

BC Wildlife Federation: Noise Management for Outdoor Shooting Ranges

Implementation Manual

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1.0– Introduction

The issue of public encroachment on outdoor shooting ranges is a very present issue in the lives of those associated with gun clubs today. Increasing amounts of people are moving from cities to the countryside where the majority of outdoor shooting ranges are in operation. Despite the fact that the majority of these ranges have been in operation for many years before any of public took up residence in the area, it is still within an individual's legal boundaries to register noise complaints against the sounds coming from shooting ranges. There have been an increasing amount of cases resulting in the involved gun clubs ceasing operations.

Although this report focuses on noise mitigation techniques at outdoor shooting ranges, proper noise management at both outdoor and indoor ranges is an incredibly important thing for both the safety of those engaging in shooting activities, as well as those being affected by the noise output created from shooting sports.

Currently there are no standards established in Canada for shooting ranges to refer to when considering noise management. What this report hopes to accomplish is to provide a documented and structured approach to noise management standards and the different approaches to sound mitigation of which any Canadian outdoor shooting range can assess and apply should they deem it appropriate for their purposes.

2.0- OUTDOOR RANGES

2.1 - Sound Transmission

No set distance eliminates noise complaints entirely. However, studies conducted for the Environmental Protection Agency (EPA) indicate noise complaints are likely when inhabited dwellings exist less than one half (2) mile from the facility. Beyond that distance, the chance of generating noise complaints is reduced. There may be federal, provincial or local statutes, ordinances and/or regulations prohibiting, activities that generate noises above a certain decibel level. Besides these prohibitions, such activities may, pursuant to Provincial or local law, give a party a cause of action to sue you in civil court for noise pollution, noise nuisance, etc.

You are strongly advised to engage a local attorney licensed to practice law in your Province to advise you in regard to these matters. Organizations may be able to designate their site as a sound park giving you the same privileges as a race track. NRA recommends you talk with your neighbors and see if you can create a sound park

by using their property as a buffer. This can be recorded in your neighbor's deed with their permission.

2.2 - Range Orientation (Direction)

After all safety and other site requirements are satisfied, consider the compass orientation of the range. Within the constraints of safety and along with other site considerations, such as, terrain, the ideal orientation is with firing conducted from south to north. This provides the earliest and latest natural target illumination and the least interference from natural light in the shooters' eyes. However, safety takes priority over convenience and the range may be oriented in any direction that provides the greatest level of safety to neighbors.

2.3 - Range Layout and Considerations

There are certain basic and optional considerations used to lay out ranges. Among these are: terrain features, site dimensions, type of range, soil structure, surrounding inhabitants, access and utilities.

Material: Positions should be hard surfaced. Surface material may be concrete; however, gravel, wood or sod are acceptable alternatives. For ranges where prone shooting is conducted, gravel or similar materials may cause problems for the shooter. Asphalt is another alternative, and may be used in conjunction with a firing line cover. For ranges with multiple firing lines, hard surfaced areas (walkways) located forward of another firing line should be recessed or shielded from bullet impact to avoid ricochets off exposed edges. Bullets striking the smooth surface of a walkway will tend to follow the walkway contour rather than ricochet in an unpredictable manner.

Configuration: Target shooters generally prefer level firing lines, but for drainage the firing line should slope gently from front-to-rear providing a nearly level area for the shooter to stand on while shooting. Where extreme terrain features do not allow for a level firing line from side-to-side, firing line positions may be constructed at different elevations. Make allowances for radical elevation changes due to soil erosion and safety railings.

2.3.1 - Firing Line Cover



(NC Conceal Carry Class - Wendell, Classroom & Portion, 2016)

Material: Firing line covers should be constructed using low maintenance materials, such as concrete floors, sheet metal covered walls, treated lumber, corrugated plastics, etc. Corrugated plastic or metal roofs without insulation are unsuitable because of noise reflection. These materials can be covered with spray-on acoustical material or by applying other acoustic material.

Configuration: The gable, flat, or shed roofs are best suited for firing line covers. The designs are simple and construction is relatively easy.

Size: Roof pitch depends on local weather conditions. Where heavy snows are common, front to rear width must be designed to withstand snow and wind load factors. For this reason, many builders favor the gabled roof design, which adds strength via trusses. Other advantages of the gabled roof will be discussed under design considerations. The firing line cover in most competitive shooting events can be used only to protect the shooter from rain, snow or heat. Except for NRA Smallbore or International events, the sides and back are usually open to allow for unrestricted wind

movement. For informal shooting, the firing line cover may be partially or totally enclosed.

Firing line covers should include the use of guttering to redirect water off the front and back edges to aid the shooter's vision and comfort. This reduces splattering of water on equipment and the shooter.

2.3.2 - Side Berms/Walls



("Shooting Ranges | Shoot Houses | Range Systems", 2016)

Material: Core material may be broken concrete, asphalt, rock-laden fill or other fill materials discarded by area contractors. Exercise caution as local soil conservation districts may restrict such use. Surface areas subjected to occasional bullet strikes should be rock and debris-free to a depth of at least 12 inches.

As an alternative to earthen sideberms, masonry walls may be used. When using masonry walls, they should be grout filled unless using solid block and designed for the prevalent wind load. Precast concrete wall panels offer long-term use and ease of installation. They are generally less expensive than earthworks, and take up a much smaller footprint.

Geocell materials may be used to build walls in areas where the soil is not stable such as sand.

- a. **Configuration:** Side berms need not be as high as the backstop, but they should have the same slope. For efficiency and cost savings, construct all berms as a single project. Install concrete walls vertically.

b. Size: Earthen side berms suggested height is 8 feet. Caution: Where soil conditions present a problem with compaction, additional material should be added to compensate for settlement. Wooden or concrete walls are recommended to be 8 feet high, and designed to stop all projectiles from penetrating the barrier.

2.3.3 - Baffles and Other Safety Barriers



("No Blue Sky?" 2015)

2.3.3.1 - Overhead Baffles

Overhead baffles are used to contain the flight of bullets to a specified area within the range. These overhead baffles are useful in areas where space is limited. Baffles are also described in sections on particular shooting activities. Other designs may be acceptable.

Material: Construct baffles from a variety of materials, but make long-term low maintenance a design consideration. Reinforced concrete, steel, wood, and high impact bullet-resistant plastics are some of the materials available.

Configurations: Concrete panels should be pre-stressed, and a minimum of 6 inches thick. To interrupt or redirect the flight of errant projectiles, set concrete panels in place either vertically or at a 25 degree. Width of these concrete slabs depends upon the

local concrete contractor's capabilities. NRA recommends the slabs be pre-stressed and have a 5,500 psi rating, especially when using rifle calibers.

Wood and metal used in a "sandwich" configuration, with wood facing the shooter, allows bullet penetration to the metal, yet prevents backsplatter. The off-side of the baffle panel is covered with a thin layer of wood to reduce sound generated by bullet strikes. Where sound is an issue, acoustical materials may be added to the face of the baffle.

High impact clear plastics may be used as baffle material for some calibers in areas where light is needed to improve visibility. Baffles using this type of construction are very expensive, may only take two or three projectile impacts, and may be sensitive to UV radiation from the sun causing them to deteriorate over time. Such plastic prevents the escape of bullets and provides for natural illumination of the firing line area.

Plywood can also be used for baffles. To do so, construct long boxes out of plywood and 2 x 6 inch lumber to be filled with a medium capable of stopping any bullet fired on the range, such as 3/4 inch crushed rock. Prior to baffle construction, select and test materials to be used in baffle construction to determine effectiveness for bullet containment. In some cases, the baffle must be designed with 2 x 8 inch or 2 x 10 inch lumber. Test every design to determine if it will stop the projectiles used at the range. If it fails, increase the baffle's depth until you can effectively stop and contain the projectile. This will also require engineering the support structure to handle the additional load.

Baffles designed using dimension lumber and built (See drawing A-14) are acceptable for pistol ranges. Recommend testing the baffle to ensure that projectiles will be contained.

- You may add conveyor belting to the face of the baffle. This will reduce the velocity of the projectile, help protect the baffle, and will not be a reactive target for the shooter. As a projectile impacts the baffle, the remaining velocity and aerodynamic properties of the projectile change significantly.
- Projectiles may travel the legal length of the property as long as they remain on property owned or controlled by the range.

Size: Overhead baffles must extend the entire width of the firing line and connect to either a side wall or side berm. Recommend concrete slabs be a minimum of 4 feet wide, 6 to 8 inches thick and 16 to 40 feet in length, and have a 5,500 psi rating.

Lengths up to 40 feet of pre-stressed concrete will increase the effectiveness of the range design and give a larger open area without obstruction from support structures. Build wood/steel laminated panels 16 feet long and 4 feet wide. Thickness depends on laminations required for a specific range. Do not forget to design baffles taking snow and/or wind loads into consideration.

- There are times when the earthen side berms need to be accessible, or a road runs down range parallel to the side berm, for maintenance. In this case, the overhead baffle assemblies may not extend all the way to the side berm. The proper procedure is to construct a side baffle that attaches to the baffles and runs parallel to the side berm or perpendicular to the existing baffle assembly. In this situation, it should be designed so you cannot see blue sky from the shooting position.

2.3.3.2 - Ground Baffles

Material: Construct ground baffles from a combination of earth, steel, wood or concrete.

Configuration: Install ground baffles vertically to coincide with overhead baffles or spaced effectively to eliminate or reduce horizontal surface areas exposed to direct fire. This reduces the possibility of ground generated ricochets. Steel ground baffles sloped toward the firing line have been used effectively to trap errant projectiles. The ground baffle's top edge or that surface exposed to direct hits must be designed to reduce even more the possibility of ricochets escaping between overhead baffles. Geocell materials can be utilized to build ground baffles by offering a vertical wall of earth.

Size: Ground baffles vary in height depending on the distance between the targets and the firing line and the spacing required to reduce horizontal surfaces.

The NRA highly recommends that you do not use an earth only ground baffle, unless the earthen baffle will be regularly maintained at the steepest slope that the soils will allow. Otherwise erosion will wear the slop down and render it ineffective.

3.0 – Sound Abatement on Shooting Ranges

3.1 – Introduction

In the past few years, public recognition of sound and how it affects the public has prompted noise abatement programs for all sources of sound. Prolonged exposure to high levels of sound without hearing protection can result in permanent hearing loss. OSHA -- the US Occupational Safety and Health Administration -- has determined that a

sound level of 90 dBA is the threshold for hearing conservation programs. Because firearms easily exceed this level of sound, users must wear hearing protection.

Today, regulations control sound emissions of most outdoor activities. When examining recreational activities, many of the regulations from federal agencies are not actively enforced. Therefore, state and local laws have been enacted which place great emphasis on community noise from industrial and recreational activities. Most states have enacted range protection acts that have been successful in preventing prosecution of ranges in relation to sound issues.

Shooting ranges produce high levels of sound. Sound waves often travel well beyond the boundaries of the range property. Escaping sound may be perceived as unwanted community noise by neighboring property owners. It is important for range owners and operators to work with the local zoning board. Shooting ranges should be highlighted as noise parks if such a classification is available. This designation should make the ranges visible to zoning planners and developers prior to developing neighboring properties.

Range owners/operators should implement sound abatement programs into their yearly planning. These noise plans must actively pursue the goal of a sound abatement plan: preventing conflict before it occurs. These plans may entail contacting an acoustical consultant before a problem develops. This consultation may be prior to the opening of a new range, or at the beginning of the shooting season. Sound levels should be taken at the property lines during normal operation of the range, such as during competitions of day-to-day activity. These documented evaluations will be compared to future levels as changes are made to and around the range. The evaluations will also determine if the range satisfies local sound laws or ordinances.

Sound abatement planning also allows range layouts to change and gives the range design team the flexibility to change locations, directions, and entire sites if necessary. Developing good public relations with the range neighbors and community at large is essential. Show the community that you are bringing in money to the community when people visit your facility and subsequently patronize sporting goods shops, hotels, and restaurants. Some ranges have made deals with these types of businesses during weekend shooting events. If you show that you are a valuable community asset, the community is more likely to support you.

3.2 – Terms and Definitions

The following definitions will help the layman understand some of the technical terms used by engineers and others who practice in the field of acoustics, and are not an attempt to teach the reader to be an acoustical expert. It provides only the essential elements of sound and a general description of when sound becomes "noise".

Sound

To develop a complete description of the sound generated by gunfire, consultant's measure and describe its frequency spectrum, its overall sound pressure level (SPL), and the variation of both of these quantities with time. Sound is the stimulus for hearing, even though not all sounds are audible to the human ear. Sound waves behave like ripples on a pond after someone throws a rock into it. The object thrown becomes the sound source, the ripples the sound pressure waves. In the pond we see a two-dimensional pattern of circular waves, but in the atmosphere sound waves spread out in three dimensions, in a far more complex pattern that can be greatly affected by different weather conditions.

Noise

A noise can be categorized as hazardous, nuisance or objectionable. If there is a noise ordinance, look for these words. In some cases the hazardous level can be quantified in specific terms such as sound pressure levels above 125 dB, or being subjected to 90 dB for a time period of 8 hours. A nuisance level may also be quantified depending upon the ordinance. According to HUD, it is defined as 55 dB and occurring between the hours of 11:00 p.m. to 7:00 a.m. The objectionable level is not always quantified. No dB level is mentioned. It is merely pervasive, unwanted, untimely, annoying, and generally irritating. It could be anything including a dripping water faucet.

3.3 - CONCEPTS AND METHODOLOGY

3.3.1 - Concepts

The information in this section is designed to provide a general discussion on sound, its potential effects and sound abatement technologies suited for use on ranges. This will be helpful to ranges which may be required to install sound abatement materials or where future land use criteria deem it necessary.

Any observer may or may not consider "sound" generated by a given source to be "noise". Therefore, in most recreational activities, especially with small arms, planners

of ranges must consider what effect sounds generated will have on the nearby environment.

"Noise" exposure is the integrated effect, over a given period of a number of different sound levels and durations. The integration also includes specific weighting factors for the events during certain time periods in which sound affects the environment more severely, such as when people are trying to sleep. The US national quiet time is considered to be between 10 pm and 7 am. Due diligence would require ranges to exceed this, i.e. operations should start later than 7am and cease earlier than 10 pm. The various scales for "noise" exposure in use throughout the country differ by the methods of integration or summation, time period weighting factors and frequency weightings.

That certain types of noise can affect human health and safety is well documented. Adverse effects depend on their loudness and frequency spectrum. Generally, sounds generated on ranges will have little, if any, effect on the physical or psychological health of inhabitants of the surrounding area. Where they do, it is noted for inclusion in a "noise" plan.

From the first planning meeting to the last nail driven during construction, it is important that the master plan include a sound mitigation program. Failure to adopt such a plan can result in financial losses for the range owners or operators, or the termination of an otherwise quality range operation.

- (1) Develop concepts and methods to abate sound for eventual use on planned ranges. Although the physics of sound is the same everywhere, each range will be different from others.
- (2) Conduct research on materials that may be suitable for use on a particular type range such as bench rest, pistol, small-bore or high-power. Specific applications can then be determined.
- (3) Develop specifics on:
 - a. Terrain features
 - b. Soil and surface geology characteristics
 - c. Hydrology and vegetation
 - d. Existing land uses and utilities
 - e. Population densities
 - f. Other environmental considerations, such as air quality, prevailing wind conditions, temperature changes and humidity fluctuations

3.4 - Land Use Determinants

Master Plan

Developing a master plan for a specific site may seem to be a lot of unnecessary work in some cases, but its smart planning. The master plan outlines sound abatement technology and involves a study of the following:

- (1) Any sound abatement program must meet the standards of existing regulations, ordinances or laws. In most instances, existing laws will specify a sound level for a particular land use. To determine if the facility will meet the standards, measurements must be taken to determine what if anything must be done to mitigate any problem. Sound level measurements for small arms will use the fast or impulse detector response mode as identified on a Precision Integrating Sound Level Meter and Analyzer. Sound measuring devices must meet ANSI standards and have a factory calibration date within one year of the date when testing is to be conducted. All meters used for testing must be designed to allow for field calibration with field calibrators having a factory calibration certificate validated each year.
- (2) A complete description of the proposed site and surrounding areas including site maps to aid in determining if the land use is compatible with current and projected land uses around the proposed site. In addition, it is advisable to conduct an environmental analysis, a part of which would be the development of a "noise" profile as discussed in this chapter. (See Section I, Chapter 3, Paragraph 2.14 for guidance and procedures for conducting an environmental analysis.)
- (3) A study of the economic impact the proposed range will have on the area surrounding or in close proximity to the proposed site.
- (4) A complete description of the range facility including detailed drawings. Have a consultant draw a "noise" profile overlay and include it in the sound abatement program. Include in this portion of the document solutions to the identified existing or potential problems. How much will they cost? How effective will they be? Are they politically and socially possible?
- (5) A complete description of the community and neighboring properties. Include: existing use, planned use, safety and other environmental considerations.

- (6) A sound survey of the area. This will provide information on which future plans will hinge. It will also provide a vehicle whereby public input can be obtained towards the construction of a project. It will also provide time to educate the community on the benefits of the project. Where results of these surveys show significant levels, public opposition may exist. The master plan must include sound abatement strategies that will answer opposing arguments.

3.5 - Land Use Compatibility

3.5.1 - Area

Land use as it relates to existing conditions is but one facet of the study and is directly linked to what future conditions may exist at a site. Regulation of land use in some areas can be so stringent that any other use than what already exists may be rejected. When a range locates in an area the one factor seldom considered is the community and its role as a regulatory body. Should a noise complaint arise as a result of range operations and the proper approvals have been received, the noise problem is no longer a problem the range facility must face alone. The community must also become involved and assist in resolving the conflict. In other instances, even with full knowledge of the presence of a range, adjoining parcels have been rezoned for new housing developments, giving little, if any, forethought to future consequences.

One of the primary yet often overlooked considerations in developing a range project is the economic impact the facility will have on the community. How it affects the community should it locate nearby, or if it is forced to move to another site are critical issues. Local economies are important. Even though shooting is a recreational activity, the range becomes part of the local business community. Outside activities, such as tournaments, bring outside money into the economy thereby playing an important political role in the local community.

3.5.2 - Existing Conditions

What are the existing conditions at the proposed or existing site? Study the environment to determine what impact is occurring. This is the reason an environmental analysis (EA) is necessary. Conducting an EA requires a thorough review to determine if there is any reason to implement a major and costly sound abatement program. It requires a complete description of what may or may not occur if the range is built.

3.5.3 - Future Conditions

As a general guide, the following categories were developed based on field and text book work:

- **Unacceptable:** If the sound level exceeds 90 dB (A) for 1 hour out of 24 or exceeds 85 dB (A) for 8 hours out of 24 and the receiver is less than 1/4 mile from the sound source.
- **Discretionary:** Normally Acceptable, if the level exceeds 80 dB (A) for 8 hours out of 24 or if there are "loud" impulsive sounds (referring to sonic booms, artillery, etc.) on site and the distance from the property boundary and the receiver is one mile or more.
- **Discretionary:** Normally acceptable if the level does not exceed 75 dB (A) at the property boundary more than 6 hours out of 24 hours and distance from the boundary line and the receiver is over 2 mile.
- **Acceptable:** If the sound levels at the receiver do not exceed 65 dB (A) more than 8 hours out of 24 or activities do not extend into the nighttime hours of 10 p.m. through 7 a.m. Active shooting is to take place during the daytime hours of 7 a.m. to 10 p.m., with curtailed, but not necessarily discontinued activities during evening hours of 7 p.m. to 10 p.m. Shooting activities should not continue into nighttime hours, between 10 p.m. and 7 a.m. unless needed for mandatory low light training by law enforcement personnel.

3.6 - Regulatory Controls

Governmental planning organizations offer services to local agencies to assist them in developing goals and policies for community "noise" control. They also provide general land use, environmental protection and open space recommendations. In July 1981, the U.S. Environmental Protection Agency developed a Community Noise Assessment Program designed to assist communities to assess, control and improve their noise environment. Even though this document focuses on larger more densely populated areas, it does provide some valuable tips for the range planner.

A number of states have laws relating to noise. Most of these noise laws are concerned with motor vehicle, snowmobile, or boating sounds. A few, such as Connecticut, Illinois, and New Jersey, have very clear noise laws relating to impulse sounds. Some laws include definitive methods for measuring the sound, and clearly defined acceptable levels. Others are very vague.

3.6.1- The Community and its Role

- a. Develop a noise control program and goals.
- b. Develop details of an acoustical survey, before, during and after.
- c. Develop details for an attitudinal survey.
- d. Gather existing complaint data.
- e. Present the program design, and its implementation costs.
- f. Make noise measurements. The standard criteria to be used when taking noise measurements are:
 - (1) At the property line, and in direct line with the receiver.
 - (2) Select measuring points that are clear of interfering objects (other than naturally occurring ones, such as trees) or terrain.
 - (3) Describe the surface area over which the sound travels. Certain surface area configurations, such as a good grass cover affects the rate of decay for sound. The intervening distance between a point source and a receiver is also an attenuating factor. As a rule, each time the distance is doubled the sound pressure level is reduced by one half, or reduced by about 6 dB. Take note of any walls, buildings, signs, people or other barriers normally between the point source and the measuring point. These obstacles serve also to attenuate the sound pressure levels. A hard surface does not add much to attenuation but distance, thick grass and heavy shrubbery do.

Significant terrain features are also important, for example a noise source in a depression is provided barriers that will redirect sound and is not as serious as one at a higher elevation. Therefore, a range located in a valley presents less of a problem than one at the same general elevation as the surrounding area.

Ranges elevated above a receiver will have the advantage of atmospheric attenuation, with additional components attenuated via wind. Atmospheric and wind attenuation is a function of temperature, wind speed, humidity and frequency. Atmospheric attenuation has a greater effect on high frequencies such as the supersonic crack of a bullet. Wind and temperature together

affect propagation of sound in a variety of ways, but one of the more important is called a temperature inversion, but are normally directional. A wind gradient tends to cause a sound wave traveling with the wind to slope or bend toward the ground and appear to be louder. A sound wave traveling against the wind will bend upward and away from the earth, hence developing a sound shadow very near the source. This is one reason it is difficult to hear upwind from a source. Another reason is the masking effect of wind noise around the ears.

(4) Note noise reflecting off surface areas, such as trees, bodies of water, overhead firing line covers, hillsides, hard surfaces such as pavement can have a marked affect as well. Information needed on the field data sheet should include:

- a. The time the receiving property is occupied.
- b. What are the characteristics of the home?
 1. Is it air conditioned?
 2. Do they have a stereo?
 3. Is the room most used in the house closest to the range?
 4. Are there large pane windows facing the range?
 5. How thick are the walls?
 6. Is the house insulated?
 7. The elevation of the house in relation to the range?
- b. Conduct attitudinal survey.
- c. Review complaint data.
- d. Review noise survey results. A review of the survey results will now permit a fuller understanding of the situation. Once the data collection is complete, break it down into categories for analysis. There are three sources for solutions to a noise problem.
 - (1) What the range can do to abate sound levels over what existing laws allow,
 - (2) Measures available to the complainant,
 - (3) The role of the community in the matter;

- f. Apply strategy analysis for development of "noise" abatement alternatives.
- g. Compile alternatives and recommendations for "noise" abatement.

3.6.2 Populations

Information on population characteristics such as density, growth rates for previous periods and projected future growth rates also provide valuable information. A range builder can use this data to determine how growth rates will add or detract from the proposed facility. Population growth provides additional resources for the properly sited facility, and potential problems of encroachment for an improperly sited one.

3.6.3 - Noise profiles

During the site selection process, have a consultant develop a sound "noise" profile for each proposed site to determine what abatement procedures, if any, will be needed on each. Remoteness has, in the past, been the accepted norm used to select a site. By using modern technological advances in acoustical materials, outdoor ranges can be sited near population centers. Developing a noise profile requires the services of an engineer practicing in the field of acoustics or someone thoroughly familiar with sound testing equipment and sound abatement methodologies.

3.6.4 - General considerations

Cooperation with other range operations, community groups, educational institutions, recreational related organizations and others can gain needed support when justification is being put together. Early cooperation will show other groups how the facility will benefit the local community.

3.7- Noise Abatement Programs

Noise abatement programs are necessary on all ranges from the standpoint of the user. Hearing protection should be a requirement for all users who are within 50 feet of the firing line.

Sound abatement shields or barriers should be installed on ranges where neighbors are within 1/4 mile of the facility unless significant natural barriers exist. Any fixtures or terrain features must serve either to redirect or capture sound. Exact configurations depend upon site characteristics.

3.7.1 - Noise Measurement Standards

Select equipment based on the following:

- (1) Must meet all ANSI specifications.
- (2) Select multi-directional microphones.
- (3) Position microphones 4-5 feet above the ground on a tripod.
- (4) Select test sites at property boundaries or according to existing statutes.
- (5) Use a wind screen in all outdoor conditions.
- (6) Average wind speeds must be less than 12 mph. (Wind noise at higher speeds will invalidate data.)
- (7) Set sound level meter on tripod or stand and use a 5 foot extension for the microphone. (Use an extension on the microphone when necessary.)
- (8) Calibrate sound level meter and other recording devices before, during (every hour) and after sampling.
- (9) Have equipment factory calibrated once each year.



("ITM Instruments Inc.", 2016)

3.7.2 - Sound Monitoring Plan

It is imperative to maintain a consistent and efficient sound monitoring plan for your shooting range. Obtaining the proper equipment is the first step, followed by deciding on which locations at your range should be tested. Sound measurements should be taken both at the source, and at various points along the range property line. It is highly recommended to perform testing at a point closest to your neighbors. In addition, testing should be done during different levels of activity. Testing while the range is busy will help to get better results. It is also recommended to perform sound testing during special events. The basic recommended process is as follows:

- Acquire sound level testing equipment
- Identify monitoring sights
- Perform sound level testing
 - Maintain logs for every testing period
- Repeat on a regular basis
 - Annual or biennial recommended

Below is an example log for sound level measurements

Date: May 13th, 2016

Location	Pressure rms (Pa)	Sound Intensity Level (dB) - Continuous	Sound Intensity Level (dB) - Impulse	Intensity (W/m²)
Location 1	89	85	140	12
Location 2	86	81	138	11
Location 3	81	73	110	8
Location 4	83	75	113	10
Location 5	79	66	105	6

3.7.3 - Selection of Sound Abatement Applications

Sound levels can be significantly reduced through good design. Sound usually travels from the source to the receiver via multiple paths (e.g. direct and reflected paths). By blocking line of sight, propagation paths, or the direct path from the firearms to the receiver, the major component of the sound is minimized. Diffraction, refraction, the bending of sound waves, and reflection of sound waves will still allow sound to propagate to the receiver.

What are some practical examples of noise control on outdoor ranges? The most common type of sound abatement used on shooting ranges is barriers. Since a firing line cover provides shelter for the shooters, it is a common starting point in noise control. Across the country, cover designs vary greatly. They range in height from 7 to 15 feet. Some have flat roofs, some slanted, and others gabled. Many are made with 4x4 posts, while others use metal poles or I-beams.

Roofing materials range from corrugated metal to a full wooden-shingle construction. Corrugated metal roofs have a limited number of attachment points and are very resonant. This means that the material is likely to ring when excited, either by a stone hitting it or a pressure pulse from discharging firearms (e.g. a giant drum). A more damped firing line cover made from typical roof material (e.g. wood and shingles) is desirable.

To eliminate the direct source-to-receiver path of noise, construct a barrier, berm or wall. To eliminate the direct path to this side of the range, another barrier should be constructed extending from the back wall forward 10 to 20 feet beyond the firing line, or long enough to block the line of sight from the other end of the firing line to the concerned receiver. These walls should be physically coupled to the firing line cover, if possible. If cracks exist between these two structures, sound will be able to propagate away from the range in those directions. The mass of the barrier is also critical. The more massive the wall, the better the transmission loss will be, i.e., more sound reduction.

The effect of enclosing a range with barriers is to direct all of the sound from the firearms in the forward direction and away from the noise-sensitive area. Sound will still propagate to the neighboring community due to diffraction and reflections from downrange obstacles (e.g. the hillside, berms, and trees). Insulation added to the walls and ceiling of the firing line cover will reduce the impact of the sound reflected onto the shooter or range user. Insulation will also help reduce the sound pressure levels being projected forward of the firing line area by absorbing the sound energy instead of

reflecting it. Insulation can be added to the firing line cover in many forms. Attaching batting to the underside of the firing line cover, using blown-in insulation, or installing a drop ceiling with attaching insulation board have all been used successfully on shooting ranges.

Another solution to fixed point firing ranges is the tube range. This design consists of one or two sections of 36 inch or greater class III drain pipe. The pipe should be concrete -- not metal. Metal pipes tend to ring loudly even when partially buried in the ground. The ends of the tube are capped; these caps are typically made of plywood with holes cut into each cap just large enough to handle the firearm and have an unobstructed view of the targets. In this manner, the tube acts like a large silencer. Some tube designs include internal baffles to break-up the sound waves as they propagate down the tube. This design is generally used for bench rest shooting only. Three-position shooting is possible on this type range if trenches are dug at the front of the tube and adjustable platforms constructed for other positions.

What about shotgun ranges where the targets can vary 180° horizontally and vertically? Barriers can be utilized in some situations with limited success. Because of the movement of the firearm, enclosing the range is difficult. For example, an enclosed trap or skeet range is not commonplace but could be done in a dome-like structure. For these situations, landscaping appears to be the only solution. Sound control by landscaping employs three processes: ground impedance, natural barriers, and to a lesser extent, increasing the noise of the environment.

Cook and Haverbeke (Tree and Shrubs for Noise Abatement, Nebraska Agricultural Experimental Station Research Bulletin#246, July 1971, CN: DNAL 100-N27-(3)) studied the effect trees and other forms of vegetation had on transmission of sound. They planted trees and shrubs in the form of shelter belts and wind-breaks, and measured sound levels of traffic noise and pure tones. They found that 65-100 foot wide stands of dense trees and shrubs are needed to reduce noise. For optimum results, the trees should be close to the source as opposed to close to the receiver. Trees, with uniform vertical foliage, should be planted as close as possible to form a continuous, dense barrier. Sparsely-planted trees offer little resistance to propagating sound. Where year-round screen is desired, evergreens or deciduous varieties which maintain their leaves are recommended.

4.0 - Noise Mitigation Solutions

The information on the various alternatives presented below was retrieved from a variety of academic based resources all included in the references of this document.

The information was retrieved between January 5th 2016 and March 16th 2016.

Noise mitigation alternatives may be either: 1) administrative, controlling noise emission sources, or 2) technical, providing engineered noise controls. In addition, there is a distinction between options that are more likely to be effective in the short term and in the long term.

4.1 - Proactive and Continuous Public Relations Efforts

Completely eradicating noise on a shooting range is simply not possible with our current resources. Therefore, proactively maintaining good relationships with your neighbors, those sharing the sounds coming from the gun range with club members, is an extremely important interaction that can assist in preventing noise complaints. Below are a number of options that may help to assist with your ranges public relations efforts.

1. Invite members of the community to voice their concerns directly to the club
 - a. Let's community members feel like they have some sort of control, and that the club is willing to listen
2. Display and communicate community efforts
 - a. Youth training courses
 - b. Shooting competitions translate into money for the community
3. Notify the public of events (especially particularly loud events) prior to the event date
4. Keep member logs of when and what they shoot
 - a. Other shooting activity in the area could be being blamed on the range
5. Encourage law enforcement to actively use the range
 - a. Promotes public safety and well-being

4.2 - Restriction of Certain “Loud Guns” or Attachments / Reduction on Firearm Discharge Time

4.2.1 - Restriction of Certain Firearms

One of the easiest solutions to reaching a common ground with neighbors complaining of noise issues is to simply restrict the use of certain firearms or reduce the hours available for club members to shoot.

The engineering behind firearm design allows for diversity in the noise expulsion levels of differing makes of guns. It is inevitable that certain guns will be much louder than others, and therefore cause more of a public disturbance in the surrounding areas. The restriction of these types of firearms may help in reducing irritating noise for gun club neighbors.

Taking this route may help to reduce noise exposure to neighbors, however there are a number of problems that arise. The noise emissions from individual firearms varies from several factors such as barrel length, firearm weight, cartridge load, barrel compensators or muzzle brakes, and bullet weight (affecting muzzle velocity). It is not possible for a range officer to estimate, by cursory inspection, noise emissions of any particular firearm and cartridge combination. For safety reasons, firearms must be, and remain, put away during check-in, and may not be taken out until they arrive at the particular range.

AR style semi-automatic rifles, now very popular with shooters, often are fitted with a muzzle brake. This brake reduces the recoil of the firearm to make the shooter more comfortable, accurate and stable for subsequent shots. Muzzle brakes, however, also change the directivity of the muzzle blast noise emission, turning it back on the shooter and propagating less noise downrange. Therefore, measuring noise at the shooting station from a muzzle brake firearm would register a louder noise level while actually providing a lower noise level downrange in the community area.

The same phenomenon occurs with certain pistols equipped with compensators, essentially the same devices as muzzle brakes but for pistols instead of rifles. Noise monitoring may not be effective because it is difficult to isolate noise emissions from a single firearm amidst a line of shooters firing nearly simultaneously. Special considerations could be made for firearms such as a .338 Winchester, as the impulse noise level it produces is significantly higher than many other firearms available for use in Canada.

4.3 - Reduction in Shooting Range Hours

Another solution is to reduce the hours in which members can discharge their firearms on the range. Simply allowing access to the range 1 or 2 hours later in the morning and/or 1 or 2 hours earlier in the afternoon may assist in reducing noise complaints by providing more quiet time in the morning and in the afternoon when many might like to be outdoors barbequing or enjoying the quiet.

Another option in this category is to restrict specific ranges (those that are more difficult to provide sound attenuation solutions for such as trap ranges) to shortened and/or specific hours. While this option does not directly change overall noise levels, it may help in finding a common ground with those who share the noise. It would be very beneficial to include both neighbors being affected by the shooting range noise and gun club members in a discussion on when the most optimal times for both parties are for shooting activities.

4.4 - Range Layout Alterations

4.4.1 – Directional

The layout of a shooting range can have a dramatic effect on the sound levels that carry into surrounding areas. When discharging a firearm the noise generated from the muzzle blast propagates spherically in all directions, and is approximately 10-15 decibels louder when heard in front of the gun (the direction of firing). Whether your gun club is in the design phase or already fully operational, ensuring that the direction of firearm discharge on all ranges on the property is pointing away from the surrounding public to the best of your abilities can be a simple fix, or at the very least a feasible step in the right direction.



("Capitol City Rifle & Pistol Club | Shooting Range", 2016)

This could be the most simple, straightforward, and affordable fix if your range doesn't already have this in place. Quite often it can be accomplished by the staff of the range itself, or with minimal expenses of hiring an excavator to build simple dirt berms for bullet containment.

4.4.2 - Submerged Range

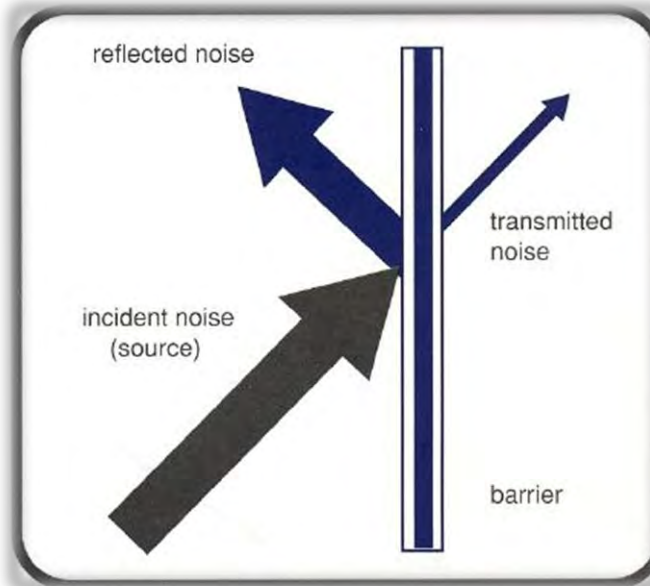
Creating a natural barrier by means of submerging a range can assist in keeping noise levels down. Simply by hiring an excavator and lowering the depth at which the club members are shooting from creates natural earth barriers that reflect and absorb noise. This option is on the less expensive side of the spectrum when it comes to noise attenuation techniques, while still remaining moderately effective.

4.5 - Barriers and Sound Attenuating Materials

4.5.1 – Barriers

Installing engineered barriers in order to create natural dirt barriers can assist in the efforts of mitigating noise by redirecting and absorbing sounds made from shooting sports. Barriers can come in a variety of forms, from high walls to surround an entire

gun club, to walls surrounding specific ranges or firing sheds for members to shoot from. Barriers are typically effective in reducing high frequencies by 10-15 decibels and low frequencies by 2-5 decibels.



("Sound Barriers Diagram and Technical Information", 2016)

While placing barriers close to the source of receiver is very effective, the most significant reductions in noise levels occur when barriers are placed close to the shooter. Walls surrounding entire gun clubs or individual ranges are relatively far from many shooting positions, and therefore are less effective in reducing both the noise from the muzzle blast and the supersonic projectile shockwave created from a gunshot.

Building a firing shed out of noise attenuating materials and placing smaller barriers between shooter locations is the best approach to both reducing noise carrying to gun club neighbors, and improving range safety and communication for members.



("Shooting Ranges | Shoot Houses | Range Systems", 2016)

4.5.2 - QBO Blankets

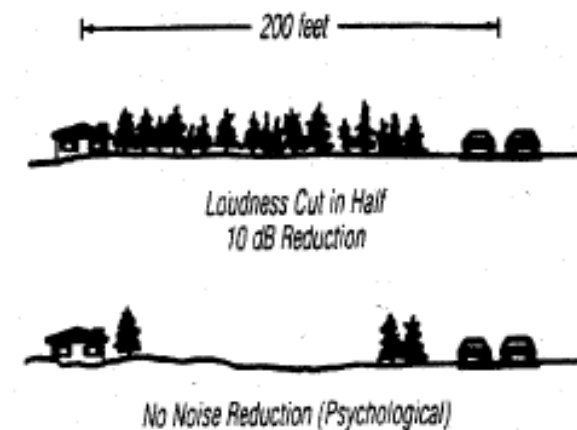
Lining existing firing shacks or building simple new ones to line with a sound attenuating material such as QBO sound blankets is also a more affordable option. The blankets are used to combat outdoor stationary noise, and protect neighbors from excessive decibel levels. These blankets have been tested to collapse up to 90% of the noise that is sourced from within them. The blankets can be ordered in various sizes, starting at \$320 for 1 4x6 blanket, and ranging up to \$1080 for 1 4x20 blanket. The QBO blankets can also be cut to size to fit your scenario.



("QBO Sound Blankets | Acoustic Materials - Soundproofing by Netwell Noise Control", 2016)

4.5.3 - Trees and Vegetation

Trees and vegetation can act as natural sound barriers in the right circumstances. Trees scatter and absorb sound with the effectiveness directly correlating with density. Foliage absorbs the high frequencies with low frequencies being reduced through ground absorption. The branches and trunk of the trees scatter sound. Studies have shown noise reductions between 3 and 30 decibels per 100 meters of dense forest. If you are considering locations for the creation of a new range, this is something that should be taken into consideration. Existing ranges are either subject to what they currently have in regards to surrounding vegetation, or they will need to transplant new trees.



("NPC Online Library: Highway Traffic Noise", 2016)

4.6 - Baffle Systems and Tube Ranges

4.6.1 - Baffle Systems

Baffle systems essentially reflect and absorb sound. When discharging a firearm, the sound hits the baffles and is reflected upwards, or hits sound-absorbing surfaces several times before it reflects back towards the shooter. Reflections from baffle systems can produce louder sounds behind the shooter than the direct sound due to the directivity of the muzzle blast. Most often, the majority of this sound results from the interaction with the first baffle. Therefore, mitigating noise on the first baffle will reduce the loudest event, which has been correlated to complaints.



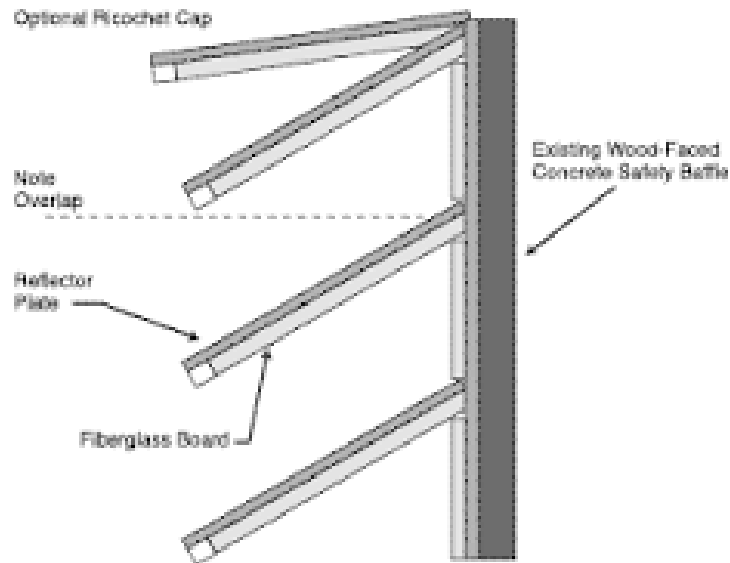
("No Blue Sky?" 2015)

Equipping your shooting range with a variety of engineered baffles and/or barriers may be on the more expensive side of things when it comes to noise mitigation techniques, often costing upwards of \$100,000 per individual range for a full “no-blue-sky” setup. However, the positive effects brought on in the form of both sound management and shooting safety are well worth the investment if it is within your budget.

Material usage when designing and building baffles or barriers is a very important consideration, as it will have an effect on the significance of your sound reduction, as well as other safety hazards. Materials such as rubber or fiberglass are not “acoustical” materials, and contribute to fire hazards or mold and mildew growth.

Companies such as Troy Acoustics have looked into combatting this with their “Portland Cement Wood Fiber Board”, which has a 0 flame spread and 0 smoke developed fire rating, as well as significant effects on noise reduction.

The example venetian blind absorber depicted below is a series of reflector plates, 4 feet wide at a 45-degree angle. The panels can be constructed of 3/4-inch pressure-treated plywood covered with 2-inch fiberglass boards (6 pounds per cubic foot). Sound is reflected upward or hits sound-absorbing surfaces several times before it reflects back toward the shooter. This particular baffle system is designed for a 10 dB reduction or 50-percent loss in volume.



(Hansen, 2016)

See Appendix 9.6 and 9.7 for examples of a covered shooting structure design and typical baffled range layout.

4.6.2 - Tube Ranges

Tubes, or muzzle blast mufflers, are a relatively new approach to sound mitigation techniques. They have been tested in the United States and Switzerland, and have been shown to reduce muzzle blast volume by 10 – 20 decibels. This technique does not succeed in abating the projectile shock sound; however reducing the muzzle blast also decreases the noise level exposure for adjacent shooters, limiting the potential for hearing damage. If shooting from a firing shack or similar structure, this option is relatively simple and cheap to do on your own.



("Calton Moor Range - Target Shooting & Informal Long Range Shooting Practice", 2016)



("backyard indoor gun range - Saubier.com", 2016)

5.0 - Public Relations

5.1 - Purpose

Public relations include ongoing activities to ensure the organization has a strong public image. Public relations activities include helping the public to understand the organization and its products. Similar to effective advertising and promotions, effective public relations often depend on designing and implementing a well-designed public relations plan. The plan often includes description of what you want to convey to whom, how you plan to convey it, who is responsible for various activities and by when, and how much money is budgeted to fund these activities. Similar to advertising and promotions, a media plan and calendar can be very useful, which specifies what media methods that are used and when.

Often, public relations are conducted through the media; that is, newspapers, television, magazines, etc. Publicity is mention in the media. Organizations usually have little control over the message in the media, at least, not as much as they do in advertising. Consider advertising, collaborations, annual reports, networking, TV, radio, newsletters, classifieds, displays/signs, posters, word of mouth, direct mail, special events, brochures, neighborhood newsletters, etc.

The basic public relations plan that follows is an outline and series of suggestions from which specific efforts can be developed. The intent is to provide a basic tool that can be customized locally to meet the unique needs of a specific range.

5.2 – Public Relations Plan

5.2.1 – General Information

A range may need a public relations plan to raise funds, recruit members, combat zoning or other government restrictions to its operations or simply to enhance its overall image. Whatever the need, it is important the plan be worked out in detail before any action is taken. Each individual involved in the plan's implementation must fully understand the goal(s) to be achieved and what their responsibilities are in relation to such goals. Every step of the plan must be fully documented to prevent any misconception and to provide a well-defined course of action.

5.2.2 - Audience Selection

When your goal has been determined, you must define the "public" you are trying to reach. The benefits of a well-conducted public relations program are numerous. A good program can help erase misunderstandings about guns and can show the sport of shooting as a healthy, constructive activity for the whole family. Establishing a friendly working arrangement with the local news media will promote understanding and cooperation in the community, and help attract new members.

5.2.3 - Spokesperson Selection

Who should handle public relations for the range? Your public information director should be someone who is sincerely interested in range activities and should be able to gain the respect of newspaper, radio, and TV people. The person must also have good oral and written communication skills.

When you have chosen your public information director, he or she should be invited to participate in all club or range activities at the top level. This person should be present at the board meetings and other policymaking discussions so that they are well informed on every aspect of club or range operations.

Your public information director should seek to establish cordial relations with local newspaper staffers, plus radio and television people. Outdoors writers, news

commentators, sports writers, and feature editors will most often be receiving material and deciding on its use.

5.2.4 - Special Events

Social and special events can be effective elements in certain types of public relations plans. Due to the nature of the issues surrounding firearms, organizations are advised that such events should not include alcoholic beverages if the event takes place at a range or if firearms are present.

Special events can be used to enhance your public image, raise funds and support membership recruitment or general range usage by the public.

Invite the media to visit the club, especially when there are interesting events taking place. Offer the use of the range facilities and, where appropriate, send complimentary passes. Whenever the media shows an interest in the range activities, a good public information director will be prepared to develop this interest.

Community involvement is very important. The more the public knows about what goes on at a range, the less they fear it. If you have the resources, offer to hold a competition that is designed to raise funds for some local charity or related activity. Plan events that will promote media coverage of a positive nature.

5.3 - COMMUNICATIONS VEHICLES

5.3.1 - Press Release

The backbone of every public relations effort is the press release. Writing a release is not particularly difficult, but there are some basic points to remember. The most important is to tell the media "Who, What, Where, When, Why and How". Write only the facts. Keep the story brief. Don't editorialize or use extra adjectives or superlatives. Remember, news editors don't like cute grammar. Avoid all jargon -- it is absolutely imperative that you use non-technical language to make your story easily understood by the editor and the general public.

The following events or activities are a good base for sending out a news release to your local media: • A range public service project, such as hunter safety classes, a Hunter Sighting-In Day, or junior instruction classes. • An interesting meeting or speaker program. • The opening of a new shooting range. • An upcoming competitive shooting match. • Match results when a club member does well in a match. • When there is a

good human interest story, such as an exceptional junior shooter, a novelty shooting match, or an unusual firearm being used.

A point of contact must be supplied on the release and this person must be available to respond to the media within a reasonable time. Reporters operate on deadlines and any range seeking to use the media to disseminate information must adapt realistic media deadlines.

The media carries a news story for two basic reasons: (1) it is a matter of sensational and/or controversial impact; and (2) it is a current point of interest and information for the reader, viewer, or listener. Much as we might wish it otherwise, the degree of sensationalism and urgency (or current activity) usually dictates whether the story will be used.

No one can guarantee the printing of a story in the daily press. But the chances of having coverage of your event will be improved if you follow the steps in this guide. While there are many friends of the shooting sports in the public media, there are also many persons who are not sympathetic toward our cause. Your personal attention to journalists will help overcome that attitude.

Always write at least one rough draft to use as a working copy. When you are ready to submit your final version to the media, be sure to submit a clean, typed (double-spaced), and complete version.

Almost everyone is familiar with the Five W's (and one H) formula that news journalists follow: who, what, when, where, and why (plus how). Editors will look for these basic elements in your story. These elements need not be in any specific sequence, but it is important that they all appear in your story. When you have finished your first draft, read it thoroughly to make sure that all these elements are in the story:

Always remember to observe the following guidelines:

- a. Type your story double-spaced on one side of plain 8 " x 11" white paper. Never submit a story in longhand. Furnish a digital copy of your story via email or on CD to accompany your printed version.
- b. Use at least 1 inch right and left margins. (This space is useful for editing purposes.)

- c. In the upper right-hand corner, give the name of your club and the name, address, and phone number of the person who should be contacted for information and assistance.
- d. Always give a dateline (place of origin of the event) and a "slug" headline that will attract the editor and will indicate the content.
- e. Be prepared to furnish additional background information if the news media should call. In all cases, respond promptly and courteously to every request from the media for additional information or assistance.

Editors will require high quality photographs. Try to submit digital photos in a .jpg format with a minimum resolution of 300 DPI and measurements of 3"x 5". The photos should have definite news or human interest value, and action should be emphasized. Always try to show people who are doing something, not just standing around looking at the camera!

If your club has an experienced photographer, fine. If not, ask your local newspaper editors about securing the services of a good photographer.

Always include a caption with each photo. The caption should explain what is taking place in the photo, and should be no more than a few lines in length. Identify each person in the photo, and be sure to identify your contact person at the end of each caption.

5.3.2 - Broadcast Public Service

Public Service Announcements (PSA's) on radio and television are excellent ways to reach the public. Although some broadcasters still use 30 second PSA's, most are now 10 or 15 seconds. Your local television station will have a person in charge of public service. They will work with you to produce a finished announcement. Radio stations generally prefer copy they can read live on the air.

The open and close of a PSA are the most important parts. The average viewer or listener retains 12% to 15% of what they hear or see. Your script needs to get their attention immediately or the audience will mentally tune you out. The close is the portion of the PSA the audience will be most likely to recall, so be sure to state your case and who you are at the end of the announcement.

When writing for broadcast, you can expect the average 30 second announcement to contain 75 words. Shorter PSA's are proportionate in their length.

When trying to get a local radio or television station to broadcast your announcement, it is best to make contact by telephone, send them a letter of introduction with the script, then follow up with a personal visit. Although this takes time, it helps to set-up a working relationship and establishes your credibility. After the station has aired your PSA, remember to send them a thank you letter for their files.

5.3.3 - Public Speaking Events

Establishing a good working relationship with members of the media is vital, as is providing the media with appropriate, well-written news stories. But an effective club public relations program will also include dealing directly with the general public. Ranges need the understanding of both the non-shooting and shooting portions of the community. Telling the townspeople about your range activities is an excellent way to promote good community relations. Interesting, informative talks presented by your range will help to give townspeople a favorable impression of your range activities. It takes work to prepare a talk. Ranges need to develop members who are adept at making speeches or organizing presentations for the public. Accepted length of time for a speaker is usually 20-30 minutes. Movies and slides are wonderful visual aids in a speech. The speaker can also plan a brief period to answer questions from the audience.

Be sure to choose interesting topics. For example, you may have an outstanding shooter in your club who can demonstrate safe, but intriguing, shooting. The shooter might perform demonstrations of accuracy while also explaining and emphasizing the safe handling of firearms. In presenting such demonstrations, remember -- safety first.... always! This type of presentation can be entertaining and educational to those unfamiliar with shooting practices, and may even encourage persons to enroll as members of your club.

If you want to speak to a specific organization, be sure to contact that group's program chairperson. He or she can tell you what topics and length of time are appropriate for the group. Be sure to provide the program chairperson with a brief, but complete, summary of your range history and activities. Also include appropriate contact information for your range. When you select a speaker, be sure to provide the group's program chairperson with information about your speaker, including name, occupation, other organizations to which your speaker belongs, honors and awards received, etc. Remember that any speech or presentation on behalf of shooting and the right to bear arms will be important for the shooting sports and for our country as well. Educate the public and they will be more likely to support your programs!

5.3.4 - Other Public Relations Resources

Technology today makes it easier than ever for people to find your information. If your range does not currently have a website, now is the time to start developing one. This is the easiest way for you to market your range and the services your range provides to the shooting community. Items of interest to consider making available on a range website include: range location and contact information; hours of operation; upcoming shooting events; articles on past shooting events; membership information, etc. Some ranges even produce a monthly or quarterly newsletter. This may also be an item to consider making available in an electronic format online and emailing to a list of all of the members of your range on a monthly or quarterly basis.

6.0 – Issues Management

Please heed the following considerations and questions should your range receive a sound complaint.

- Who is the complainant? Can it be worked out? Can you give the complaining person a club benefit? Do they want to belong to the club? Can you give them free membership?
- Is the club violating a noise ordinance? Is the shooting in early morning or at night? What are your Sundays and holiday schedules?
- The following information applies to when a noise ordinance is involved.
 - What does the preamble say? For example, does the ordinance control certain types of noises from a particular emitter zone only during certain hours?
 - Are there exemptions that fall under the category of "recreation, shooting and training"? Please note the importance of your range name. Mention ranges or shooting in your range/club's purpose statement or bylaws or include words such as "...for all other purposes consistent with law...."
 - Are quantitative, described levels specified? Without a specific level, an ordinance is too vague or subjective.
 - If quantitative levels are not established, does the ordinance define such words as hazardous, objectionable or nuisance? Be careful when subjective words are used. Some people apply their own value judgements to ranges. When this happens, difficulties arise in defending sound issues.

- Does the ordinance specify the scale, mode, location for measurement, hours of the day, time weighted average (TWA), noise zones or other information pertinent to decibel testing?
- What to do when no noise ordinance exists
 - Since there is no violation of law, range officials who might otherwise conduct testing are at a disadvantage. Without standards prescribed by ordinance, range officials may not know:
 - what mode or scale to use on the test meter.
 - what type of meter to use.
 - who to share the results with once they have conducted the test.
 - whether the results will be interpreted as a/an:
 - hazardous level.
 - nuisance level.
 - objectionable level.
 - area where a Time Weighted Average applies.

Having a plan on how to deal with noise complaints before they occur is an ideal tool for any range to implement, and should be taken very seriously. Conducting a SWOT analysis can help in managing what your range's current situation is in regards to positives and negatives.



("Stock Images similar to ID 185217368 - swot business infographic", 2016)

When speaking with those who are complaining about the noise levels coming from your shooting range, ensure that you are speaking professionally and courteously at all times. Standardizing responses and letting them know how seriously you take noise management can benefit the relationship between you and your neighbors immensely. Filling them in on your pro-active approach to noise management and consistent noise level monitoring displays good intentions and a commitment to maintaining a good relationship

7.0 - Glossary

Absorption Coefficient: The fraction of incident sound not reflected by a surface. Values range from 0.01 for marble slate, to 1.0 for absorbent wedges used in anechoic rooms.

Acoustics: (1) The study of sound, including its generation, transmission, and effect. (2) The properties of such areas as rooms and theaters, which have to do with how clearly sounds are transmitted and heard in it.

Ambient Noise: The totality of noise in a given place and time. It is usually a composite of sounds from varying sources at varying distances. Also see residual noise.

A-Weighted Sound Level (La): Sound pressure level, filtered or weighted to reduce the influences of the low and high frequency noise. It was designed to approximate the response of the human ear. Noise is measured on a dBA scale. Small arms fire is generally measured on the A weighted scale and impulse response mode.

Background Noise: The total noise in a situation or system except the sound that is desired or needed.

Baffle: A shielding structure or series of partitions which reduces noise by lengthening the path of sound transmission between source and receiver.

Daytime: The hours between 7 a.m. and 7 p.m.

Decibel (dB): In layman's terms, the unit used to measure the relative loudness or level of a sound. The range of human hearing is from 0 to 140 decibels.

Evening: The hours between 7 p.m. and 10 p.m.

Impulsive Sound: Noise with an abrupt onset, high intensity, and short duration typically less than one second and often rapid changing spectral composition.

Inverse Square Law: The law describing the situation in which the mean square sound pressure changes in inverse proportion to the square of the distance from the source. Under this condition the sound pressure level decreases six decibels for each doubling of the distance from the source.

L(eq) energy equivalent sound level (Leq): Is a measure which describes with a single number the sound level of a fluctuating noise environment over a time period. It is a sound level based on the arithmetic average energy content of the sound.

L(dn): is the Leq (energy averaged sound level) over a 24-hour period. It is adjusted to include a 10 dB penalty for noise occurring during the nighttime hours (10 p.m. to 7 a.m.). Weight is given to nighttime noise in this way to account for the lower tolerance of people to noise at night.

Microphone: An electroacoustic transducer that responds to sound waves and delivers essentially equivalent electric waves.

Nighttime: The hours between 10 p.m. and 7 a.m.

Noise: Any unwanted sound, and by extension, any unwanted disturbance within the frequency band. Sound that is loud, disagreeable, untimely or unwanted

Noise Contour: A continuous line on a map of the area around the noise source connecting all points of the same noise exposure level.

Noise Level Reduction: The amount of noise level reduction achieved through the incorporation of noise attenuation in the design and construction of the structure.

Peak Sound Pressure: The maximum instantaneous sound pressure (a) for a transient or impulsive sound of short duration, or (b) in a specific time interval for a sound of long duration.

Reflection: The throwing back of an image, of the original sound, by a surface.

Refraction: The bending of a sound wave from its original path, either because of passing from one medium to another or because (in air) of a temperature or wind gradient.

Residual Noise Level (ambient): The residual noise level is the level of the unidentifiable noise which remain after eliminating all identifiable noises.

Shielding: Attenuating the sound by placing walls, buildings or other barriers between the sound source and the receiver.

Sound: A vibratory disturbance in the pressure and density of a fluid or in a solid, with frequency in the approximate range between 20 and 20,000 hztz, capable of being detected by the organs of hearing.

Sound Level: The weighted sound pressure level obtained by use of a sound level meter having standard frequency-filter for attenuating part of the sound spectrum.

Sound Level Meter: An instrument, comprising of a microphone, an amplifier, an output meter, and frequency-weighting networks. Sound level meters are used for the measurement of noise and sound levels in a specific manner.

Sound Pressure: (1) The minute fluctuations in the atmospheric pressure which accompany the passage of a sound wave. The pressure fluctuations on the tympanic membrane are transmitted to the inner ear and give rise to the sensation of audible sound. (2) For steady sound, the value of the sound pressure averaged over a period of time.

Sound Pressure Level (SPL): In dB, 20 times the logarithm to the base 10 of the ratio of the pressure of this sound to the reference pressure. The reference pressure shall be explicitly stated. The following reference pressures commonly used are: (1) 20 micropascals (2x.0001 microbar) [20 micro newton/meter squared] (2) 1 microbar (3) 1 pascal

Sound Transmission Coefficient: The ratio of transmitted to incident energy flux at a discontinuity in a transmission medium.

Sound Transmission Loss (TL): A measurement of sound insulation provided by a structural configuration. Expressed in decibels, it is ten times the logarithm to the base ten of the reciprocal of the sound transmission coefficient of the configuration.

Yearly Day-Night Average Sound Levels (DNL): The 24-hour average sound level, in decibels, for the period from midnight to midnight. Day night averages are obtained after the addition of ten decibels to sound levels for the periods between midnight and 7 am and between 10 pm and midnight, local time, as averaged over a span of one year. It is the standard metric of the Federal Aviation Administration for determining the cumulative exposure of individuals to noise.

8.0 - Vendors and Services

Eagle Industrial Hygiene Associates

Noise Consultants

<http://www.eagleih.com/>

1 (215) 672-6088

Edward George & Associates

Noise Consultants

<http://www.edgeorgelaw.com/>

1 (781) 322-7575

Hansen Consulting

Noise Consultants

1 (781) 640-4457

Don Turner LLC

Operations and Management Consultants

1 (602) 799-6466

Savage Range Systems, Inc.

Portable Ranges and Range Equipment

<http://savagerangesystems.com/>

1 (413) 642-4219

Armortex

Shooting Houses

<http://www.armortex.com/>

1 (800) 880-8306

Action Target Inc.

Shooting Houses

<http://www.actiontarget.com/>

1 (801) 377-8033

Siebein Associates, Inc.

Sound Abatement

<http://www.siebeinacoustic.com/>

1 (352) 331-5111

Meggitt Training Systems

Sound Abatement

<http://meggitttrainingsystems.com/>

1 (800) 813-9046

Acoustic Sciences Corporation

Sound Abatement

<http://www.acousticssciences.com/>

1 (800) 272-8823

Okie Environmental & Consulting Services, LLC

Sound Testing Equipment

1 (405) 384-1351

Hansen Consulting

Sound Testing Equipment

1 (781) 640-4457

E.A.R Inc.

Sound Testing Equipment

<http://earinc.com/>

1 (800) 525-2690

Troy Acoustics

Outdoor shooting range noise control and acoustics

<http://troyacoustics.com/applications/shooting-ranges/>

1 (818) 376-8490

Range Systems

Ballistics Materials Specialists, Shooting Houses

<https://www.range-systems.com/>

1 (888) 999-1217

ITM Instruments

Sound level meters

<http://www.itm.com/category/sound-level-meters>

1 (800) 561-8187

NetWell Noise Control

Sound proofing materials (QBO blankets)

<http://www.controlnoise.com/soundproofing-a-gun-range/>

1 (800) 638-9355

Meggitt Training Systems

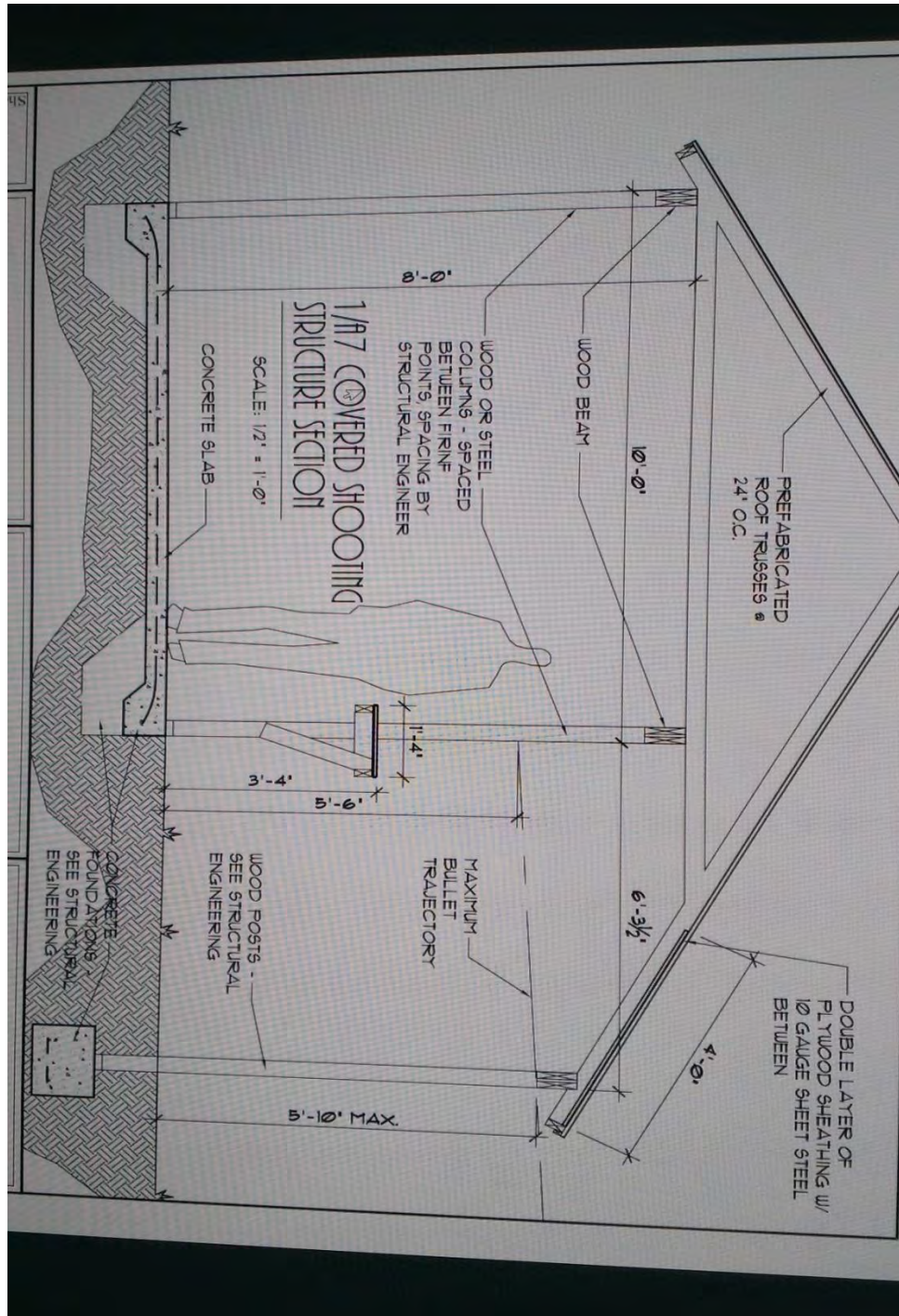
Gun range design, equipment, and instillation

<http://meggitttrainingsystems.com/>

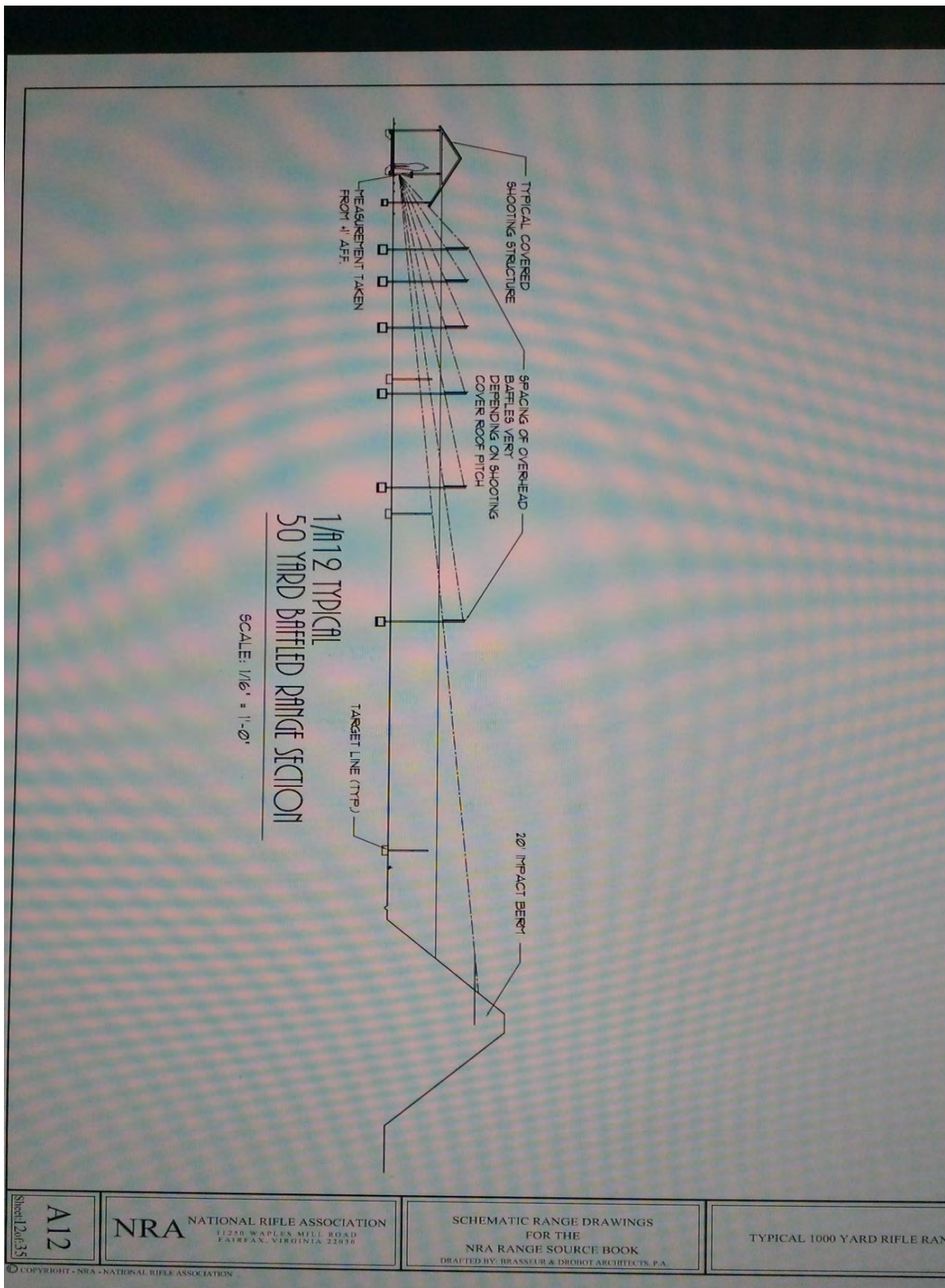
1 (800) 813-9046

9.0 - Appendix

9.1 – Covered Shooting Structure Example



9.2 – Typical Baffled Range Layout



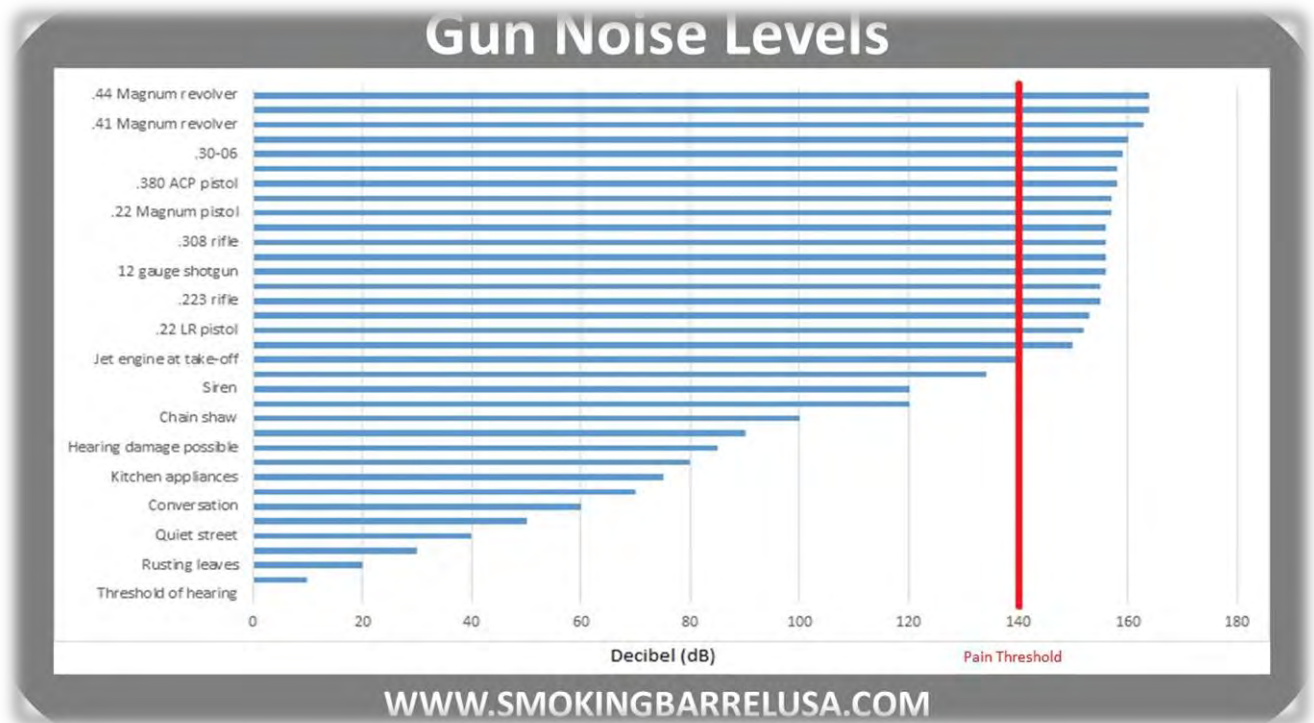
9.3 - Continuous noise / Impulse noise limits per province

This table displays the noise level limits for continuous and impulse noise levels on a provincial and country wide basis.

Jurisdiction (federal, provincial, territorial)	Continuous Noise*	Impulse / Impact Noise*	
	Maximum Permitted Exposure Level for 8 Hours: dB(A)	Maximum Peak Pressure Level dB(peak)	Maximum Number of Impacts
Canada (Federal)	87	-	-
British Columbia	85	140	-
Alberta	85	-	-
Saskatchewan	85	-	-
Manitoba	85	-	-
Ontario	85	-	-
Quebec	90	140	100
New Brunswick	85	140	-
Nova Scotia	85	-	-
Prince Edward Island	85	-	-
Newfoundland and Labrador	85	-	-
Northwest Territories	85	140	100
Nunavut	85	140	-
Yukon Territories	85	140	90
Average	85.5	140	96.7

9.4 - Gun Shot Noise Levels

This chart displays the decibel levels of various types of firearms and other noise emitting sources.



("The Smoking Barrel - Shooting Straight", 2016)

10.0 - Bibliography

Primary Reference

NRA Range Source Book. (2012) (1st ed.). Fairfax.

The National Rifle Association Range Source Book contains extensive information on all aspects of shooting ranges, including noise management and range development and operations.

Secondary References

Cotter, D. (1993). *Shooting Range Public Relations, Management and Planning Manual*. Retrieved from http://www.nssf.org/ranges/rangeresources/library/detail.cfm?filename=community_relations/shooting_range_public_relations.htm&CAT=Community%20Relations

This report explores techniques that can assist in a shooting range's public relations efforts. The content assisted in providing a basis of understanding to work with in regards to dealing with noise complaints.

Murphy, W., & Tubbs, R. (2007). Assessment of Noise Exposure for Indoor and Outdoor Firing Ranges. *Journal Of Occupational And Environmental Hygiene*, 4(9), 688-697. <http://dx.doi.org/10.1080/15459620701537390>. Retrieved from <http://www.tandfonline-com.ezproxy.library.uvic.ca/doi/pdf/10.1080/15459620701537390>

This report contains an assessment of noise exposure levels for indoor and outdoor shooting ranges. In addition, it includes information on noise measurements, equipment, and calibration.

National Institute for Occupational Safety and Health,. (2011). *Noise and Lead Exposures at an Outdoor Firing Range*. California. Retrieved from <http://www.cdc.gov/niosh/hhe/reports/pdfs/2011-0069-3140.pdf>

This report contains information and recommendations on noise testing performed at a California shooting range.

RCMP, (1999). *Shooting Ranges and Sound*. Ottawa. Retrieved from <http://file:///C:/Users/Owner/Downloads/Range-Guidelines-sound.pdf>

This publication covers information on the physics of sound, and how it applies to firearms. In addition, it discusses a variety of information on sound level assessment and measurement, shooting range design, and sound abatement techniques.