

Gun range noise attenuation prototype

August 21, 2012

Pontiac Lake Recreation Area

7800 Gale Road Gun Range

Waterford, Michigan 48327

The project:

- This project is a cooperative effort between the writer and the Michigan Department of Natural Resources to develop a practical, low-cost method of attenuating the gun noise at the Gale Road Gun Range, while maintaining the friendly and fun environment. This specific project is proposed as the initial phase of a multi-phase program. The sound attenuation from this phase is to be significant to a large number of neighbors. Other phases are required to provide a balanced level of attenuation to all of the adjacent community. The other phases include a wall to the rear of the skeet range, a large earthen berm on the East of the gun range and another wall to the rear of the gun range.
- The design elements have been primarily developed by Rick Phillips and Jack Stockbridge. Rick has years of experience with gun ranges, and Jack has years of experience in noise attenuation.
- The results are significant. The documentation shows the near field attenuation of greater than 10 dB. A reduction to the down-range community of the same magnitude is expected. Winter noise levels 1 ¼ miles to the Northeast are around 65 dBA Fast, depending on the day and the gun. A 10 dB reduction of sound by completing the initial phase will be a tremendous relief to the adjacent down-range community.
- Discussions with shooters have been generally positive. Some lament the loss of the fully open feeling without the structure. The shooters feel the wide target area visibility continues to be a positive aspect. Others appreciate the wind break the structure provides and that their casings roll out at their feet.

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The original project objectives:

- Reduce the down range gun range noise by 10 dB.
- Reduce the gun range noise directly to the side by 10 dB.
- Reduce the noise to the rear of the gun range by 1 to 2 dB.
- Maintain the positive shooting environment.
- Maintain a safe shooting environment by using bullet friendly materials.
- Provide improved casing retrieval down-range from the line of fire.
- Enable periodic cleaning of leaves, etc., with minimal effort.
- Use standard, low-cost, construction materials to support an affordable project with manageable maintenance cost.

Essentially, all objectives have been met:

- Ten out of twelve down-range mic positions / measurement types met the 10 dB objective. Two mic positions / measurement types showed a 6 dB reduction, less than the intended 10 dB but still significant. The down-range positions showed reductions up to 20 dB.
 - The overall noise (dBA Fast) 20 yards directly down-range had a 6 dB reduction. This point is close to line of sight from the gun, where the structure will have a reduced effect. The impulsive noise at the same position shows a 10 dBA Imp Peak Hold reduction.
 - The impulsive noise (dBA Imp Peak Hold) 20 yards down range and 20 yards to the side had a 6 dB reduction. This point was attenuated to the same level as other adjacent positions, a possible indication that the sonic traveling bullet down range is creating a floor noise level. The overall noise at this same position shows a 10 dBA Fast reduction.
- The increase in the impulsive noise at the shooter's ear is felt to be mainly due to the new feature that returns the casing. The overall noise at the shooter's ear is the same as without the structure. Interviews with shooters indicated the increased impulsive noise was not a factor, with positive comments on the brass return features.
- The initial retail estimate for material is \$1,290 per double station, or \$20,640 for the project.

20ft above ground	Overall	Impulsive
20Yd down range	dBA	dBA-Imp
Directly down range	Fast	Peak Hold
Original	111	122
Improved	105	112
Improvement	6	10

20 yds. down-range

20ft above ground	Overall	Impulsive
20Yd down range	dBA	dBA-Imp
10Yd to the right	Fast	Peak Hold
Original	109	121
Improved	99	109
Improvement	10	12

20 yds. down-range
& 10 yds. To the East

20ft above ground	Overall	Impulsive
20Yd down range	dBA	dBA-Imp
20Yd to the right	Fast	Peak Hold
Original	106	115
Improved	96	109
Improvement	10	6

20 yds. down-range
& 20 yds. To the East

20ft above ground	Overall	Impulsive
10Yd down range	dBA	dBA-Imp
Directly down range	Fast	Peak Hold
Original	118	126
Improved	104	110
Improvement	14	16

10 yds. down-range

20ft above ground	Overall	Impulsive
5Yd down range	dBA	dBA-Imp
5Yd to the right	Fast	Peak Hold
Original	116	127
Improved	101	112
Improvement	15	15

5 yds. down-range
& 5 yds. to the East

3ft above ground	Overall	Impulsive	20ft above ground	Overall	Impulsive
Shooters Ear	dBA	dBA-Imp	0Yd down range	dBA	dBA-Imp
Shooters Ear	Fast	Peak Hold	Next to structure	Fast	Peak Hold
Original	120	135	Original	114	127
Improved	126	134	Improved	94	114
Improvement	-6	1	Improvement	20	13

Shooter

Next to the enclosure

20ft above ground	Overall	Impulsive
10Yd behind	dBA	dBA-Imp
Directly behind	Fast	Peak Hold
Original	111	121
Improved	107	119
Improvement	4	2

10 yds. behind

Gun range noise attenuation prototype results

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Mic positions relative to the shooter with before and after readings.
Both the dBA Imp Peak Hold and dBA Fast filtered values are shown.

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General Information

- The noise readings were taken within the gun range to get repeatable and representative values. These are called “Near Field” readings or “Direct Field” readings, where the readings are directly from the source. The readings shown accurately relate the attenuation in the measured directions. When using the Near Field approach, consistent mic location is vital. Small changes can have a significant impact. To insure the accuracy, the mic stands were anchored in concrete with a tight fitting sleeve between the mic mast and the mounts. Several readings were repeated on different days with 0 dB to 1 dB variation.
- The noise propagation to the adjacent community is very dependent on these conditions: temperature, humidity, wind, and the temperature difference between the surface of the surrounding lakes and the air above the lakes. The community readings on cold days can be much louder. The range is surrounded by lakes and hills. Quantifying the improvement using community noise levels in the summer would be misleading. The day to day, hour by hour measurement fluctuation make the data useless.
- The mic was positioned atop a metal pipe 20 feet off the ground. The noise bubble heard by the adjacent community leaves the range at a slight upward angle, captured by the elevated mic. The elevated mic also avoids the sonic bullet noise right next to the mic that would give misleading readings.
- To better relate the intensity of the noise, the sound is filtered two different ways. The noise readings included dBA Impulsive Peak Hold and dBA Fast without peak hold. The dBA Impulsive Peak Hold filter is used to relate the shock wave portion of the noise. The dBA Fast without peak hold filter is used to relate the overall noise. Independently, they do not fully relate the intensity of the gun noise. Taken together, they give a more accurate impression.

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Discussion Points:

- The noise from the skeet range and the gun range combine to produce the “overall range noise” heard by the community. Some communities around the range mainly hear the gun range and others mainly hear the skeet range. Some hear a combination. This project focused on attenuating the gun range noise to the West, Northwest, North, Northeast, and East.
 - There will be significant attenuation of the overall range noise to the North, and Northeast. The overall range noise to the North, and Northeast is primarily due to the gun range, not the skeet range.
 - There will be partial attenuation of the overall range noise to the East. The gun range noise directly to the East will be significantly attenuated. However, these neighbors hear a combination of gun range and skeet range noise.
 - There will be no overall range noise reduction to the Northwest and West. The overall range noise to the Northwest and West is primarily due to the skeet range. The skeet range noise is not reduced by this project. There is mainly Park for two miles to the Northwest.
 - This project will not give attenuation to the overall range noise to the South, Southwest or Southeast. There is minimal attenuation from the gun range to the South, Southwest and Southeast .
- The gun range noise to the rear was only slightly attenuated, within the original objectives. Features to the rear of the gun range are needed to attenuate the gun range noise to the South. A 25 foot tall rear berm would be most effective but poses major challenges such as cost and handicap accessibility. A tall vertical rear wall would reflect noise back down range, canceling some of the effectiveness of the proposed structures and pose a snow removal challenge. A rear enclosure is not practical due to the smoke accumulation from muzzle loading firearms. A 4-foot-tall solid wood wall 12 feet behind the line of fire, where an open fence is currently, would offer a balance of a small amount of noise attenuation to the South for a limited cost.

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Discussion Points:

- The noise attenuation features in the structure are expected to improve stray bullet containment. However, there are no claims to this aspect. The writer has no experience in stray bullet containment. The stray-bullet containing features of the prior structure were maintained.
- The immediate vertical features inside the prior shooting station were duplicated to maintain the same level of bounce-back risk from wads and cartridges.
- Each features in the proposed structure is part of the overall system to maximize the attenuation. The removal of any features to thrift this project will increase the noise to different areas of the surrounding community. The loss of attenuation to a specific area can be dramatic with even a minor omission.

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Technical understanding:

- +1 dB is barely noticeable to the human ear for low intensity sound like music.
- +1 dB is noticeable for high intensity sound like gun fire.
- +3 dB is the increase if the source is doubled, two guns at the same time.
- +3 dB is noticeable for steady state sounds like music.
- +3 dB is definitely noticeable for high intensity sounds like gun fire.
- +6 dB is double the sound pressure on the ear.
- +10 dB is three times the sound pressure.
- +10 dB is perceived as twice the sound level.
- <http://www.elcaudio.com/decibel.htm>



The original frame structure exists to insure stray bullets do not leave the range.
The noise enclosure puts sides and a roof to the existing structure.
There is no down range noise improvement with just sides and a roof, the noise is just redirected.
The internal baffles and noise absorbing insulation are vital and effective.
The target visibility is the same.



Gun range noise attenuation Prototype pictures

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