

Sound study report for the proposed Northern Arizona Regional Shooting Facility site

The Arizona Game and Fish Department conducted a sound study on July 22, 2006 to determine if sound from firearms discharged at a proposed shooting range site near Willard Springs could be detected at various distances from the site, and if so, at what levels. This study was conducted to address concerns expressed by some members of the public in the early scoping period about potential noise in the Munds Park and Oak Creek Canyon areas.

The Department has received and posted the report from the sound consultant, Acoustical Consulting Services (ACS).

Overview of results

The report shows that no audible or measurable firearm noise was detected at most of the six monitoring stations, including the monitors at Munds Park and at Don Hoel's Cabins in Oak Creek Canyon.

The two monitoring stations that did have measurable readings were both within a mile of the firing point—well away from any residential areas—and those readings were in compliance with the state's legal limit of 64 decibels (dBA) for outdoor shooting ranges.

Overview of the testing procedure

The testing involved the discharge of five different firearms of various calibers from two firing points in the proposed range area. Sound monitoring equipment was set up at six sites at different intervals from the firing points. These sites (corresponding to how they are numbered in the report) are listed below and were located at the following distances from the firing point:

Sound measuring location	Distance from firing point
#1 – Former rest stop along I-17 north of Munds Park	2 miles
#2 – West of Willard Springs exit off I-17	.7 mile
#3 – Crazy Park	1 mile
#4 – Don Hoel's Cabins, Oak Creek Canyon	2.5 miles
#5 – Newman Park	2 miles
#6 – Munds Park (near northernmost residences, east of I-17)	3 miles

The sound monitors at each site took readings of ambient (normal background) noise, and then measured for any sound difference upon firearm discharge. Sound measurements are based on sound pressure levels expressed in decibels (dBA). A higher decibel level of sound generally correlates with people's judgment of the annoyance of the sound.

Additional factors

There are several factors to consider when using and interpreting the data from this study.

First, the study was conducted in open forested areas without any noise mitigation efforts. The Arizona Game and Fish Department may incorporate berms and other noise suppression and safety features as are necessary in the actual range design, which would further reduce any sound emanating from the range.

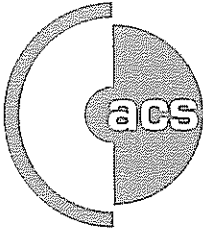
Second, professional sound analysts explain in the report that multiple discharges of firearms (e.g., simulated shooting range conditions) will not result in a cumulative increase in sound. See page 5 of the report.

Third, sound decibel readings need to be considered in comparison to everyday sounds. For example, the typical ambient sound measurements at the Munds Park monitor were between 50 and 54 dBA. Other noise sources measured during that time included a passing truck (63 dBA) and an overhead aircraft (64 dBA).

Below are some other comparative sound measurements of various common activities:

Activity	Decibel reading		Activity	Decibel reading
Normal breathing	10 dBA		Freeway traffic at 165 feet	70 dBA
Rustling leaves	20 dBA		Garbage disposal at 3 feet	80 dBA
Whisper	20-30 dBA		Diesel truck at 50 feet	90 dBA
Stream; refrigerator humming	40 dBA		Gas lawnmower at 3 feet	100 dBA
Dishwasher (next room)	50 dBA		Jet flyover at 1,000 feet	110 dbA
Normal conversation at 3 feet	60-65 dBA		Accelerating motorcycle at 3.3 feet	110 dBA

We hope the study helps provide an explanation and alleviate concerns about potential noise issues related to the proposed range. The Arizona Game and Fish Department will continue to post updates to the Web site as they become available.



Arizona Game and Fish
Mr. G.M. Merrill
2221 W Greenway Road
Phoenix, AZ 85023

August 28, 2006

Dear Mr. Merrill

Re: **NOISE STUDY FOR WILLARD SPRINGS SHOOTING RANG**

ACS has been retained to assess the potential noise impact from the proposed Willard Springs Shooting Range to the surrounding communities.

1.0 TECHNICAL TERMS:

Decibel (dB) - A unit for measuring the intensity of sound. The human hearing range is from 0 dB (the theoretical threshold of audibility) to 130 dB (the average pain threshold). {The sound pressure level in decibels is equal to 10 times the logarithm (to the base 10) of the ratio between the pressure squared divided by the reference pressure squared. The reference pressure used in acoustics is 20 microPascals.}

Changes in Intensity Level, dB	Changes in Apparent Loudness
1	Almost imperceptible
3	Just perceptible
5	Clearly noticeable
10	Twice (or half) as loud

dBA - Sound pressure level expressed in decibels, filtered or weighted at the various frequencies to approximate the response of the human ear.

Leq(h) - The equivalent energy level that is the steady state level that contains the same amount of sound energy as a time varying sound level for a sixty minute time period.

Ldn - Day Night average sound level (DNL) is the 24 hour average sound level, in decibels, obtained after the addition of 10 decibels to the sound levels occurring between 10 pm and 7 am.

2.0 NOISE STANDARDS:

Typical municipal ordinances set not-to-exceed limits and consider instantaneous noise levels below 50 to 55 dBA at night and 60 to 65 dBA during the day to be acceptable. Some suburban and rural municipalities have set nighttime limits as low as 45 dBA. Many local ordinances do not quote decibel levels and only make general statements prohibiting noise in terms of nuisances, disturbances, or unnecessary noise. The definition of these terms is usually left to the governing authorities. Enforcement procedures are usually provided for sources that do not comply with the ordinance limitations. (Noise and Noise Control Vol I. Crocker, Malcom & Kessler, Frederick. CRC Press, 1982, pp. 237-240.)

Aside from ARS 17-602, The Willard Springs Shooting Range is not subject to any National, State or Local Noise Code or Ordinance. In addition to ARS 17-602, information on other Standards/Guidelines are presented for comparison purposes only:

2.1 ARIZONA REVISED STATUTES TILE 17-602

A. The legislature finds that outdoor shooting range noise standards are a matter of statewide concern. City, town, county and any other state noise standards are preempted as applied to outdoor shooting ranges.

B. Each outdoor shooting range in this state shall measure the noise emitted from the range pursuant to subsection E at least once. In addition, the range shall measure the noise it emits if the range expands the area designed and operated for the use of firearms or explosives by more than twenty per cent in size than at the time of its initial noise measurement or if the range introduces the use of a type of firearm or explosive device that will increase noise production. The range shall pay for the measurement and shall keep the results of the measurement at the range at all times. Any person may review the noise measurement during the range's business hours. Ranges that are located at least one mile from areas that are zoned for residences, schools, hotels, motels, hospitals or churches are exempt from this subsection.

C. Any person, at the person's expense, may measure the noise emitted from an outdoor shooting range pursuant to subsection E.

D. The noise emitted from an outdoor shooting range shall not exceed an Leq(h) of sixty-four (64) dBA.

E. In measuring the noise emitted from an outdoor shooting range:

1. If a range performs the measurement of noise pursuant to subsection B, sound pressure measurements shall be taken twenty feet from the nearest occupied residence, school, hotel, motel, hospital or church, or from the nearest proposed location of a residence, school, hotel, motel, hospital or church if the property is zoned for such a structure but is currently unimproved. If a person performs the measurement of noise pursuant to subsection C, sound pressure measurements shall be taken twenty feet from the person's residence, school, hotel, motel, hospital or church, or twenty feet from the proposed location of the person's residence, school, hotel, motel, hospital or church if the property is zoned for such a structure but is currently unimproved.

2. Sound pressure measurements shall be made in a location directly between the range and the nearest existing or proposed residence, school, hotel, motel, hospital or church. If there are natural or artificial obstructions that prevent an accurate noise measurement, the measurement may be taken within an additional twenty feet radius from the initial measurement location.

3. Sound pressure measurements shall be made on the A-weighted fast response mode scale. Measurements shall be taken during the noisiest hour of peak use during the operation of the range. Measurements shall be taken according to American National Standards institute's standard methods ANSI S1.2-1962 (R1976) American national standard method for physical measurement of sound and ANSI S1.2-1971 (R1976) American National Standard method for measuring sound pressure levels. Measurements shall be taken using a type 1 sound meter meeting the requirements of ANSI S1.4L-1971. Any part of the measurements conducted on a range shall comply with the range safety rules.

2.2 U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD):

While HUD has no specific responsibility to try to reduce the noise problem at the source, it does have the responsibility to be aware of the noise problem and its impact on the housing environment. The most basic mandate which drives the department's involvement with the noise issue is the Housing Act of 1949 which sets forth the national goal of "a decent home and suitable living environment for every American family."

The noise environment at a site is determined by combining the contributions of different noise sources. Whenever possible, the analysis should assess noise environments expected at least ten years in the future. The HUD Guidelines are followed to estimate the contribution of aircraft, automobile, truck, and train noise to the total day-night average sound level (DNL) at each site. The DNL contributions from each source are expressed in decibels. The combined DNL from all sources is the value used to determine the acceptability of the noise environment.

HUD's regulations do not contain standards for interior noise levels. Rather a goal of 45 decibels is set forth and the attenuation requirements are geared towards achieving that goal. It is assumed that with standard construction any building will provide sufficient attenuation so that if the exterior level is 65 Ldn*or less, the interior level will be 45 Ldn or less.

HUD Regulations set forth the following exterior noise standards:

65 DNL (Day/Night average) or less - Acceptable

Exceeding 65 DNL but not exceeding 75 DNL - Normally Unacceptable
(To achieve an acceptable status, appropriate sound attenuation measures must be provided)

Exceeding 75 DNL - Unacceptable

*Ldn - Day Night average sound level (DNL) is the 24 hour average sound level, in decibels, obtained after the addition of 10 decibels to the sound levels occurring between 10 p.m. and 7 a.m..

2.3 EPA STANDARDS AND REGULATIONS:

The major contribution of the July 1973 Public Health and Welfare Criteria for Noise document is the identification of the Equivalent Sound Level, Leq, and Day/Night Sound Level, Ldn, as the environmental sound level descriptors best relating to the effect of noise on man. The March 1974 report known as the "Levels" document identified a Day/Night Sound Level of 55 dB as being the level required to protect public health and welfare. (Indoor 45 dB)

NOTE #1: This desirable condition could currently [1978] be met at only about 10% of U.S. urban sites; also, about 75% of the U.S. urban population, and about 50% of the entire U.S. population are already exposed to higher levels than this.

NOTE #2: It is very important that these noise levels not be misconstrued. Since the protective levels were derived without concern for technical or economic feasibility, and contain a margin of safety to insure their protective value, they must not be viewed as standards, criteria, regulations, or goals. Rather, they should be viewed as levels below which there is no reason to suspect that the general population will be at risk from any of the identified effects.

3.0 METHODOLOGY:

Sound level measurements shall be performed at six (6) receive locations during the firing of five (5) rounds* from five (5) different firearms from two (2) proposed firing locations. The measurements shall be performed with Type I (accuracy) Sound Level Meters with the following meter settings: "A" weighting, "fast" response.

For each firearm, 5 shots* will be fired within a two (2) minute period. There will be one (1) minute of silence before and after each firing period.

Measurement of ambient (without shooting) noise levels shall be conducted at all monitoring stations at the same day of the week, the same time of day, and the same weather conditions as the actual noise testing.

* NOTE: Guns fired sequentially simply increase the duration of the noise and not its loudness. It is unlikely that firearms will be fired simultaneously under actual range conditions. Thus the use of only single shots of the "loudest" firearm is required. (The National Rifle Association, NRA Range Development Division, *Protocol for Conducting Sound Level Measurements*, 1991)

4.0 MEASUREMENT RESULTS:

The measurements were performed on 7/22/06 with Larson Davis Type I Sound Level Meters (Model 814 and 820) with the following meter settings: "A" weighting, "fast" response. During the testing period, the weather conditions were approximately: 82°, 28% humidity, with no or light wind. The results were as follows:

Sound Measuring Location #1

Minimum Ambient: 45 dBA
 Typical Ambient Noise Level: 51 - 53 dBA
 Maximum Ambient Noise Level: 58 dBA
 Other Noise Sources: 68 dBA (Truck)

Firearm	Firing Position 1	Firing Position 2
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	Not Audible	Not Audible
7mm Remington magnum caliber rifle	Not Audible	Not Audible
12-gauge shotgun	Not Audible	Not Audible
.44 magnum caliber revolver	Not Audible	Not Audible
.50 caliber Browning rifle	Not Audible	Not Audible

Sound Measuring Location #2

Minimum Ambient: 40 dBA
 Typical Ambient Noise Level: 45 - 47 dBA
 Maximum Ambient Noise Level: 52 dBA

Firearm	Firing Position 1	Firing Position 2
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	57 dBA	Not Audible
7mm Remington magnum caliber rifle	48 dBA	Not Audible
12-gauge shotgun	Not Audible	Not Audible
.44 magnum caliber revolver	Barely Audible	Not Audible
.50 caliber Browning rifle	61 dBA	47 dBA (2 of 5 shots audible)

Sound Measuring Location #3

Minimum Ambient: 31 dBA
 Typical Ambient Noise Level: 34 - 37 dBA
 Maximum Ambient Noise Level: 44 dBA
 Other Noise Sources: 60-70 dBA (ATVs)

Firearm	Firing Position 1	Firing Position 2
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	50 dBA	Not Audible
7mm Remington magnum caliber rifle	47 dBA	Not Audible
12-gauge shotgun	40 dBA	Not Audible
.44 magnum caliber revolver	46 dBA	Not Audible
.50 caliber Browning rifle	54 dBA	Barely Audible

Sound Measuring Location #4

Minimum Ambient: 45 dBA
 Typical Ambient Noise Level: 48 - 53 dBA
 Maximum Ambient Noise Level: 60 dBA
 Other Noise Sources: 64-73 dBA (Motorcycle)

Firearm	Firing Position 1	Firing Position 2
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	Not Audible	Not Audible
7mm Remington magnum caliber rifle	Not Audible	Not Audible
12-gauge shotgun	Not Audible	Not Audible
.44 magnum caliber revolver	Not Audible	Not Audible
.50 caliber Browning rifle	Not Audible	Not Audible

Sound Measuring Location #5

Minimum Ambient: 46 dBA

Typical Ambient Noise Level: 48 - 54 dBA

Maximum Ambient Noise Level: 62 dBA

Other Noise Sources: 68 dBA (Truck); 78 dBA (Motorcycle)

Firearm	Firing Position 1	Firing Position 2
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	Not Audible	Not Audible
7mm Remington magnum caliber rifle	Not Audible	Barely Audible (3 of 5 shots)
12-gauge shotgun	Not Audible	Not Audible
.44 magnum caliber revolver	Not Audible	Not Audible
.50 caliber Browning rifle	Not Audible	Not Audible

Sound Measuring Location #6

Minimum Ambient: 44 dBA

Typical Ambient Noise Level: 50 - 54 dBA

Maximum Ambient Noise Level: 60 dBA

Other Noise Sources: 63 dBA (Truck); 64 dBA (Aircraft)

Firearm	Firing Position 1	Firing Position 2
	Noise Level Maximum dB(A)	Noise Level Maximum dB(A)
.30-06 caliber rifle	Not Audible	Not Audible
7mm Remington magnum caliber rifle	Not Audible	Not Audible
12-gauge shotgun	Not Audible	Not Audible
.44 magnum caliber revolver	Not Audible	Not Audible
.50 caliber Browning rifle	Not Audible	Not Audible

5.0 CONCLUSIONS:

- At virtually all of the receive locations there was no audible or measurable shooting noise.
- Receive Location 2 was immediately adjacent to the Firing Position 1. At this location, of the shots that were audible, the maximum impact was 61 dBA.
- At receive location 3 (approximately 1 mile west of Firing Position 1), of the shots that were audible, the maximum impact measured was 54.6 dBA.
- At Receive Location 5 three shots were barely audible, but not measurable.
- At the other three receive locations no shots were audible.
- All measurements at each location were well within compliance with ARS 17-602.

If you have any questions or concerns, please call me at (480) 827-1007.

Respectfully,

Tony Sola
Acoustical Consulting Services