Sound Decisions About Highway Noise Abatement

Barriers in Your Backyard

Construction of Noise Barriers
The actual cost of noise barriers can often be more than $2 million a mile under normal conditions and can become more than $3 million a mile if noise walls have to be placed on bridges or involve other special designs, such as retaining walls. The costs to the impacted community for the installation of a noise barrier may include some loss to back yard area due to the need to acquire right-of-way to construct the barrier. If there are trees growing in the area where the noise barrier will be constructed, it is most likely that they will have to be removed to accommodate the construction. However, efforts will be made to save as many trees as possible. Generally speaking, it is best to locate noise barriers as close as possible to either the highway or the impacted community to be most effective. Either way, the barriers will be built on PENNDOT owned right-of-way and will be the property of the Department.

Maintenance of Noise Barriers
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What Projects Are Eligible?
Only certain highway improvement projects are eligible for noise mitigation in Pennsylvania. These projects have the potential to alter the acoustical environment and are analyzed for noise impacts and abatement is considered. The scope of these types of projects include highways on new locations, substantial alteration of either the vertical and/or horizontal alignment on existing highways, and various other improvement projects, including certain auxiliary lanes, weigh stations, rest areas, etc.

Applying The Process To Eligible Projects
There is a specific process that PENNDOT uses to identify communities that will be considered for noise abatement and to determine whether noise abatement measures can be implemented within state or federal guidelines. This process includes the following steps.

The first step in the process is to determine which land-uses in the project could be affected by the project. The Federal Highway Administration (FHWA) has established noise abatement criteria for various land uses which PENNDOT uses to determine impacts and where abatement consideration is warranted. Locations such as residences, libraries, houses of worship, hospitals, schools and parks are often the most common land uses that receive abatement consideration.

Monitor Noise Levels
After noise-sensitive locations that may be affected by the proposed highway project have been identified, existing traffic noise levels are monitored at locations that are representative of affected neighborhoods. The results of the monitoring sessions are used to ensure that the noise prediction model will provide accurate results. Many people ask why their house was not monitored and included in the computer model and additional locations are added to comprehensively delineate the impacted areas.

The Noise Abatement Process

Noise Abatement Consideration
The next step is where noise mitigation is considered at the noise-impacted locations. If you attend a public meeting for a highway project that includes a discussion of noise issues, you may hear people talking about warranted, feasible and reasonable. The terms describe the three steps PENNDOT must take when considering noise abatement for noise-sensitive areas.

To determine whether abatement consideration is warranted, we compare the noise modeling projections to the noise impact criteria for the land use. Using criteria based on FHWA guidelines, abatement is warranted if the future noise levels approach or exceed the noise abatement criteria or are elevated by 10 decibels (dB(A)) above the existing conditions. PENNDOT defines an impact for residential areas as 66 dB(A). For communities where noise abatement consideration is warranted, the next step is to consider whether the noise abatement would be feasible for each affected community. Traffic noise abatement is typically provided by using highway noise barriers. Feasible noise barriers are those that provide at least 5 dB(A) of noise reduction to sensitive locations and pose no safety, engineering, or access restrictions.

If a noise barrier system is determined to be feasible, the next step is to determine whether or not the barrier is reasonable for construction. For a barrier to be reasonable it must be cost effective and maintenance, constructability, drainage and utility impacts, as well as the desires of the affected residents, must be considered.

Your Role in the Process
For some highway projects, more than one alternative design is considered. The design of noise barriers begins when a final alignment has been selected for the highway. During noise barrier design process, you will have opportunities to have your concerns addressed through public meetings. To fully participate, try to attend these meetings, fill out all project questionnaires, and voice your concerns and opinions. It is during these meetings that the affected community gets to choose the type, texture and color of the barrier facing the residents.

When it is determined that noise barrier is warranted, feasible and reasonable, public preferences are considered. If the majority of affected residents do not want the noise wall, the barrier will not be constructed.
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Keep in mind these decisions are normally true for vehicular speeds over 30 miles per hour. Highways are typically dominated by tire noise while local streets are typically dominated by engine and exhaust noise. The sound will travel farther over a hard reflective surface than one covered with vegetation. Spreading effects diminish sound at a constant rate as the sound travels away from its source. Sound from a line source — such as a highway — decreases at a rate of approximately 3 dB(A) per doubling of distance from the source.

Principles of Outdoor Sound Control
When trying to solve a noise problem, we look for practical solutions in terms of treating the source of the noise, and the path between the noise source and the listener. Since the source of traffic noise is the combination of vehicles on a highway, the only practical option is to try to reduce the noise along the path between the highway and the listeners.

Traffic Noise Generation
When a sound source is stationary, it is called a point source and it radiates sound equally in all directions like a pulsing sphere. When many sound sources are moving in a line, the sound radiates like a pulsing cylinder from the sources. Traffic noise is generated in this fashion. It is important to distinguish point sources from line source because each has different characteristics.

Traffic Noise Sources
The principal noise sources of highway vehicles are the exhaust system, engine, and tires. Exhaust noise is typically controlled by mufflers, assuming they are used and are functioning properly. Engine noise can only be controlled by vehicle manufacturers and proper maintenance. Factors that PENNDOT has no control over. Tire noise is generated by the interaction of each vehicle’s tires with the road surface. Engine and exhaust noise are usually louder than tire noise at vehicular speeds under 30 miles per hour. The reverse is normally true for vehicular speeds over 30 miles per hour. Highways are typically dominated by tire noise while local streets are typically dominated by engine and exhaust noise. The overall noise level generated by vehicles on a highway depends on the number of vehicles, the speed of the vehicles, and the types of vehicles. The figures below show generally how these factors influence noise levels.

Traffic Noise Propagation
The travel, or propagation, of traffic noise depends mainly on three factors — atmospheric effects, ground effects, and spreading effects. Atmospheric conditions change the direction of sound travel and constantly change. Ground conditions also affect sound travel.

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Available Abatement Options
Noise barriers and other techniques are available to abate traffic noise. In Pennsylvania, PENNDOT only uses noise barriers that have been approved through a rigorous product evaluation process to ensure safety, integrity, longevity, and preservation of aesthetics. The pictures on the back page of this brochure show some of the different types of noise abatement options PENNDOT has available. Consult the local PENNDOT Engineering District for color and texture availability in your area.

How Speed Affects Traffic Noise
Traffic at 65 miles per hour sounds twice as loud as traffic at 30 miles per hour.

How Traffic Volume Affects Noise
2000 vehicles per hour sound twice as loud as 200 vehicles per hour.

Table: Sound Pressure Levels for Common Sources

<table>
<thead>
<tr>
<th>dB(A)</th>
<th>Perception of Loudness</th>
<th>Sound Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1/6 as loud as 50 dB(A)</td>
<td>Normal breathing</td>
</tr>
<tr>
<td>20</td>
<td>1/8 as loud as 50 dB(A)</td>
<td>Broadcast studio</td>
</tr>
<tr>
<td>30</td>
<td>1/4 as loud as 50 dB(A)</td>
<td>Library</td>
</tr>
<tr>
<td>40</td>
<td>1/2 as loud as 50 dB(A)</td>
<td>Refrigerator</td>
</tr>
<tr>
<td>50</td>
<td>Reference level</td>
<td>Clothes dryer</td>
</tr>
<tr>
<td>60</td>
<td>2 times louder than 50 dB(A)</td>
<td>Air conditioning unit</td>
</tr>
<tr>
<td>70</td>
<td>4 times louder than 50 dB(A)</td>
<td>Pick-up truck @ 50mph, 50’</td>
</tr>
<tr>
<td>80</td>
<td>8 times louder than 50 dB(A)</td>
<td>Medium truck @ 50mph, 50’</td>
</tr>
<tr>
<td>90</td>
<td>16 times louder than 50 dB(A)</td>
<td>Motorcycle @ 50mph, 50’</td>
</tr>
<tr>
<td>100</td>
<td>32 times louder than 50 dB(A)</td>
<td>Jet flyover @ 1000’</td>
</tr>
</tbody>
</table>
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