single-family residences within Zone II (one along South 1825 West and one on Step Mountain Road). However, the Step Mountain Road area is experiencing increased development, which may add to the number of noise-sensitive land uses within Zone II in the future. Tables 4-4 through 4-6 and Figures 4-6 through 4-8 provide details of the Noise Zones beyond the boundary.

Table 4-3. Small Arms Noise Zones Acreage

	Noise Zone Acreage	
Noise Zone	**Total**	**Off-Post**
Zone II (87 – 104 dB Peak)	11,540	1,936
Zone III (> 104 dB Peak)	2,356	74

Legend: dB = decibels

Table 4-4. Small Arms Noise Zones Extension – Northeastern Area (Route 68)

Noise Zone	Distance		Affected Land Use
	Kilometer[1]	Mile[2]	
Zone II (87 – 104 dB Peak)	0.8	0.5	Residential (1 property) Undeveloped Scrub Land
Zone III (> 104 dB Peak)	< 0.1	< 0.1	Undeveloped Scrub Land

Legend: dB = decibels
Notes:
[1] Distance listed reflects maximum extension beyond the boundary.
[2] Mileage conversion is rounded for simplicity.

Table 4-5. Small Arms Noise Zones Extension – Northwestern Boundary (Step Mountain Road Area)

Noise Zone	Distance		Affected Land Use
	Kilometer[1]	Mile[2]	
Zone II (87 – 104 dB Peak)	0.7	0.4	Residential (1 property) Undeveloped Scrub Land
Zone III (> 104 dB Peak)	0	0	n/a

Legend: dB = decibels
Notes:
[1] Distance listed reflects maximum extension beyond the boundary.
[2] Mileage conversion is rounded for simplicity.

Table 4-6. Small Arms Noise Zones Extension – Southwestern Boundary (Cedar Valley Area)

Noise Zone	Distance		Affected Land Use
	Kilometer[1]	Mile[2]	
Zone II (87 – 104 dB Peak)	1.5	0.9	Agricultural Undeveloped Scrub Land
Zone III (> 104 dB Peak)	0.2	0.1	

Legend: dB = decibels
Notes:
[1] Distance listed reflects maximum extension beyond the boundary.
[2] Mileage conversion is rounded for simplicity.

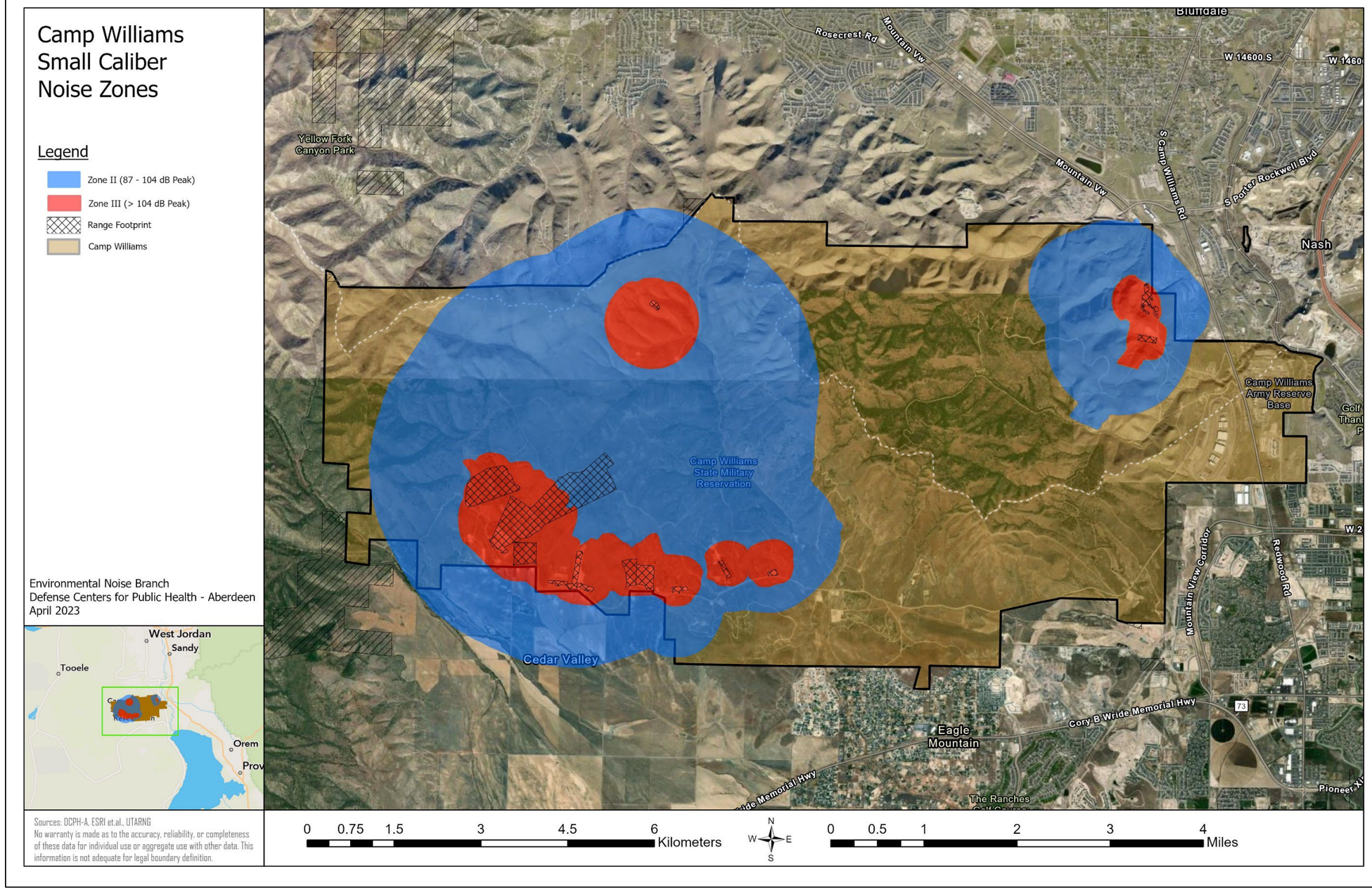

Figure 4-5. Camp Williams Small Arms Noise Zones

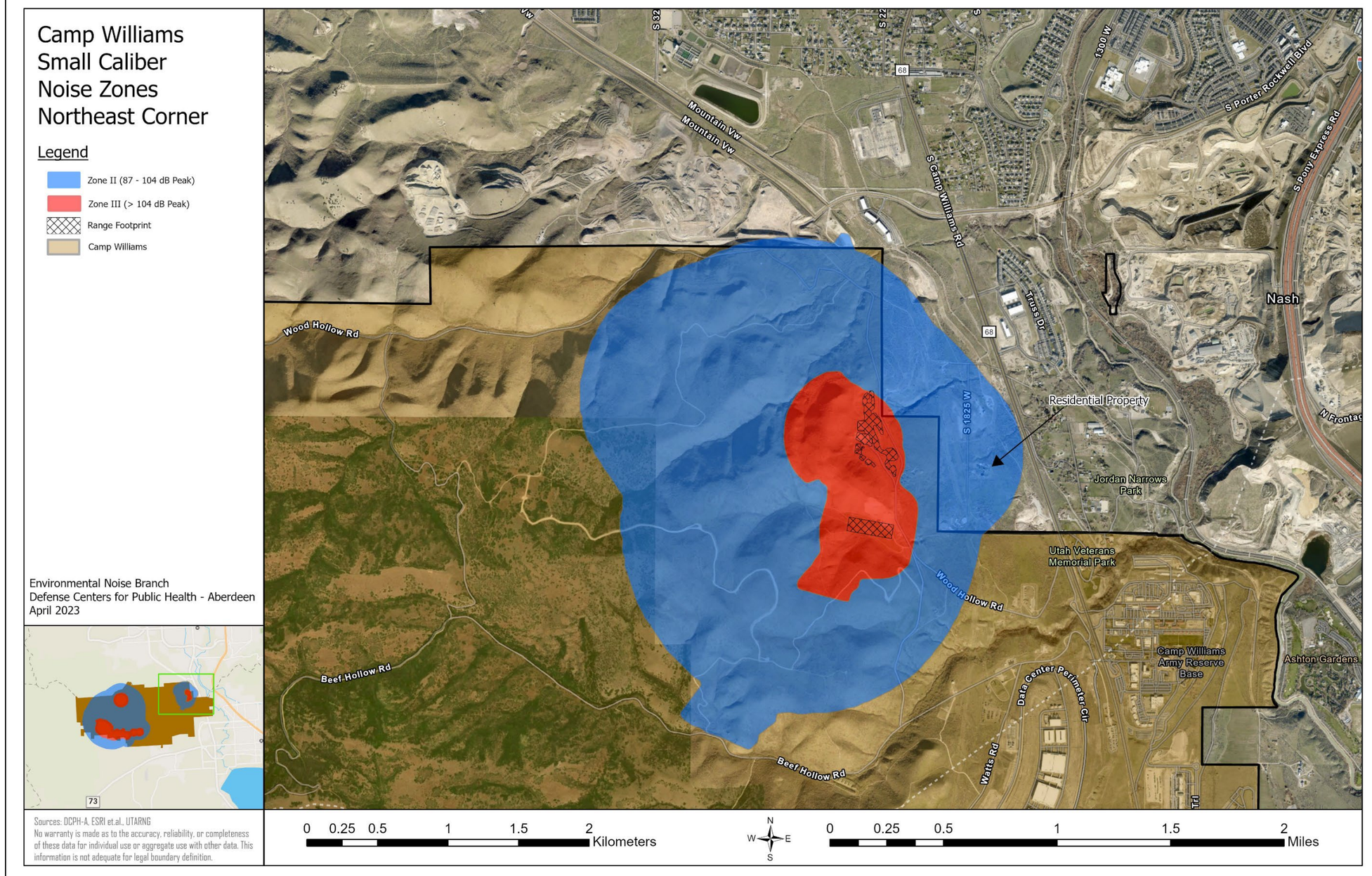

Figure 4-6. Camp Williams Small Arms Noise Zones – Northeastern Area

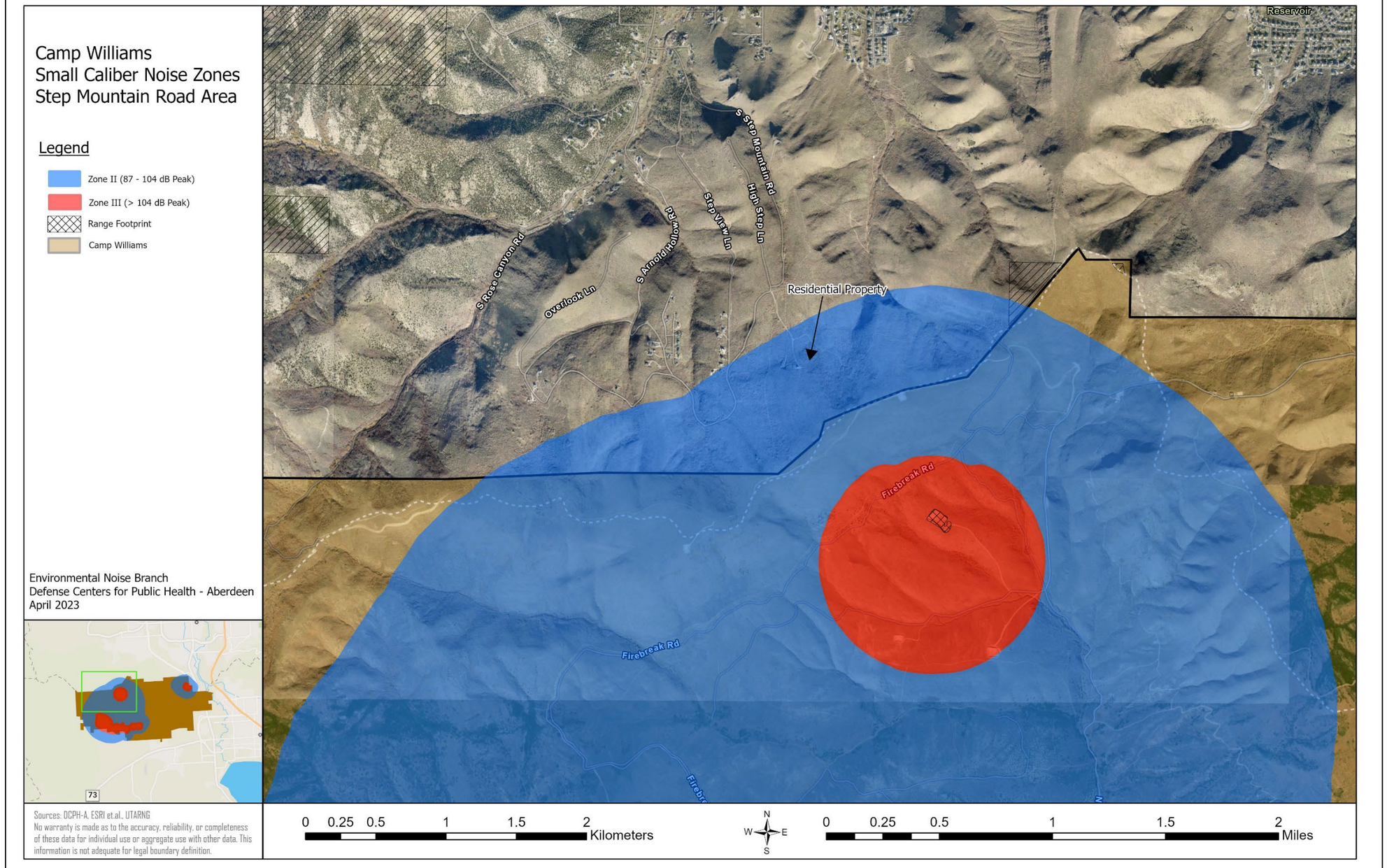

Figure 4-7. Camp Williams Small Arms Noise Zones – Step Mountain Road Area

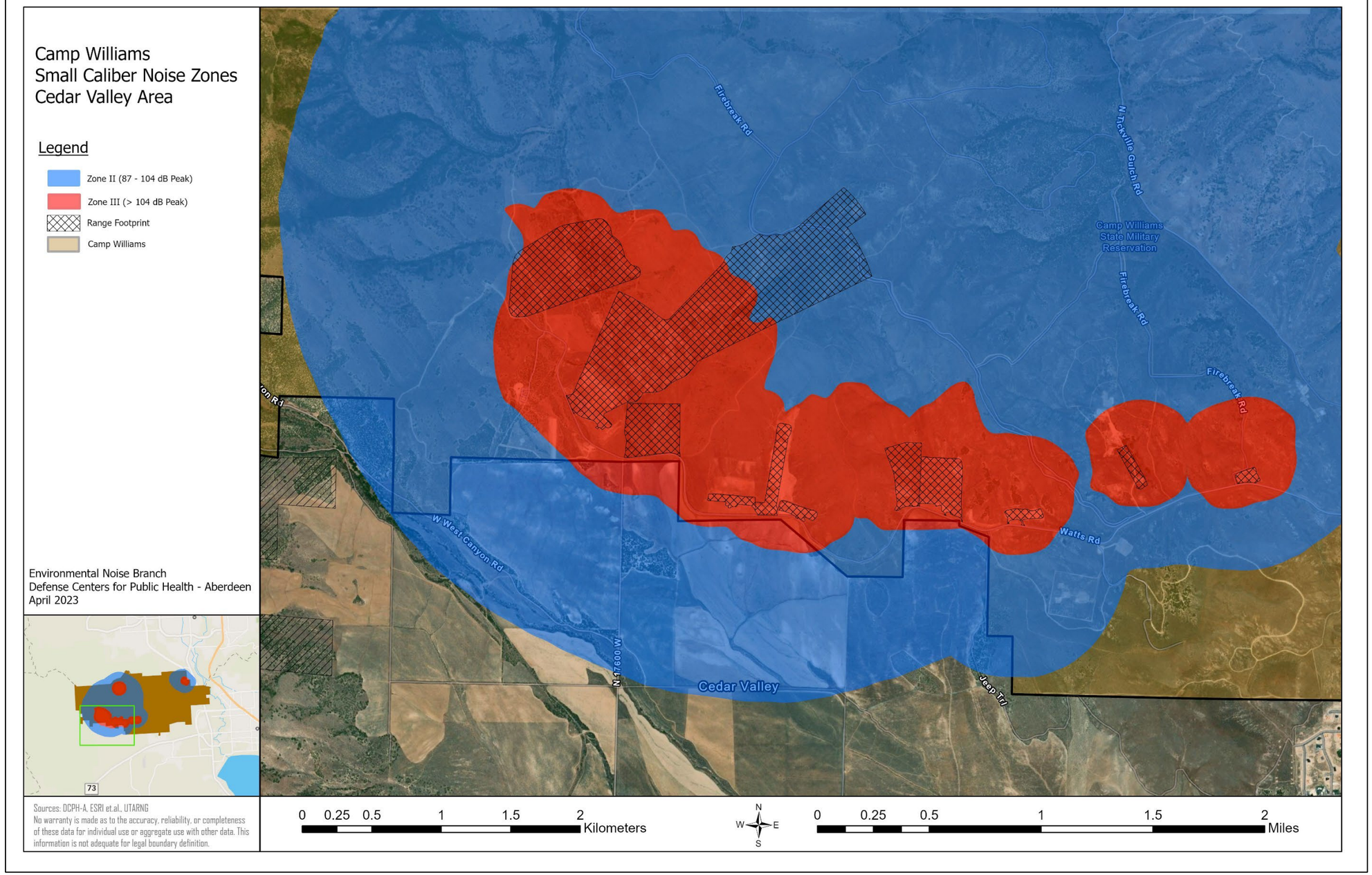

Figure 4-8. Camp Williams Small Arms Noise Zones – Cedar Valley Area

4.3.2.2 NON-FIXED SMALL ARMS AREAS

In addition to the live-fire small arms ranges on Camp Williams, troops may conduct collective training utilizing blank ammunition and/or simunitions, which produce training scenarios that replicate real-world environments. With the absence of specific firing and target point locations, Noise Zones for these activities cannot be modeled. However, by looking at predicted peak levels of small arms ammunition, we can assess noise exposure from these training activities.

Tables 4-7 and 4-8 list the predicted peak levels for blank ammunition utilized in non-fixed firing areas. 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., zero 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 4-7 indicates that under unfavorable weather conditions, a Zone II noise level (87 dB Peak) extends approximately 200 meters for the 5.56mm blank at all three given azimuth angles. It should be noted that this is highly dependent upon actual firing location whereas the risk for potential impacts are reduced as the distance from the receiver increases.

It should be noted that variables such as actual firing location within the training area/complex and weather conditions at the time of firing would all influence the degree of noise impact. Most of the non-fixed weapons blank ammunition activity occurs at sites over 800 meters from the boundary and which have little to no populated areas in the immediate vicinity. However, in the southeastern corner there is residential development along the boundary (Eagle Mountain). If training occurs within 800 meters of the boundary, it is possible the firing activities may be audible outside the reservation and these areas may be exposed to noise levels which approach/exceed Zone II.

Table 4-7. Predicted Peak Noise Levels for 5.56 mm Blank Round

Distance, meters	Predicted Level, dB Peak Azimuth		
	0°	90°	180°
100	87-97	86-96	87-97
200	80-90	79-89	80-90

Legend: dB = decibels
Notes:
The 0° is directly in front of the weapon and the 180° azimuth is directly behind the weapon.
Blank is defined as any round that contains propellant but no bullet.
Highlighted row indicates the maximum distance where levels approach/exceed 87 dB Peak (Zone II).

Table 4-8. Predicted Peak Noise Levels for 7.62 mm Blank Round

Distance, meters	Predicted Level, dB Peak Azimuth		
	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

Legend: dB = decibels
Notes:
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.
Highlighted row indicates the maximum distance where levels approach/exceed 87 dB Peak (Zone II).

Non-live fire activity also includes simunitions (marking rounds), which have reduced noise levels. Based on field measurements, Zone II levels would only be exceeded at approximately 75 meters or less.

In addition to non-fixed firing areas there are shoot house structures which utilize blank ammunition. The *exterior* noise level of a shoot house is greatly reduced due to the attenuation of the structure itself. Some facilities are completely covered with a roof; other designs have an open roof (either full or partial). Although the specific design may vary, generally a shoot house with a roof would be expected to provide up to 25 dB noise level reduction (NLR), and a shoot house with the open roof design may provide up to a 15 dB NLR. Overall, firing inside a shoot house is negligible if sited at least 100 meters from noise sensitive receivers.

Additional small arms operations include a live-fire sniper rifle course which occurs for a limited yearly training event (usually winter timeframe). The course is conducted in various Training Areas including the 200 Series, 300 Series, Blacks Ridge, East Wood Hollow, and Paiute sites. The largest firearms used are the 300 Winchester Magnum rifle and/or the M2010 Enhanced Sniper Rifle. Zone II levels would be expected as far as 800 meters (180º azimuth) from the firing locations. The 200 Series and Paiute Training Areas are in the southeast region of Camp Williams and approximately 500 meters from the boundary. The closest sensitive land use is a residential development along Mountain View Corridor (Highway 85) approximately 200 meters from the Camp Williams boundary. The area is undergoing increased development which may expose more residences to Zone II levels in the future. Depending upon the sniper course location within the 200 Series and Paiute Training Areas (i.e., firing location), it is possible these activities may be audible outside the reservation boundary and may expose nearby residences to Zone II levels.

4.3.3 DEMOLITION AND LARGE CALIBER NOISE

The large caliber designation includes weapons 20 mm or greater and any weapon that contains demolition/explosive charges. The launch noise from the 40mm grenade and simulator training (pyrotechnic and non-pyrotechnic) are not included in large caliber Noise Zones. These activities are addressed separately via peak noise levels in Sections 4.3.4 and 4.3.5.

4.3.3.1 DEMOLITION AND LARGE CALIBER NOISE ZONES

At Camp Williams, training is conducted with a multitude of large caliber weapons including artillery, mortars, aerial gunnery, mines, rockets, grenade launchers, and explosive demolition charges. Training occurs year-round; however, as with most ARNG training centers, the majority of training occurs seasonally between April and October.

Appendix C lists the large caliber and demolition expenditures by facility used to produce the Army defined Noise Zones. The Noise Zones were modeled using an assessment period of 104 days which is the standard assessment period for all ARNG facilities (AR 200-1). The Utah National Guard 385-63-1 indicates firing restrictions such that: “Mortar or artillery firing is prohibited between 2350 and 0600 (1150 pm and 6 am)” and “All blasting will be conducted between the hours of 0700 and 1900 (7 am and 7 pm), unless approved by Range Control” (UTNGR 2022). Based on the permissible firing hours all training activity was modeled during acoustical daytime (0700-2200 hours (7 am – 10 pm)). Although it is possible there may be limited mortar or artillery firing between 2200 and 2350 (10 pm – 1150 pm) (acoustical nighttime), Camp Williams Range Control states artillery training is extremely rare during this narrow timeframe.

Sound propagation outdoors can be strongly affected by ground topography. Although man-made barriers or berms are considered impractical to mitigate the effects of explosive demolition and large caliber weapons, natural topography, such as large hills, mountains, and valleys between a source and receiver can lead to the shielding or even focusing of sound waves. Such effects can result in significant variations in received sound levels. The topography at Camp Williams varies significantly, particularly on the north end of the reservation, along the Salt Lake County and Utah County border, where the Black Ridge Mountain Range shows the terrains mitigating (i.e., shielding) effects (Figure 4-9 and Table 4-9). The Ridge is acting as a natural sound barrier, preventing the sound from traveling over the Black Ridge Mountain Range.

Table 4-9. Demolition and Large Arms Noise Zones Acreage

	Noise Zone Acreage	
Noise Zone	**Total**	**Off-Post**
LUPZ (57 – 62 dB CDNL)	3,836	0
Zone II (62 – 70 dB CDNL	3,127	0
Zone III (> 70 dB CDNL)	2,452	0

Legend: CDNL = C-weighted Day-Night average sound Level, dB = decibels

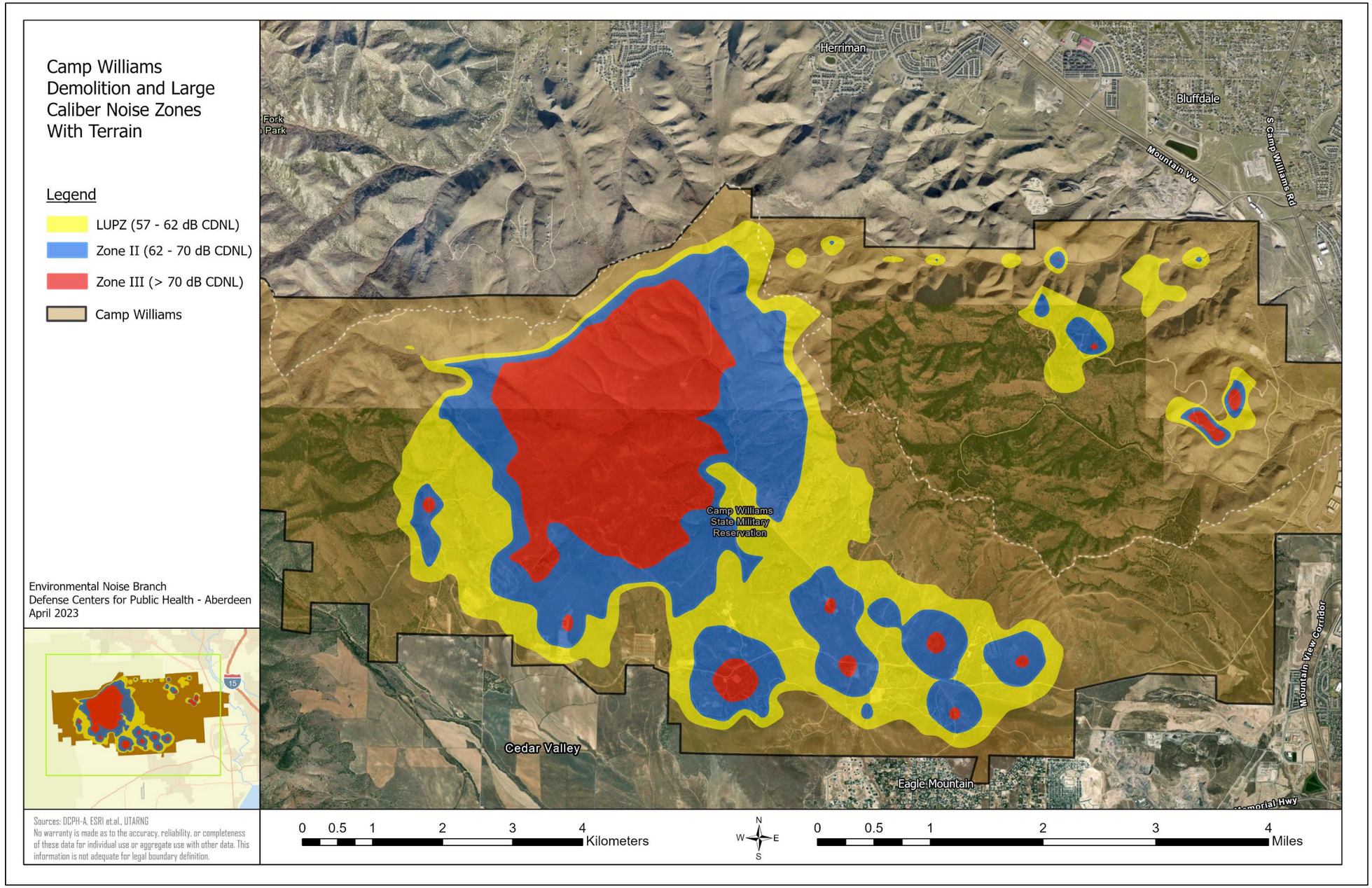

Figure 4-9. Demolition and Large Caliber Noise Zones

4.3.3.2 SUPPLEMENTAL SINGLE EVENT PEAK LEVELS (DEMOLITION AND LARGE CALIBER WEAPONS)

Annual average noise levels are suitable as the primary environmental noise descriptor for land use compatibility since it provides a reliable relationship between noise exposure and community response. However, individual training events can be audible outside of a Noise Zone and in some cases objectionable to the surrounding community. 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 pertaining to blast noise. It is worth noting the vibration that often accompanies low-frequency noise from demolition activity is almost always air-borne (not ground-borne). Neighbors located near the "loud" area on the map may occasionally notice a picture or window rattling from air-borne vibration; however, this rattling does not indicate damage, and almost always occur at levels well below those required to cause structural damage.

On Figure 4-10, weather conditions that enhance sound propagation (unfavorable weather or PK15(met)) are illustrated on the left map and neutral propagation conditions (PK50(met)) are illustrated in the map on the right. Both weather scenarios are provided to demonstrate the influence of meteorological conditions on noise propagation from single events. Peak contouring for current "routine" demolition and large caliber weapons activity single events (FY19 to FY22) is described in this section. In addition, Section 6.5 provides supplemental single event Peak sound levels for Artillery Firing Points (AFP) that may be used less frequently, as well as Peak sound levels for infrequent large demolition events.

Once again, the presence of the Black Ridge Mountain range shows significant attenuation along the northern boundary in this modeling scenario. Under unfavorable weather Peak levels above 115 dB extend beyond the northern and southern boundaries (Figure 4-10 and Tables 4-10 through 4-13). The areas inside the contours north do not contain any sensitive land uses. However, the southeastern portion of the contour contains residential land use concentrated in medium to high density subdivisions (Arrival, Cedar Pass Ranch, Meadow Ranch, North Ranch, Spring Run, Valley View, Valley View Foothills, Valley View South, Westview Heights) in the city of Eagle Mountain (Figure 4-11). Peak sound levels above 130 dB extend beyond the southern boundary, encompassing multiple residences in the Hidden Hills Road and Vande Way area (northern area of the North Ranch and Arrival Subdivisions). Residences in these neighborhoods would be expected to occasionally experience high noise levels from artillery firing activity, particularly given the right meteorological conditions. These noise contours, like others in this study, establish the most common or concentrated areas of noise generated by the various training and operational activities at Camp Williams. On occasion, noise from a particular event may extend into an area not covered by a depicted noise contour.

Although the contours contract considerably under neutral conditions, Peak levels above 115 dB still extend beyond the northern and southern boundaries, but to a much lesser degree.

Table 4-10. Demolition and Large Caliber Weapons Single Event Peak Levels– Northern Boundary

	Unfavorable Weather Conditions			Neutral Weather Conditions		
	Distance			Distance		
dB Peak	Kilometer[1]	Mile[2]	Affected Land Use	Kilometer[1]	Mile[2]	Affected Land Use
115 – 130	1.5	0.9	Undeveloped (Scrub Land)	1	0.6	Undeveloped (Scrub Land)
> 130	1	0.6		0.4	0.25	

Legend: dB = decibels
Notes:
[1] Distance listed reflects maximum extension beyond the boundary.
[2] Mileage conversion is rounded for simplicity.

Table 4-11. Demolition and Large Caliber Weapons Single Event Peak Levels – Southern Boundary (Cedar Valley Area)

	Unfavorable Weather Conditions			Neutral Weather Conditions		
	Distance			Distance		
dB Peak	Kilometer[1]	Mile[2]	Affected Land Use	Kilometer[1]	Mile[2]	Affected Land Use
115 – 130	3	1.9	Undeveloped (Scrub Land)	0.8	0.5	Undeveloped (Scrub Land)
> 130	0.4	0.25		0	0	n/a

Legend: dB = decibels
Notes:
[1] Distance listed reflects maximum extension beyond the boundary.
[2] Mileage conversion is rounded for simplicity.

Table 4-12. Demolition and Large Caliber Weapons Single Event Peak Levels– Southern Boundary (Eagle Mountain Area)

	Unfavorable Weather Conditions			Neutral Weather Conditions		
	Distance			Distance		
dB Peak	Kilometer[1]	Mile[2]	Affected Land Use	Kilometer[1]	Mile[2]	Affected Land Use
115 – 130	2.5	1.6	Residential (medium to high density)	0.3	0.2	Residential (medium to high density)
> 130	< 0.1	< 0.1	Residential (3 properties)	0	0	n/a

Legend: dB = decibels, n/a = not applicable
Notes:
[1] Distance listed reflects maximum extension beyond the boundary.
[2] Mileage conversion is rounded for simplicity.

Table 4-13. Demolition and Large Caliber Weapons Single Event Peak Levels – Southeastern Boundary (Mountain View Corridor Area)

	Unfavorable Weather Conditions			Neutral Weather Conditions		
	Distance			Distance		
dB Peak	Kilometer[1]	Mile[2]	Affected Land Use	Kilometer[1]	Mile[2]	Affected Land Use
115 – 130	0.9	0.6	Undeveloped (Scrub Land)[3]	0	0	n/a
> 130	0	0	n/a	0	0	

Legend: dB = decibels, n/a = not applicable
Notes:
[1] Distance listed reflects maximum extension beyond the boundary.
[2] Mileage conversion is rounded for simplicity.
[3] Mountain View Corridor area is undergoing continuing development which could increase the footprint of residential development into the 115-130 dB area.

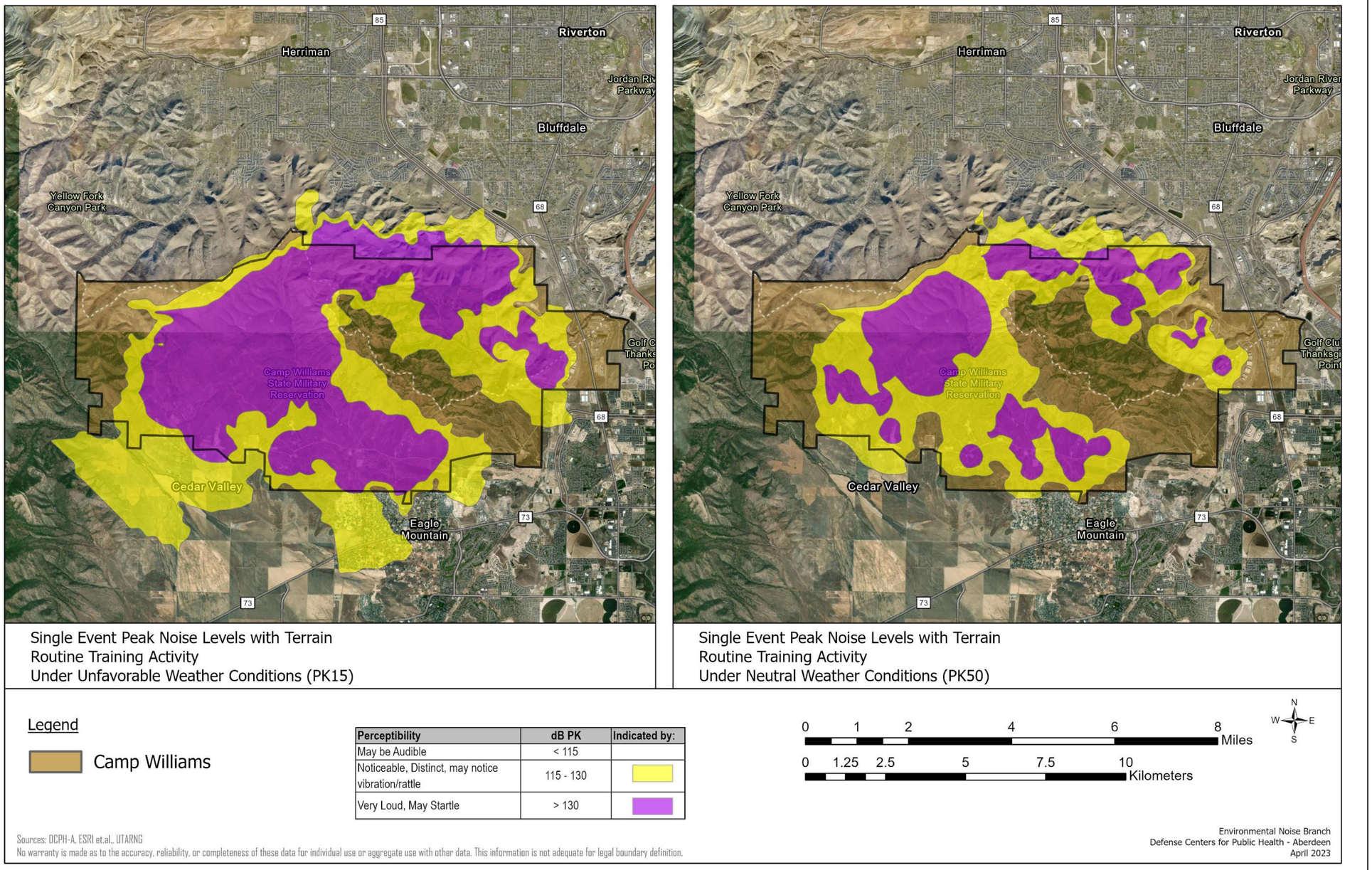

Figure 4-10. Single Event Peak Levels Routine Training Activity

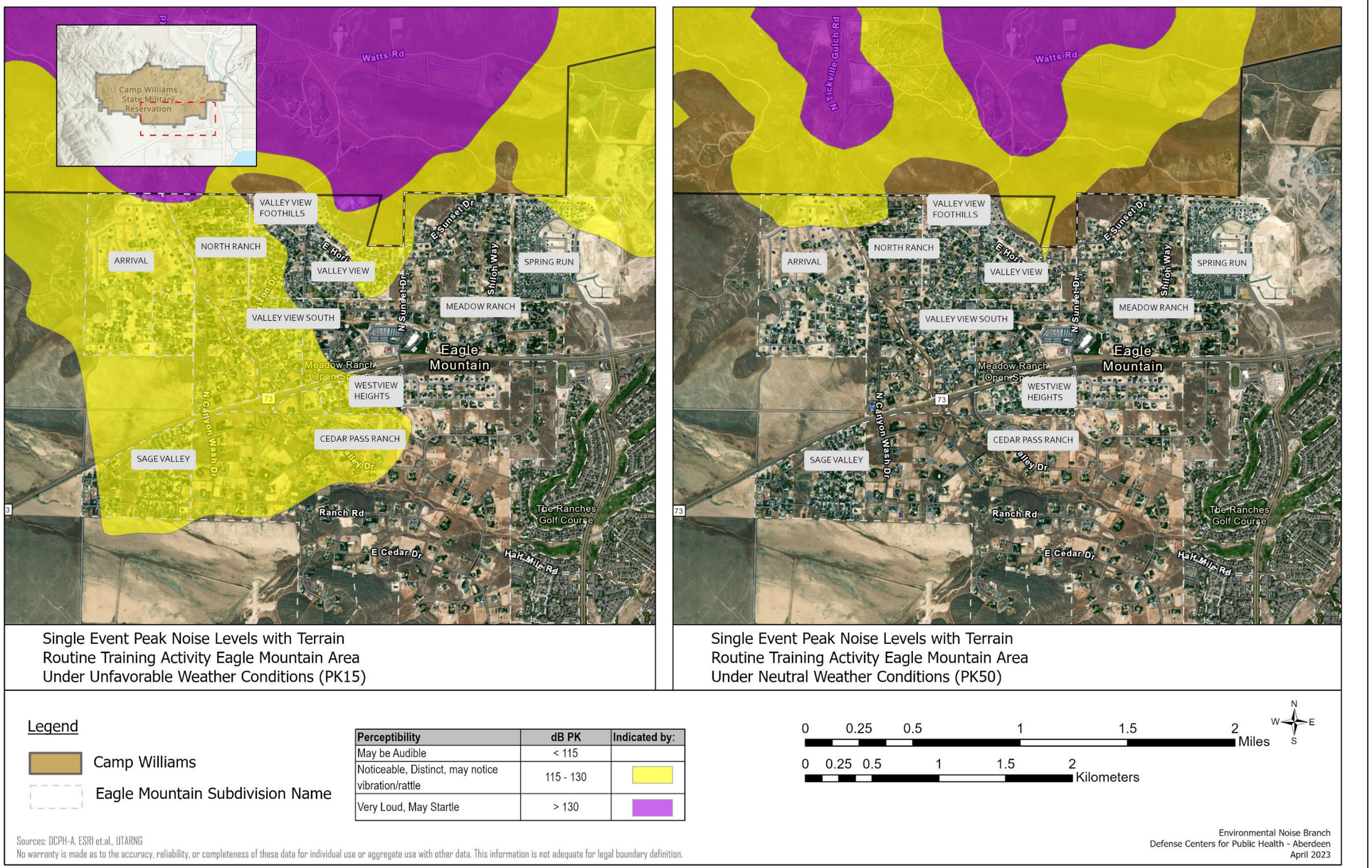

Figure 4-11. Single Event Peak Levels Routine Training Activity Eagle Mountain Area

4.3.4 GRENADE LAUNCHER NOISE

The 40mm Grenade family contains both high-velocity grenades fired from MK19 grenade machine guns and low-velocity grenades fired from handheld weapons (M203 and M320). Both grenade launchers can fire High Explosive (HE) rounds and Target Practice (TP) rounds. A 40mm TP round simulates the firing and distance capabilities of a HE round without the impact noise and safety concerns. With inert rounds, training often occurs close to the installation boundary. This section addresses the potential impacts from the launch noise of 40mm Grenades.

Tables 4-14 and 4-15 list calculated distances for firing 40mm TP rounds, which correlate to audibility of predicted Peak decibel levels in the Army's Complaint Risk Guidelines criteria (Table 3-2). The distances and levels listed represent a conservative approach and were calculated based upon hearing conservation criteria (U.S. Army 1999) and known measurements (U.S. Army 1984). As evidenced in the Tables, in most cases, once the receiver is beyond 300 meters from the side or 110 meters to the rear of the firing point, noise impacts are minimal.

The firing line at the Grenade Launcher Range is approximately 130 meters from the southern boundary, however, the adjacent areas offpost are undeveloped. Other Grenade activities generally occur at distances greater than 800 meters from the Camp Williams boundary.

Table 4-14. Audibility to the Side of the Grenade Launcher, Inert Round (40 mm)

Risk of Complaints	Distance from Grenade Launcher (meters)	Noise Level dB Peak
Low	> 300 ^	< 115
Moderate	65 - 300 ^	115
High	< 65 ^	>130
Risk of hearing damage for unprotected ears	< 19 +	>140

Legend: dB = decibels
Notes:
* -- *Inert is defined as any round that does not make noise upon impact, such as smoke, illum, TP*
^ – *Calculated value*
+ – *Known value, hearing conservation criteria.*

Table 4-15. Audibility to the Rear of the Grenade Launcher, Inert Round (40 mm)

Risk of Complaints	Distance from Grenade Launcher (Meters)	Noise Level-dB Peak
Low	> 110 ^	< 115
Moderate	25 - 110 ^	115
High	< 25 ^	>130
Risk of hearing damage for unprotected ears	< 7 +	>140

Legend: dB = decibels
Notes:
* -- *Inert is defined as any round that does not make noise upon impact, such as smoke, illum, TP*
^ – *Calculated value*
+ – *Known value, hearing conservation criteria.*

4.3.5 PYROTECHNIC/SIMULATOR NOISE

Pyrotechnics and 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 levels generated by the munitions they replicate, and 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 4-16 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 against noise level results from several noise monitoring studies (U.S. Army 1983, U.S. Army 1984, U.S. Army 1989). Based on Table 4-16, under neutral weather conditions, the risk of complaints will be low beyond 500 meters, as the Peak level would not exceed 115 dB Peak. 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 115 dB Peak distance increases to approximately 800 meters.

Table 4-16. Predicted Peak Noise Levels for Typical Army Simulators

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

Legend: dB = decibels
Note: Highlighted cells indicate where peak noise levels approach 115 dB.

Simulators are primarily used at the Combat in Cities Facility and at the MOUT at Camp Williams. The two facilities are located greater than 1,000 meters from the boundary, thus the risk of complaints is considered low. Table 4-16 is provided to help predict complaint risk for any other locations that may utilize simulators. It should be noted that variables such as actual firing location within the training area and weather conditions at the time of firing would all influence the degree of noise impact.

4.4 AIRCRAFT NOISE ASSESSMENT

There are no permanent aviation facilities or aircraft stationed at Camp Williams; however, helicopter operations are conducted within the boundary primarily by the ARNG, along with several other services. Training includes terrain flights, sling load operations, and general aviation support. The Camp has three helicopter landing zones in the southwestern area of Camp Williams (Figure 4-12). Aircraft generally enter and depart the airspace from the north using the Mountain View Corridor (Highway 85) or from the southwest through Cedar Valley. Helicopter aircraft maintain a minimum of 1,000 feet Above Ground Level (AGL) from all residential developments and 1,000 feet slant distance from all building structures for noise abatement.

4.4.1 ACTIVITY

Noise Zones for aviation activity are addressed using the A-weighted Day-Night average sound Level (ADNL) with an assessment period of 365 days. As ADNL is calculated using average daily operations, it takes a considerable number of helicopter flights to generate Noise Zones. For example: in the departure/approach path from/to the runway for a UH-60 at 200 feet AGL it would take over 200 daytime or over 32 nighttime flights or a combination of 32 daytime and 8 nighttime flights in a 24-hour period to generate a Zone II (65–75 dB ADNL). Note: acoustic daytime is defined as 0700-2200 (7 am to 10 pm) and nighttime is 2200-0700 (10 pm to 7 am).

Aircraft operations at Camp Williams are considered low with an annual average of 615 flights (average of less than 2 flights per day) (Table 4-17). The limited number of flights, in conjunction with the wide distribution of aircraft throughout the Camp does not generate a noise contour above 50 dB ADNL. Although this activity does not generate a Noise Zone, individual overflights to/from Camp Williams could generate noise levels that some individuals might find disruptive and/or annoying (see Section 4.4.2).

Table 4-17. Camp Williams Annual Activity

AIRCRAFT TYPE	Average Number of Flights per Year between	
	0700-2200 (7 am to 10 pm)	2200-0700 (10 pm to 7 am)
AH-64	300	100
UH-60	100	50
UH-72	20	15

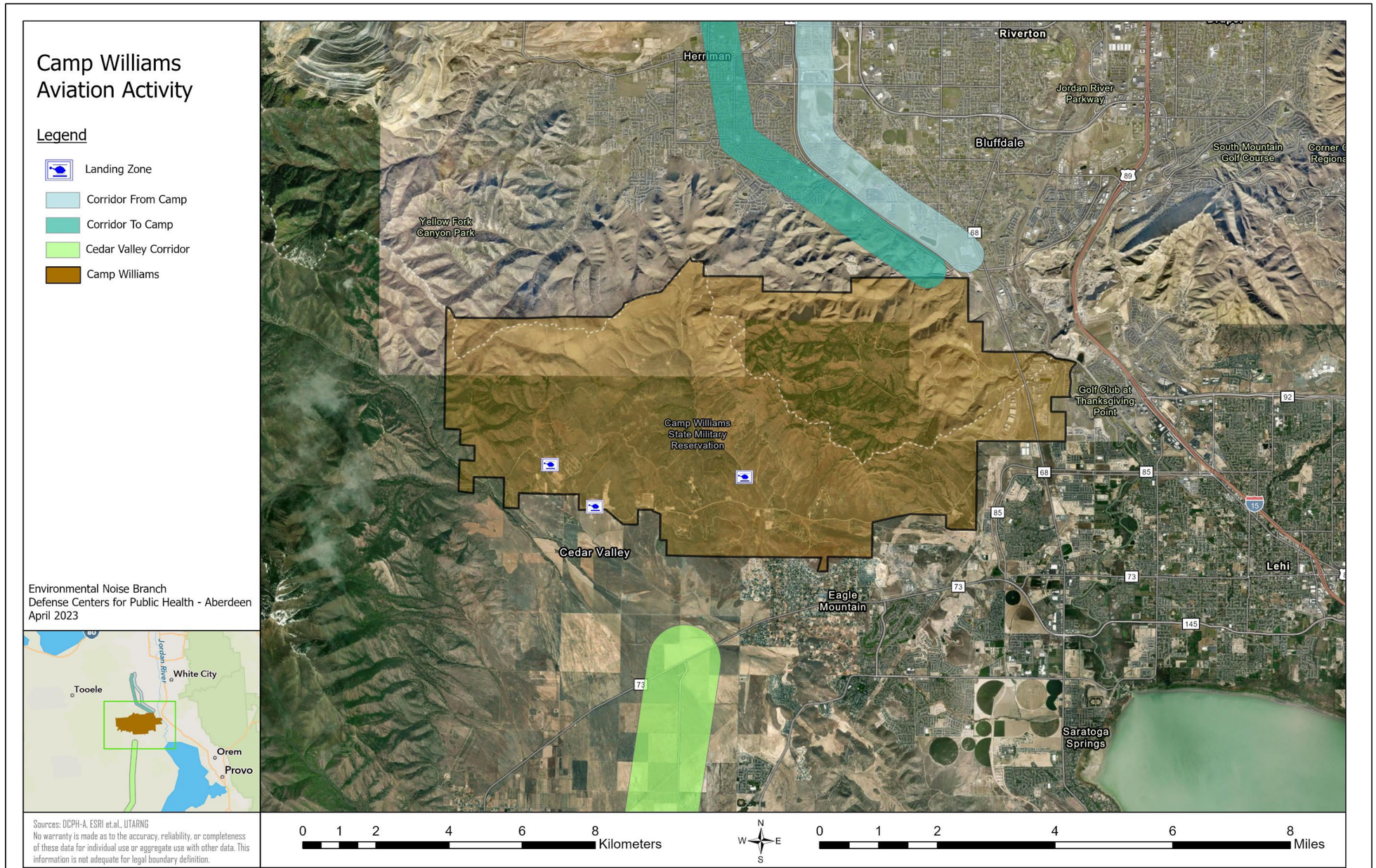

Figure 4-12. Camp Williams Aviation Activity

Currently the only Drop Zone (DZ) is a leased property (Grant Smith Farms) approximately 7 miles south of Camp Williams (Figure 4-13). There is a residential subdivision (White Hills) just northeast of the DZ. The closest towns are 1.5 miles from the DZ, Cedar Fort to the north and Fairfield to the southeast. Drop Zone activity is primarily personnel parachute jumps. Normal drop altitudes are between 1,250 – 2,000 feet AGL for Static Line Operations and 8,000 feet AGL (12,999 feet Mean Sea Level) for Military Free Fall.

The DZ is typically used between 30 and 45 days per year with drops spread out throughout the year. Each aircraft makes multiple passes for personnel jumps. When referring to **passes**, this is the number of times the aircraft will fly over the DZ and release troops until the aircraft is empty. The number of troopers dropped is dependent upon the length of the DZ in seconds + 1 and the type of aircraft. Under ideal conditions 16 jumpers can be released at the Grant Smith Farms DZ.

To maintain consistency, troop count is usually less, 10 jumpers per pass is standard for C-130 and C-17 operations. Due to a slower drop speed for rotary-wing, their operations allow for a slightly higher number of jumpers per pass. CH-47 can accommodate 12-15 jumpers per pass and UH-60 in a dual ship mission can drop 12 (six jumpers per aircraft).

Fixed-wing aircraft (C-130 and C-17) **may have up to 12 passes** spread over a 4-to-8-hour period. Rotary-wing aircraft (CH-47 and UH-60) **may perform twice as many passes** over a 2-to-4-hour period to drop the same number of personnel. Occasionally the rotary-wing aircraft will also land at the DZ. 19th Special Forces Group personnel report that the total operations between 0700-2200 range from **250 – 306** passes and from 2200-0700 range from **17 – 23** passes (Table 4-18).

The maximum number of passes (329 annually) results in an average of less than 1 per day and would not generate a noise contour above 50 dB ADNL. Although this activity does not generate a Noise Zone, individual passes could generate noise levels that some individuals might find disruptive and/or annoying (see Section 4.4.2).

Table 4-18. Grant Smith Farms Drop Zone Annual Activity

AIRCRAFT TYPE	**Average Number of Passes per Year between**	
	0700-2200 (7 am to 10 pm)	**2200-0700 (10 pm to 7 am)**
C-130	180 – 200	6 – 12
C-17	20 - 40	~6
UH-60 (dual ship)	42 – 50	~5
CH-47	8 - 16	0

Figure 4-13. Grant Smith Farms Drop Zone Vicinity

4.4.2 SUPPLEMENTAL SINGLE EVENT LEVELS (AIRCRAFT OVERFLIGHT)

4.4.2.1 ANNOYANCE FROM SINGULAR OVERFLIGHT

Individual aircraft overflights beyond an airfield and/or helipad, transitioning to or training within the local flying area, 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. Singular aircraft overflight is often the culprit of noise complaints received by an installation.

Scandinavian Studies (Rylander et al. 1974, 1980, 1988) found that a good predictor of annoyance in areas around airports with 50 overflights per day or more is the maximum level of the noisiest aircraft type that occurs at least 3 times (24-hours). The research demonstrated that few individuals considered themselves "highly annoyed" in areas exposed to maximum levels of 70 decibels A-weighted (dBA) or less; however, progressive increases were evident for those same areas exposed to 80 and 90 dBA (Table 4-19). Furthermore, although the Rylander studies did not include sampling in excess of 90 dBA, it is intuitive that a greater number of individuals would describe even a very low number of overflights at an extremely high dBA level as very annoying.

Table 4-19. Percentage of Population Highly Annoyed at Varying Decibel Levels

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

Source: Rylander 1980
Legend: dBA = decibels A-weighted

Although limited research is available correlating Maximum levels with annoyance from a single aircraft overflight (i.e., less than 50 overflights per day); anecdotal evidence shows noise complaints are regularly generated from aircraft activities along less frequented aviation routes and flight corridors in and around Army installations. Thus, these study results may also serve as an indicator for annoyance potential from intermittent overflights. The Army uses the 70 dBA Maximum level as an analysis indicator to determine where individual overflight may generate complaints. This information currently represents the best available data for this type of supplemental analysis and is not intended for land use incompatibility designations.

Maximum sounds levels from common aircraft operating in/near the UTARNG training facilities are listed in Table 4-20 and 4-21. These levels are then compared against the levels listed in the Tables to determine the percent of the population that may consider itself highly annoyed. Figure 4-14 illustrates the key aviation terms: AGL, ground track distance, and slant distance which are used to describe aircraft orientation in reference to the receiver.

Table 4-20. Maximum A-Weighted Sound Levels – Rotary-Wing Activity

Slant Distance (Feet)		Maximum Sound Level by Aircraft Type (dBA)[a,b]			
	AH-64 70 KIAS	**CH-47 Light**[c] 130 KIAS	**CH-47 Heavy**[c] 120 KIAS	**UH-60** 70 KIAS	**UH-72** 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

Legend:
dBA = decibels A-weighted, KIAS = Knots Indicated Air Speed
Notes:
[a] During flyover at constant airspeed; obtained via Advanced Acoustical Model (AAM) Program (U.S. Air Force, 2013).
[b] Only KIAS available in single track mode.
[c] Heavy indicates a sling load. Light indicates no sling load.

Table 4-21. Maximum A-Weighted Sound Levels – Military Fixed Wing

Slant Distance (Feet)	Maximum Sound Level by Aircraft Type (dBA)[a,b]		
	C-12 90% RPM 160 kts	**C-17** 90% NC 250 kts	**C-130** 970 C TIT 170 kts
500	79	97	92
1,000	73	89	85
1,500	69	84	80
2,000	67	79	77
2,500	65	76	75
5,000	57	73	66

Legend:
dBA = decibels A-weighted, kts = knots
Notes:
[a] During flyover at constant airspeed.
[b] Obtained via SelCalc Program (U.S. Air Force, 2005).

Applying the Rylander findings, the noise model was used to calculate the distance in ground track from zero (aircraft directly overhead) to where the maximum A-weighted noise level would decay to 70 dBA or below (threshold for annoyance). This considers not only those directly under a flight path but also those to the side of a passing aircraft, where noise levels may remain high enough to cause annoyance.

Table 4-22 is based on typical AGL altitudes for rotary aircraft, and lists the ground track distance, maximum sound level, and subsequent annoyance potential. Together these variables represent the best strategy for predicting areas that may be impacted based on annoyance potential from singular overflight. Current and future flight adjustments can be based on the distances in Table 4-22, to help avoid the overflight of noise-sensitive areas. As an example, Figure 4-15 illustrates the overflight annoyance potential for the UH-60 at 1,000 feet AGL.

Table 4-22. Rotary-Wing Overflight Annoyance Potential[a]

Source	AGL (feet)	Ground Track Distance[b] (feet)	dBA Maximum[c]	Population Highly Annoyed[d] (%)
AH-64 – 70 KIAS	500	0’	82	23
		1320' (1/4 mile)	73	10
		1760’ (1/3 mile)	69	4
		2640' (1/2 mile)	65	<1
	1000	0’	75	13
		1320' (1/4 mile)	71	7
		1760’ (1/3 mile)	69	4
		2640' (1/2 mile)	65	<1
CH-47 Light[e] – 130 KIAS	500	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
	1,000	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
UH-60 – 70 KIAS	500	0	77	16%
		1,320 (1/4 mile)	68	2%
		1,760 (1/3 mile)	64	<1%
	1,000	0	71	7%
		1,320 (1/4 mile)	67	1%
		1,760 (1/3 mile)	65	<1%
UH-72 – 123 KIAS	500	0	78	17%
		1,320 (1/4 mile)	69	4%
		1,760 (1/3 mile)	66	<1%
	1,000	0	72	8%
		1,320 (1/4 mile)	68	2%
		1,760 (1/3 mile)	66	<1%

Legend:
AGL = Above Ground Level, dBA = decibels A-weighted, KIAS = Knots Indicated Air Speed, kts = knots
Notes:
[a] Percent annoyance shown is based upon 50 to 200 overflights per day (Rylander et al., 1974)
[b] Distance between receiver and the point on Earth at which the aircraft is directly overhead.
[c] Obtained via AAM (U.S. Air Force, 2013).
[d] Calculated percentage based upon regression using the known values in Table 4-19.
[e] Heavy indicates a sling load. Light indicates no sling load
+35% - The Rylander studies did not include sampling in excess of 90 dBA.

Table 4-23 lists the AGL altitudes for the fixed-wing aircraft operating in/near UTARNG facilities or by the UTARNG, and lists the ground track distance, maximum sound level, and subsequent annoyance potential. When the C-130 and C-17 are at AGLs greater than 5,000 feet the Maximum level is ~66 dBA, which equates to less than 1% of the population rating themselves as highly annoyed.

Table 4-23. Fixed-Wing Overflight Annoyance Potential[a]

Source	AGL (feet)	Ground Track Distance[b] (feet)	dBA Maximum[c]	Population Highly Annoyed[d] (%)
C-12 – 90% RPM 160 kts	1,000	0’	73	10%
		1320' (1/4 mile)	68	2%
		1760’ (1/3 mile)	66	<1%
C-17 – 86% NC 120 kts	1,000	0	89	34
		1320 (1/4 mile)	82	23
		1760 (1/3 mile)	79	19
		2640 (1/2 mile)	74	11
		5280 (1 mile)	63	<1
	2,000	0	79	19
		1320 (1/4 mile)	77	16
		1760 (1/3 mile)	75	13
		2640 (1/2 mile)	72	8
		5280 (1 mile)	64	<1
	4,000	0	69	4
		1320 (1/4 mile)	69	4
		1760 (1/3 mile)	68	2
		2640 (1/2 mile)	67	1
		5280 (1 mile)	62	<1
C-130 – 970 C TIT 170 kts	1,000	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
	2,000	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
	4,000	0	69	4
		1,320 (1/4 mile)	69	4
		1,760 (1/3 mile)	68	2
		2,640 (1/2 mile)	67	1
		5,280 (1 mile)	62	<1

Legend:
AGL = Above Ground Level, dBA = decibels A-weighted, kts = knots
Notes:
[a] Percent annoyance shown is based upon 50 to 200 overflights per day (Rylander et al., 1974)
[b] Distance between receiver and the point on Earth at which the aircraft is directly overhead.
[c] Obtained via SelCalc Program (U.S. Air Force, 2005).
[d] Calculated percentage based upon regression using the known values in Table 4-19.

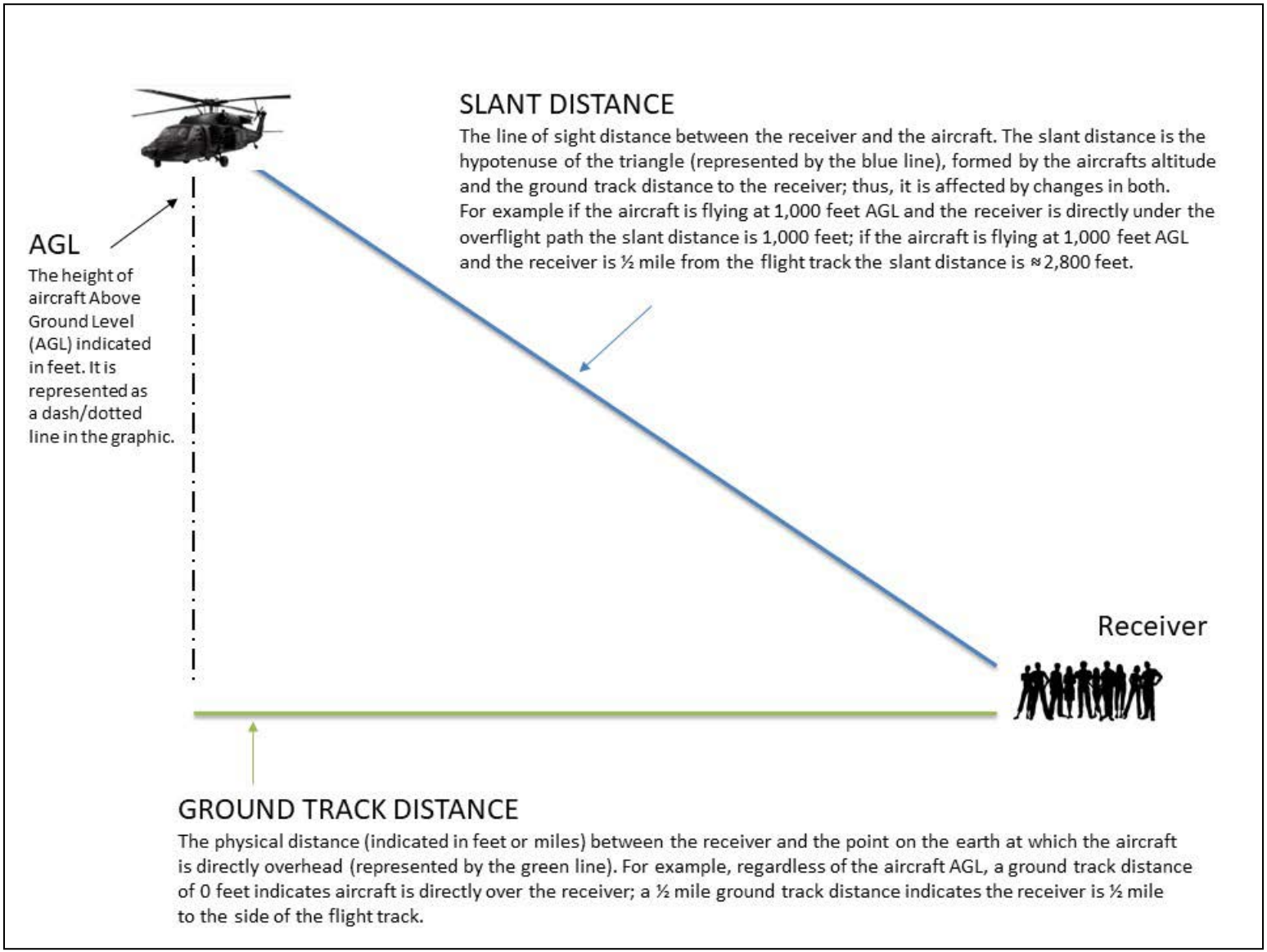

Figure 4-14. Aircraft Orientation Terms

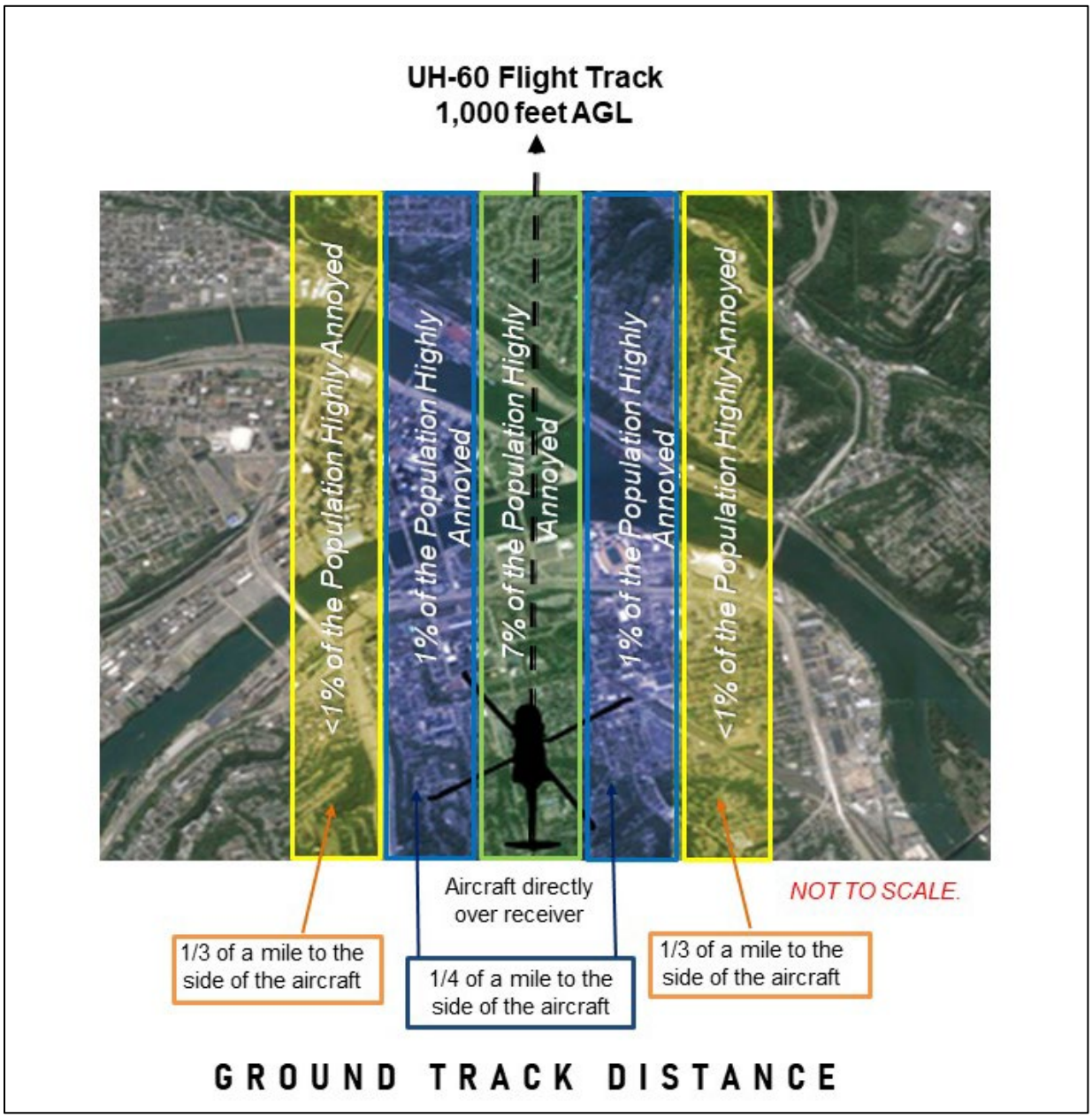

Figure 4-15. UH-60 Overflight Annoyance Potential

4.4.3 UNMANNED AERIAL SYSTEMS

Unmanned Aerial System (UAS) activity at Camp Williams is limited to the smaller systems (less than 20 lbs) such as the Puma (RQ-20) and Raven (RQ-11). These small systems are man-portable, and hand-launched. Additional activity includes micro-Drones/UAS such as the Short-Range Reconnaissance, Soldier Borne Sensor, and the Wasp (Figure 4-16). Launch, flight, and recovery of all these UAS models occur within Camp Williams with altitudes of less than 699 feet AGL. These UAS are battery powered (and largely silent unless flown close to the ground).

Puma UAS

Soldier Borne Sensor

Raven UAS

Short Range Reconnaissance Drone

Wasp Micro-UAS

Figure 4-16. Camp Williams Unmanned Aerial Systems

4.4.4 NOISE ABATEMENT PROCEDURES

There are no specifically designated aviation noise-sensitive areas near Camp Williams; however, the following procedure and policy is utilized where practical to reduce noise complaints:

- UTARNG aircraft maintain a minimum of 1,000 feet AGL above all residential development and 1,000 feet slant distance from building structures.
- Avoid overflight or close proximity flying to built-up areas.
- Avoid overflight or close proximity flying to large groups of personnel.
- Avoid overflight of chicken houses, horse farms, livestock, farmhouses, and homes at low altitudes.

Outside the approved low level training areas flight regulations require helicopters to maintain at least 500 feet AGL over unpopulated areas and at least 1,000 feet AGL over congested areas (National Guard Bureau, 2018).

5 UTAH ARMY NATIONAL GUARD AVIATION FACILITY

5.1 GENERAL

One of the primary functions of the Army Aviation Support Facility (AASF) is to maintain the flight proficiency of its assigned personnel through training. Most ARNG pilots are required to fly between 86 to 110 hours yearly. In addition to training activities, the AASF also provides aviation support as required by The Adjutant General and as required by the Governor to support State emergency management operations. This support includes hoist operations (i.e., airlifting equipment and troops) and fire bucket operations (using aircraft to pick up water in buckets to deal with wildland fires). Additionally, in wartime, the AASF units will be available to provide aviation support to airlift and combat operations, as required to accomplish the Federal military mission.

The UTARNG has aircraft stationed at two facilities the South Valley Regional Airport (West Jordan AASF) and an AASF satellite location (Hanger 10) at the Roland Wright Air National Guard Base (RWANGB). Additionally Unmanned Aerial Systems (UAS) are based at the Wendover Airport.

5.2 WEST JORDAN AASF

The UTARNG maintains and operates one AASF (West Jordan). The AASF is co-located at the south end of the South Valley Regional Airport in the City of West Jordan, a large suburb of Salt Lake City (Figure 5-1). The airport is publicly owned and operated by the Salt Lake City Department of Airports. South Valley serves as the primary general aviation reliever airport in the area, supporting business-related flying, law enforcement, fire and rescue services, recreational flying, flight training, and air charters.

The South Valley Regional Airport Master Plan (finalized in 2022) reports aircraft operations in 2020 totaled 70,990, an average of 195 per day. Military operations account for approximately 10% of flights (7,100), general aviation 89% of flights (63,276), and air taxi accounts for the remaining operations. [3]

[3] https://slcairport.com/assets/pdfDocuments/Master-Plan/U42-Aviation-Activity-Forecast.pdf

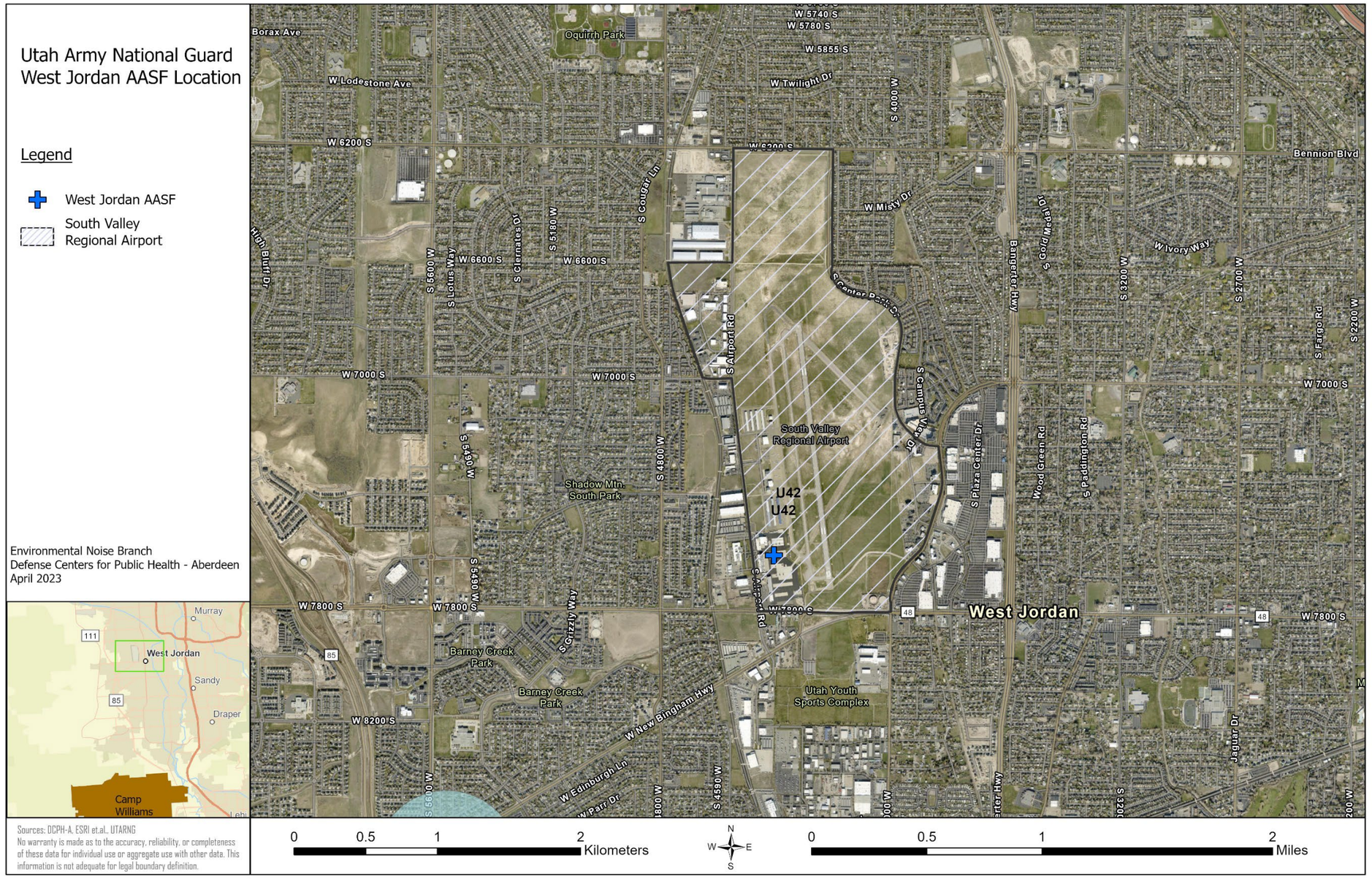

Figure 5-1. West Jordan AASF Vicinity

5.2.1 OPERATIONS

The 97th Aviation Troop Command Units at the AASF operate sixteen (16) AH-64D Apache and twelve (12) UH-60 Black Hawk helicopters. In general, aircraft operations occur daily; however, the number and frequency of these operations varies from day-to-day. AASF personnel report that daily rotary-wing operations average 16 flights per day, with heavy days (20 flights per day) one to two days per month. Aircraft typically fly between 7:00 am (0700) and 12:00 am (0000) during Daylight Savings, and between 7:00 am (0700) and 10:00 pm (2200) the rest of the year. However, there are no closed traffic pattern flights after 9:00 pm (2100) without explicit permission of the AASF / Unit Commander or designated rep; with permission closed traffic pattern can be extended, on a case-by-case basis, to 10:00 pm (2200).

Within the airport property the UTARNG helicopters use the East Sod area to conduct traffic pattern work. Use of this area reduces the burden to civilian aircraft in the traffic pattern. Helicopters operate at 5,300 feet MSL (approximately 700 feet AGL) within the East Traffic pattern. Additionally, the aircraft stationed at West Jordan fly to approved training sites or areas to conduct various types of aviation training.

Although the AASF activity accounts for a small percentage of the daily flights and would not generate Noise Zones, there is the potential that individual ARNG overflights could cause annoyance near the flight tracks. Section 4.4.2 highlights annoyance from overflight of rotary-wing activity.

5.2.2 NOISE ABATEMENT PROCEDURES

The South Valley Regional Airport is surrounded by high-density residential development. To reduce noise impacts on the community, the UTARNG follows noise abatement policies established by the Airport. These include minimum AGLs, established approach - departure routes, and traffic patterns[4].

5.2.3 AIRPORT OVERLAY ZONE

The City of West Jordan, Code of Ordinances, 13-6A-2 established an Airport Overlay Zone (Figure 5-2)[5]. Note that the overlay zone for the airport does not include a Noise Zone 65 dB DNL contour, as it does not extend off the airport property. Airport overlay zones are restrictive designations applied in addition to any other zone in this title. The airport overlay zones are defined and established as follows[5]:

- Clear Zone (Acl): A zone that commences at the end of and is equal to the width of the primary surface. Where the primary surface of the runway is two hundred fifty feet (250') wide, the clear zone shall expand outward uniformly to a width of four hundred fifty feet

[4] https://slcairport.com/assets/pdfDocuments/SVRA-Flight_Ops.pdf
[5] https://codelibrary.amlegal.com/codes/westjordanut/latest/westjordan_ut/0-0-0-12231

(450') at a horizontal distance of one thousand feet (1,000') from the primary surface, its centerline being the continuation of the centerline of the runway. Where the primary surface is five hundred feet (500') wide, the clear zone shall expand uniformly to a width of eight hundred feet (800') at a horizontal distance of one thousand feet (1,000') from the primary surface, its centerline being the continuation of the centerline of the runway.

- Approach Zone (Aa): A zone with inner edge coinciding with and being the same dimensions as the outer clear zone boundary. Where the outer edge of the clear zone is four hundred fifty feet (450'), the approach zone shall expand outward uniformly to a width of one thousand five hundred feet (1,500') from the primary surface, its centerline being a continuation of the centerline of the runway. Where the outer edge of the clear zone is eight hundred feet (800'), the approach zone shall expand outward uniformly to a width of two thousand feet (2,000') at a horizontal distance of five thousand feet (5,000') from the primary surface, its centerline being a continuation of the centerline of the runway.
- Noise Zone (An): A zone determined by the exterior boundary of the projected airport activity noise level of sixty-five (65) dB.
- Horizontal Zone (Ah): A zone, the perimeter of which is constructed by swinging arcs of a five-thousand-foot (5,000') radius from a point on the centerline and two hundred feet (200') beyond the end of each runway and connecting and adjacent arcs by lines tangent to those arcs.
- Conical Zone (Ac): A zone that commences at the periphery of the horizontal zone and extends outward therefrom a horizontal distance of four thousand feet (4,000').

Table 5-1. Permitted and Conditional Uses in Airport Overlay Zones

Use	Acl	Aa	An	Ah	Ac
Agriculture uses, except as specifically regulated elsewhere in this section		C	C	C	P
Animal specialties devoted to raising chickens, turkeys or other fowl				C	P
Athletic fields and playgrounds				C	P
Building moved from another site (see section 13-8-12 of this title)			C	C	C
Commercial and industrial uses resulting in large concentrations of people, including, but not limited to, shopping centers, restaurants and factories			C	P	P
Commercial uses, except as specifically regulated elsewhere in this section		C	C	P	P
Communication, transmission or reception towers, church steeples, flagpoles and other like extensions which exceed the height of buildings allowed in unrestricted zones			C	C	P
Electrical power generating plants			P	P	P
Electrical power transmission lines aboveground		C	P	P	P
Fairgrounds and racetracks				C	P
Gas and oil aboveground storage and pipelines		C	P	P	P
Hotel and motel			C	C	C
Industrial uses, except as specifically regulated elsewhere in this section		C	P	P	P
Large scale public utilities			C	C	C
Low power radio service facility		C	C	C	C
Outdoor theaters				C	P
Public and civic uses, public utilities, except as specifically regulated elsewhere in this section		C	C	C	P
Public and civic uses resulting in large concentrations of people, including, but not limited to, stadiums, hospitals and open air assemblies			C	C	P
Recreational and natural uses as allowed in unrestricted zones, except as specifically regulated elsewhere in this section		AC	AC	AC	P
Residential development	C	P			

Legend:
AA = Approach Zone, AC = Conical Zone, ACL = Clear Zone, AH = Horizontal Zone, C = Conditional Use
P = Permitted Use

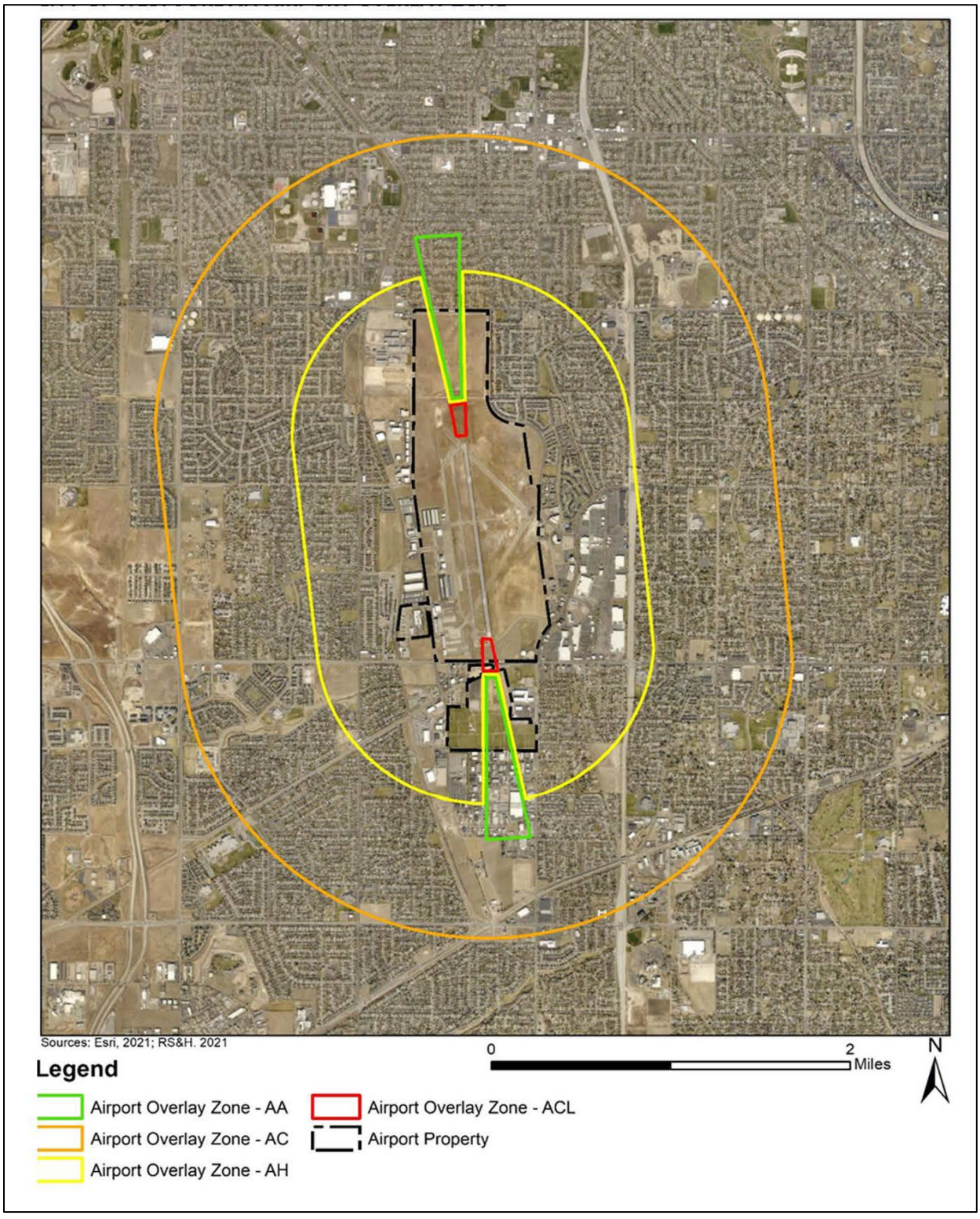

Figure 5-2. South Valley Regional Airport Overlay Zone
Source: 2022 South Valley Regional Airport Master Plan
Notes: AA = Approach Zone, AC = Conical Zone, ACL = Clear Zone, AH = Horizontal Zone

5.3 ROLAND WRIGHT AIR NATIONAL GUARD BASE

The West Jordan AASF has a satellite location at RWANGB (Hanger 10). RWANGB is located on the east side of the Salt Lake City International Airport (Figure 5-3). For calendar year 2021, the Salt Lake City International Airport aircraft operations totaled 276,615, an average of 758 per day. As shown in Table 5-2 military operations account for 1% of flights (2,883) for an annual average of 8 per day. The military operations annual count is a combination of Units, driven by Utah Air National Guard fixed-wing flights.

Table 5-2. Salt Lake City International Airport Annual Operations

Owner	Operations	Total Operations (%)
Air Carrier	174,782	63
Air Taxi	47,817	17
General Aviation	51,133	19
Military	2,883	1
TOTAL OPERATIONS:	276,615	100.0
Operations for 12 Months Ending:	12/31/2021	

Source:
https://www.airportiq5010.com/5010Web/

The 97th Aviation Troop Command Units operate two (2) UH-72 Lakota helicopters and one (1) C-12 Huron fixed-wing aircraft at Hanger 10. The UTARNG aircraft stationed at Hanger 10 fly to approved training sites or areas to conduct various types of aviation training. In general, aircraft operations occur daily; however, the number and frequency of these operations varies from day-to-day. AASF personnel report that weekly rotary-wing operations average eight flights and two to three C-12 flights. Aircraft typically fly between 7:00 am (0700) and 12:00 am (0000) during Daylight Savings, and between 7:00 am (0700) and 10:00 pm (2200) the rest of the year. However, there are no closed traffic pattern flights after 9:00 pm (2100) without explicit permission of the Unit Commander or designated rep; with permission closed traffic pattern can be extended, on a case-by-case basis to 10:00 pm (2200).

To reduce noise impacts on the community, the UTARNG follows noise abatement policies established by the Airport. These include minimum AGLs, established approach - departure routes, and traffic patterns. Helicopter traffic departing from the East ramp/ Guard ramp departs and lands directly to the ramp. Generally, Air Traffic Control (ATC) assigns 1’000 AGL for departing flights. When landing at the ramp from the East, ATC occasionally will request a lower AGL.

Although the UTARNG activity accounts for a very small percentage of the daily flights, there is the potential that individual ARNG overflights could cause annoyance (Section 4.4.2).

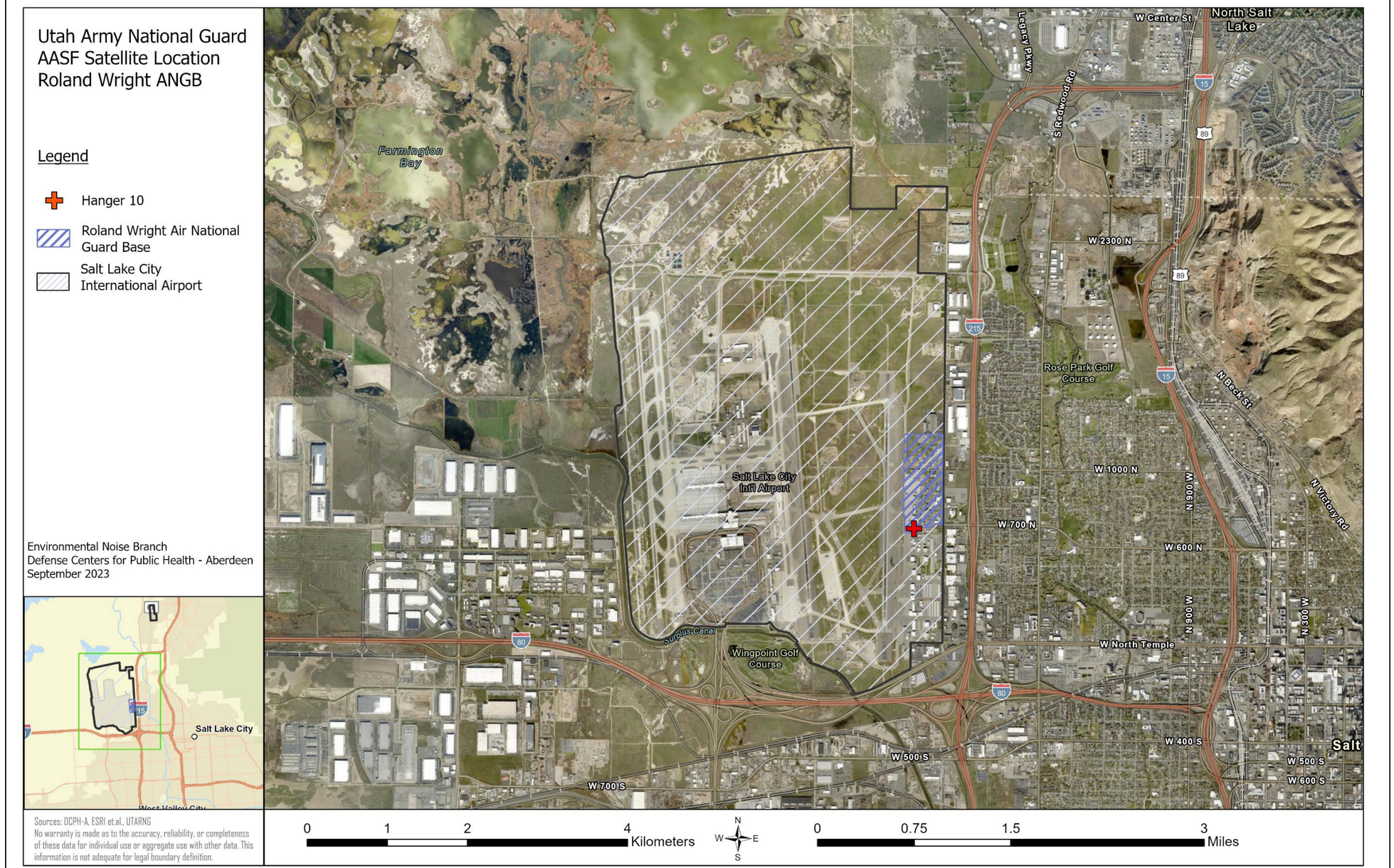

Figure 5-3. West Jordan AASF Satellite Location (Roland Wright ANGB)

5.4 WENDOVER AIRPORT

The UTARNG operates a UAS facility at the Wendover Airport (Figure 5-4). Wendover Airport is a county-owned, public-use airport located one mile south of the central business district of Wendover, a city on the border of Utah and Nevada. The Bonneville Salt Flats abuts the airport to the east. For the 12-month period ending 31 March 2023, the airport had 4,586 aircraft operations, an average of 13 per day[6]. Transient and local general aviation operations account for most of the airfield activity (3,780 flights). Military operations account for remainder (806 flights). However, UAS activity is not included in the airport operations total. The military flight count is for transient aircraft; primarily the Air Force (KC-135s) and occasional rotary-wing operations from the UTARNG and other services.

The UTARNG has four (4) RQ-7B (Shadow UAS) operating at Wendover Airport. The UAS operators report Shadow flights occur 3 or 4 days per week and up to 9 times a year. Launch and recovery of the UAS occurs in the central area of the apron, approximately 200 meters (650 feet) from the northern airport boundary. UAS launches/recovery generally occur between 8:00 am (0800) and 8:00 pm (2000). With operational flights occurring in a designated area over the Utah Test and Training Range.

Based on measurements conducted by the Army Public Health Center in 2017, the Shadow would have to maintain at least a 1,000 feet AGL from a noise-sensitive receptor to maintain levels below 70 dBA (Table 5-3). As shown in Figure 5-5, there are noise-sensitive land uses within 500 meters (1,640 feet) of the launch site. Extrapolating the measurement data indicates this area maybe exposed to levels in the mid 70's during an UAS launch. At 75 dBA Maximum level 13% of the population would consider themselves annoyed (Table 4-19). Although the predicted noise levels indicate a potential for annoyance, the UTARNG has not received a noise complaint from the UAS launches. Outside of the immediate launch area, UAS flights have a low probability of annoyance or complaints due to flight altitude's low noise signature in conjunction with the isolated location.

Table 5-3. UAS Shadow Maximum Sound Levels

Shadow AGL feet	Lmax (fast) dBA		
	Directly under flight path	200 meters (650 feet) to side	400 meters (1,300 feet) to side
5000	50	51	50
2000	64	63	66
1000	70	68	66
500	74	73	68
200	85	82	75
100	89	81	77

Legend:
AGL = Above Ground Level, dBA = decibels A-weighted
Notes:
Shadow airspeed was 65 knots for all measurements.
Distance conversion from meters maybe rounded for ease of conveyance.

[6] https://www.airportiq5010.com/5010Web/

Figure 5-4. UTARNG UAS Facility at Wendover Airport

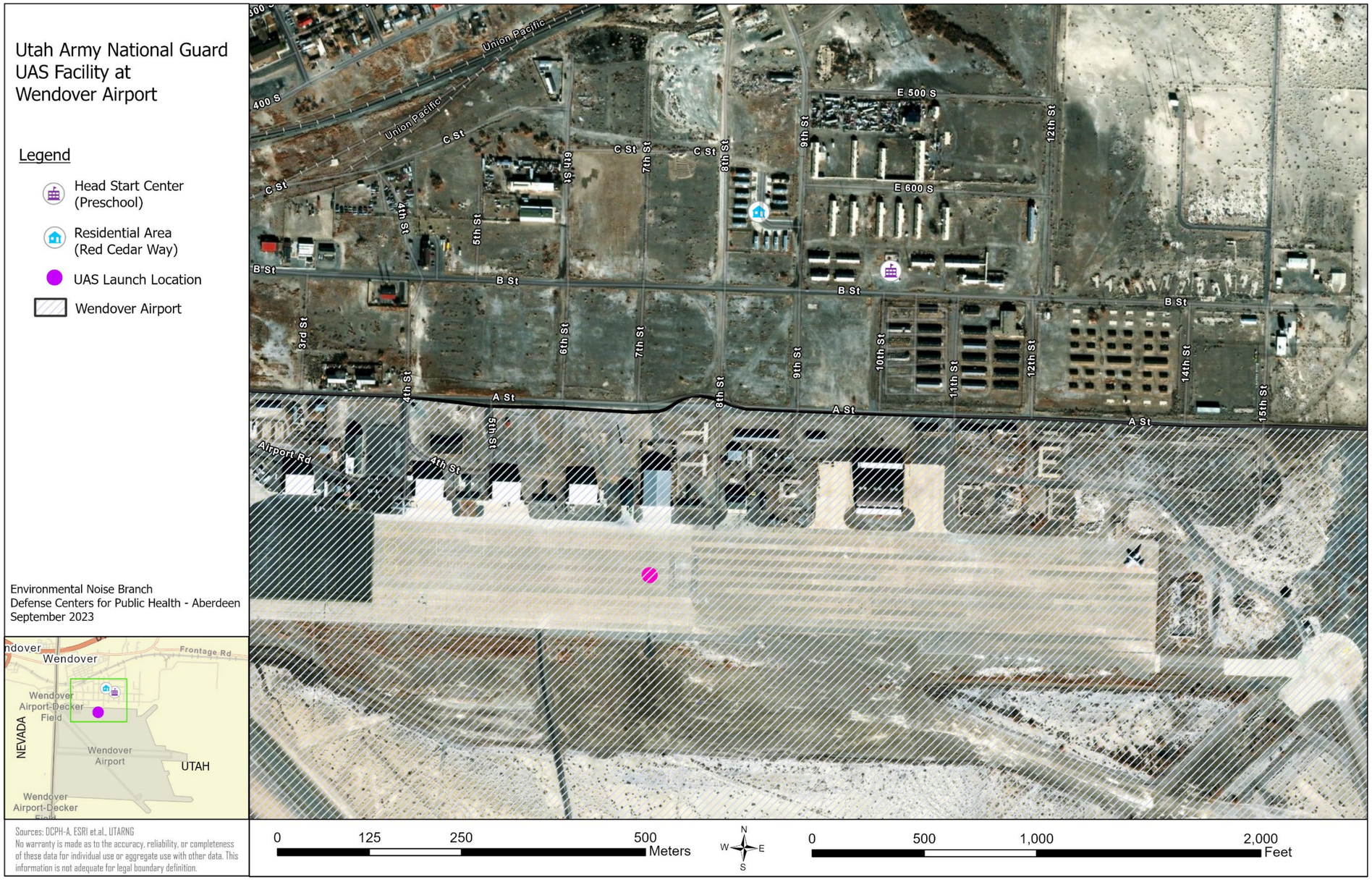

Figure 5-5. Wendover UAS Facility Northern Boundary