**INDOT’s Goal for Noise Reduction**

INDOT’s goal for substantial noise reduction is to provide at least a 7 dB(A) reduction for first-row receivers in the year the barrier is constructed. However, conflicts with adjacent properties may make it impossible to achieve substantial noise reduction at all impacted receptors. Therefore, the noise reduction design goal for Indiana is 7 dB(A) for a majority (greater than 50 percent) of the first-row receivers.

**Highway Traffic Noise Barriers:**

- Can reduce the loudness of traffic noise by as much as one-half
- Do not completely block all traffic noise
- Can be effective regardless of the material used
- Must be tall and long with no openings
- Are most effective within 200 feet of a highway (usually the first row of homes)
- Are designed to be visually appealing
- Are designed to preserve aesthetic values and scenic vistas
- Do not increase noise levels perceptibly on the opposite side of a highway
- Substantially reduce noise levels for people living next to highways

**What is Noise?**

Noise is defined as unwanted sound and can come from man-made and natural sources. Sound levels are measured in decibels (dB) and typically range from 40 to 100 dB.

Because human hearing is limited in detecting very high and low frequencies, “A-weighting” is commonly applied to sound levels to better characterize their effects on humans. A-weighted sound levels are expressed as dB(A).

**What Causes Traffic Noise?**

The level of highway traffic noise depends on three factors:

- Volume of traffic
- Speed of traffic
- Number of multi-axis vehicles

As any of these factors increase, noise levels increase. Traffic noise can also be increased by defective mufflers and steep inclines that require truck engines to labor. Traffic noise can be decreased by distance, terrain, vegetation, or man-made obstacles.

**Who Regulates Highway Noise? What is the Noise Impact Level?**

The Federal Highway Administration (FHWA) has developed regulations regarding noise analysis on federally funded highway projects, and INDOT has outlined its implementation guidance in its Traffic Noise Policy.

The policy establishes two criteria for identifying an impact resulting from a project:

1. **Accounting where future predicted noise levels would approach or exceed a set of Noise Abatement Criteria (NAC) established in the FHWA regulations.** For outdoor uses in residential areas, the NAC is 67 dB(A); INDOT defines “approaching the NAC” as within 1 dB (66 dB(A)) for residential areas. Therefore, locations where future noise levels are predicted to be 66 dB(A) or higher are considered “impacted.”

2. **Accounting locations where noise levels are expected to increase by 15 dB(A) or more over existing levels.**

**Changing in Sound Level**

<table>
<thead>
<tr>
<th>Change in Sound Level</th>
<th>Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 dB(A)</td>
<td>Slightly Perceptible</td>
</tr>
<tr>
<td>5 dB(A)</td>
<td>Clearly Perceptible</td>
</tr>
<tr>
<td>10 dB(A)</td>
<td>Twice as loud</td>
</tr>
</tbody>
</table>

Sources:

U.S. Department of Transportation, Federal Highway Administration
"Keeping the Noise Down" Highway Traffic Noise Barriers website
http://www.fhwa.dot.gov/environment/noise/noisebarriers

Indiana Department of Transportation Traffic Noise Analysis Procedure (2011) http://www.in.gov/indot/environment/services/noisebarriers
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Highway Traffic Noise Barriers:
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- Substantially reduce noise levels for people living next to highways

Accessibility:
- Subway: 1
- Bus: 1
- Park: 1
- Food: 1

Noise Barriers

Indiana citizens play an important role in shaping decisions that affect their communities.

The Indiana Department of Transportation recognizes that providing information and eliciting public input on transportation decisions is crucial to fulfilling its mission to plan, build and maintain facilities that best meet Indiana’s needs.

What is Noise?

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Because human hearing is limited in detecting very high and low frequencies, “A-weighting” is commonly applied to sound levels to better characterize their effects on humans. A-weighted sound levels are expressed as dBA.

What Causes Traffic Noise?

The level of highway traffic noise depends on three factors:
- Volume of traffic
- Speed of traffic
- Number of multi-vehicle sides

As any of these factors increase, noise levels increase. Traffic noise can also be increased by defective mufflers and steep inclines that require truck engines to labor. Traffic noise can be decreased by distance, terrain, vegetation, or man-made obstacles.

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Highway Traffic Noise Barriers:

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<table>
<thead>
<tr>
<th>Common Outdoor Noise Levels</th>
<th>Noise Levels</th>
<th>Common Indoor Noise Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decibels, dB(A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jet Flyover at 1150ft (350m)</td>
<td>110</td>
<td>Rack Band</td>
</tr>
<tr>
<td>High Power Generator at 7ft (2m)</td>
<td>90</td>
<td>Fire Bellow at 13ft (4m)</td>
</tr>
<tr>
<td>Gas Lawn Mower at 3ft (1m)</td>
<td>85</td>
<td>Garbage Disposal at 9ft (3m)</td>
</tr>
<tr>
<td>Diesel Truck at 500ft (150m)</td>
<td>75</td>
<td>Shoveling at 13ft (4m)</td>
</tr>
<tr>
<td>Gas Lawn Mower at 13ft (3m)</td>
<td>65</td>
<td>Vacuum Cleaning at 13ft (4m)</td>
</tr>
<tr>
<td>Commercial Area</td>
<td>60</td>
<td>Normal Speech at 3ft (1m)</td>
</tr>
<tr>
<td></td>
<td>55</td>
<td>Dishwasher in Next Room</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45</td>
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<td>Threat to Hearing</td>
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<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Threshold of Hearing</td>
</tr>
</tbody>
</table>

The level of highway traffic noise depends on three factors:
- Volume of traffic
- Speed of traffic
- Number of multi-lane vehicles

As any of these factors increase, noise levels increase. Traffic noise can also be increased by defective mufflers and steep inclines that require truck engines to labor. Traffic noise can be decreased by distance, terrain, vegetation, or man-made obstacles.

What Causes Traffic Noise?

The level of highway traffic noise is affected by three factors:

1. Volume of traffic
2. Speed of traffic
3. Number of multi-lane vehicles

Who Regulates Highway Noise? What is the Noise Impact Level?

The Federal Highway Administration (FHWA) has developed regulations regarding noise analysis on federally funded highway projects, and INDOT has outlined its implementation guidance in its Traffic Noise Policy. The policy establishes two criteria for identifying an impact resulting from a project:

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2. Ascertaining locations where noise levels are expected to increase by 15 dB(A) or more over existing levels.
How Are Noise Levels Predicted?

Traffic noise can be potentially reduced by modifying either the source of the noise (speed, volume or type of vehicles), the location of the receiver (the person who hears the noise), or the path by which the noise reaches the receiver. Because it is impractical to reduce the speed, volume or type of vehicles on a highway, or to relocate residences solely due to impacts from noise, the most common approach to mitigating noise is the construction of noise barriers.

What is a Noise Barrier?

Noise barriers are solid obstructions built between the highway and homes or residences along a highway. Effective noise barriers typically reduce noise levels by 5 to 10 dB, which reduces the loudness of traffic noise by as much as one-half.

Noise barriers do not completely eliminate noise, but rather reduce overall noise levels. The closer you are to the barrier, the greater reduction in noise is achieved. Noise barriers can be created from earth mounds or “berms” along the roadside, from high, vertical walls, or from a combination of berms and walls. Earth berms have a very natural appearance and are usually attractive. They also reduce noise by approximately 3 dB more than vertical walls of the same height. However, earth berms can be a lot of work, especially if the location does not have enough space, but they are usually limited to 25 feet in height for structural and aesthetic reasons.

When is a Noise Barrier Considered?

INDOT considers traffic noise barriers if it determines there will be traffic noise impacts, such as when a proposed project involves the construction of a new highway or the reconstruction of an existing highway that significantly changes the horizontal or vertical alignment or increases the number of through-traffic lanes. Construction of a new interchange also warrants a noise study.

When is a Noise Barrier Proposed?

INDOT proposes a noise barrier when a noise impact occurs and a barrier is considered to be feasible and reasonable. Under FHWA regulations, a noise barrier is determined to be feasible if it achieves at least a 5 dB(A) reduction in traffic noise at the impacted property (the receptors) nearest the noise source.

INDOT’s goal for a proposed barrier is to provide at least a 7 dB(A) reduction for receptors in the year the barrier is constructed. A barrier must also be reasonable, meaning the barrier must meet INDOT’s cost-benefit analysis and be desired by landowners.

What is a Benefited Receiver?

Benefitted receptors are those property parcels that receive a minimum 5 dB(A) reduction in future noise levels. A first-row receiver is the first receptor property parcel adjacent to the roadway. Undeveloped land that is permitted or has a foundation under construction can be a first-row receiver. There is no set distance requirement.

What is a Feasible Noise Barrier?

INDOT requires noise abatement measures to be based on sound engineering practices and standards and requires that any measure be evaluated at the optimum location.

Noise barriers require long, uninterrupted segments to be effective. As such, if there are existing roadway access points and/or driveways, it is not feasible to construct effective noise barriers. Engineering feasibility also takes into account topography, drainage, safety, barrier height, utilities, and access and maintenance needs, which may include right-of-way considerations. In situations where engineering considerations make noise barriers unfeasible, the noise analysis will explicitly state the reasons (topography, drainage, safety, or other factors).

INDOT requires that noise barriers achieve a minimum 5 dB(A) reduction at a majority (greater than 50 percent) of the impacted noise receptors (those that would receive a reduction at least 5 dB(A)). If a barrier cannot achieve this acoustic goal, it is not considered to be acoustically feasible.

What is a Reasonable Noise Barrier?

The cost of constructing a noise barrier is a significant factor in determining if a barrier is considered to be reasonable or not. To determine cost-effectiveness, the estimated cost of construction (including installation and additional necessary construction, such as foundations or guardrails) is divided by the number of benefitted receptors. INDOT’s Noise Abatement Analysis Procedure considers a material and design cost of $25,000 or less per benefitted receptor to be cost-effective.

Development in which a majority (more than 50 percent) of the receptors was in place prior to the initial construction of the roadway in its current state will receive additional consideration for noise abatement. The criteria for cost-effectiveness in these cases is 20 percent greater ($30,000 per benefitted receptor).

INDOT continues to monitor advances in technologies in addition to evaluating other methods of addressing traffic noise and its related impacts.

INDOT uses $30/acre-foot to estimate noise barrier construction cost. A cost per benefitted receptor of $25,000 or less is considered cost-effective. The cost per benefitted receptor rises to $30,000 if a majority of benefitted homes were built prior to initial construction of the roadway in its current state.

What is a Noise Survey and Why is it Important?

After a noise barrier is determined to be feasible, a noise survey helps determine if it is reasonably significant and cost-effective. A noise survey is gathering input from impacted residents, businesses, and other stakeholders in close proximity to a proposed barrier. A noise survey is a general questionnaire to respondents to solicit basic information, including their name, address, preferences regarding a barrier, and any general comments they wish to provide. The survey is mailed to each benefitted resident. If the property owner is different from the current resident, both the owner and resident are surveyed. The concerns and opinions of the property owner and the resident will be balanced with other considerations in determining whether a barrier is appropriate.

The noise survey includes a response postcard, a brief description of the project, barrier locations under consideration, and information on the basics of traffic noise. All responses or opinions regarding barriers must be expressed in writing to INDOT, by either letter, email or the response postcard.

Proposed noise barriers can cause conflicts in mixed-use developments, as barriers to protect residences may block line-of-sight to adjacent businesses. If a barrier is blocked by businesses or adjacent to the property line of a business, the business will be solicited for input to determine its concerns about line-of-sight. If a mutually satisfactory compromise cannot be reached between businesses and residences, the barrier may end at the property line dividing the two areas.

What Does a Noise Barrier Look Like?

Noise barriers typically consist of concrete panels placed between steel supports. The height and location of a barrier is determined in the INDOT analysis. The color and texture of INDOT barriers is consistent across the state.

How Does a Noise Barrier Work?

Noise barriers reduce the sound from a busy highway by either absorbing the sound, transmitting it, reflecting it back across the highway, or forcing it to take a longer path to reach a receiver. A noise barrier must be tall enough and long enough to block traffic noise from the area to which it is to be protected. Noise barriers provide very little benefit for homes on a hillside overlooking a highway or for buildings which can see over or through, it can achieve approximately 1.5 dB of additional noise level reduction for each meter of barrier height.

To effectively reduce the noise coming around its ends, a barrier should be at least eight times as long as the distance from the receiver to the barrier.

Does a Barrier Increase Noise on the Opposite Side of the Highway?

Residents adjacent to a highway sometimes believe that their noise levels have increased because of construction of a barrier on the opposite side of the highway. However, field studies have shown that this is not true. If all the noise striking a noise barrier were reflected back to the other side of the highway, the increase would be theoretically limited to 3 dB. In practice, not all of the acoustical energy is reflected back. Some of the energy goes over the barrier, some is reflected to points other than the homes on the opposite side, some is scattered by vegetation, and some is blocked by vehicles on the highway. Additionally, some of the reflected energy is lost due to the longer path that it must travel. Measurements made to quantify this reflective impact have never shown an increase of greater than 1-2 dB. This increase is not perceptible to the average human ear.

What if I Don’t Want a Noise Barrier?

Although owners of residential property generally support barrier construction, some commercial property owners may prefer not to have a barrier adjacent to their property. For example, a business that relies on highway visibility to attract customers may prefer a barrier, despite the noise reduction benefit. Prior to allowing construction of a barrier, INDOT surveys affected property owners to gauge their interest, and a majority of those owners must support construction.

Can Trees Act as a Noise Barrier?

Vegetation, if it is high enough, wide enough, and dense enough that it cannot be seen over or through, can decrease highway traffic noise. A wide strip of trees with thick undergrowth can reduce noise by 5 dB. However, it is not feasible to plant enough trees and other vegetation along a highway to achieve such a reduction. As it pertains to noise, trees and other vegetation can be planted for psychological and/or aesthetic benefit, but not to physically lessen noise levels.

Who Maintains a Noise Barrier?

INDOT constructs noise barriers only on INDOT property and is responsible for maintaining them.

Your Input Matters

INDOT strives to understand the needs of residents and businesses that may be impacted by traffic noise. Public input is an important consideration when determining whether noise abatement is appropriate for an area. For more information, contact your local district.

INDOT Offices

INDOT Crawfordville District 41 West 300 North Crawfordsville, IN 47933 Toll Free: 1-888-924-6368 eastcentral@indot.in.gov

INDOT Vincennes District 3650 South U.S. Highway 41 Vincennes, IN 47591 Toll Free: 1-800-279-5758 swcommunications@indot.in.gov

INDOT Seymour District 165 Argia Street Seymour, IN 47274 Toll Free: 1-877-305-7611 secommunications@indot.in.gov

INDOT Greenfield District 32 South Broadway Greenfield, IN 46140 Toll Free: 1-855-463-6845 eastcentral@indot.in.gov

INDOT LaPorte District 318 E. Boyd Blvd LaPorte, IN 46350 Toll Free: 1-855-463-6845 LaPorteDistrictCommunications@indot.in.gov

INDOT Fort Wayne District 3333 chilled Road Fort Wayne, IN 46808 Toll Free: 1-800-272-3555 NENforn@indot.in.gov

INDOT Office of Public Involvement 100 North Senate Avenue, Room 4N42 Indianapolis, IN 46204 Toll Free: 1-866-849-1368 pubinvolvement@indot.in.gov
How Are Noise Levels Predicted?

The FHWA Traffic Noise Model (TNM) measures traffic noise factors to generate a 3-D model that can predict noise levels during the noisiest hour of the day. Based on noise levels predicted with and without a proposed project, the model identifies where noise impacts occur and property mitigation should be considered.

What is a Benefited Receptor?

Benefited receptors are those property parcels that receive a minimum 5 dBA reduction in future noise levels. A first-row receiver is the first receptor property parcel adjacent to the roadway. Undeveloped land that is permitted or has a foundation under construction can be a first-row receiver. There is no set distance requirement.

What is a Feasible Noise Barrier?

INDOT requires noise abatement measures to be based on sound engineering practices and standards and requires that any measure be evaluated at the optimum location.

Noise barriers require long, uninterrupted segments to be effective. As such, if there are existing roadway access points and/or driveways, it is not feasible to construct effective noise barriers. Engineering feasibility also takes into account topography, drainage, safety, barrier height, utility, access and maintenance needs, which may include right-of-way considerations. In situations where engineering considerations make noise barriers unfeasible, the noise analysis will explicitly state the reasons (topography, drainage, safety, or other factors).

INDOT requires that noise barriers achieve a minimum 5 dBA reduction at a majority (greater than 50 percent) of the impacted noise receptors (those that would receive a reduction of at least 5 dBA). If a barrier cannot achieve this acoustic goal, it is not considered to be acoustically feasible.

What is a Reasonable Noise Barrier?

The cost of constructing a noise barrier is a significant factor in determining if a barrier is considered to be reasonable or not. To determine cost-effectiveness, the estimated cost of construction (including installation and additional necessary construction, such as foundations or guardrails) is divided by the number of benefitted receptors. INDOT’s Traffic Noise Analysis Procedures consider a material and design cost of $25,000 or less per benefitted receptor to be cost-effective.

Development in which a majority (more than 50 percent) of the receptors was in place prior to the initial construction of the roadway in its current state will receive additional consideration for noise abatement. The criteria for cost-effectiveness in these cases is 20 percent greater ($30,000 per benefitted receptor).

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INDOT uses $30 per foot to estimate noise barrier construction cost. A cost per benefitted receptor of $25,000 or less is considered cost-effective. The cost per benefitted receptor rises to $30,000 if a majority of benefitted homes were built prior to initial construction of the roadway in its current state.

What is a Noise Survey and Why is it Important?

A noise survey is a general questionnaire to respondents to solicit basic information, including their name, address, preferences regarding a barrier, and any general comments they wish to provide. The survey is mailed to each benefitted receptor.

After a noise barrier is determined to be feasible, a noise survey helps determine if it is reasonable to construct it on the property. One important part of the questionnaire is gathering input from impacted residents, businesses, and other stakeholders in close proximity to a proposed barrier.

Noise barriers do not completely eliminate noise, but rather reduce overall noise levels. The closer you are to the barrier, the greater reduction in noise is achieved.

Effective noise barriers typically reduce noise levels by 5 to 10 dBA, which reduces the loudness of traffic noise by as much as one-half.

Noise barriers do not completely eliminate noise, but rather reduce overall noise levels. The closer you are to the barrier, the greater reduction in noise is achieved. Noise barriers can be created from earth mounds or “berms” along the roadside, from high, vertical walls, or from a combination of berms and walls. Earth berms have a very natural appearance and are usually attractive. They also reduce noise by approximately 3 dB more than vertical walls of the same height. However, earth berms have a lot of land, especially one that is necessary for the road’s right-of-way, but they are usually limited to 25 feet in height for structural and aesthetic reasons.

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INDOT proposes a noise barrier when a noise impact occurs and a barrier is considered to be feasible and reasonable. Under FHWA regulations, a noise barrier is determined to be feasible if it achieves at least a 5 dBA reduction in traffic noise on the impacted property parcels (the receptors) nearest the noise source. INDOT’s goal for a project is to provide at least a 7 dBA reduction for receptors in the year the barrier is constructed. A barrier must also be reasonable, meaning the barrier must meet INDOT’s cost-benefit analysis and be desired by landowners.

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Although owners of residential property generally support barrier construction, some commercial property owners may prefer not to have a barrier adjacent to their property. For example, a business that relies on highway visibility to attract customers may prefer a barrier, despite the noise reduction benefit. Prior to approving construction of a barrier, INDOT surveys affected property owners to gauge their interest, and a majority of those owners must support construction.

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Vegetation, if it is high enough, wide enough, and dense enough that it cannot be seen over or through, can decrease highway traffic noise. A wide strip of trees with thick undergrowth can lower noise levels. Ninety feet of dense vegetation can reduce noise by 5 dB. However, it is not feasible to plant enough trees and other vegetation along a highway to achieve such a reduction. As it pertains to noise, trees and other vegetation can be planted for psychological and/or aesthetic benefit, but not to physically lessen noise levels.

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swincommunications@indot.in.gov

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Toll Free: 1-877-305-7611
secomcommunications@indot.in.gov

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Toll Free: 1-855-463-6844
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316 E. Boyd Blvd
LaPorte, IN 46350
Toll Free: 1-855-463-6844
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INDOT Fort Wayne District
5333 Northfield Road
Fort Wayne, IN 46808
Toll Free: 1-800-227-3555
NFInformaton@indot.in.gov

INDOT Office of Public Involvement
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Indianapolis, IN 46204
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publicinvolvement@indot.in.gov
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What is a Reasonable Noise Barrier?

Noise barriers reduce the sound from a busy highway by either absorbing the sound, transmitting it, reflecting it back across the highway, or forcing it to take a longer path to receivers. A noise barrier must be tall enough and long enough to block traffic noise from the receiver to which it is protected. Noise barriers provide very little benefit for homes on a hillside overlooking a highway or for buildings which can see over the barrier. A noise barrier can achieve a 5 dB noise level reduction when the line-of-sight from the house to the highway is broken. After it breaks the line-of-sight, it can achieve approximately 1.5 dB of additional noise level reduction for each meter of barrier height.

What is a Feasible Noise Barrier?

An effective noise barrier reduces the sound a receiver will hear by one-half. A barrier is feasible if the reduction is at least 5 dB. The cost of constructing a noise barrier is a significant factor in determining if a barrier is considered to be reasonable or not. To determine cost-effectiveness, the estimated cost of construction (including installation and additional necessary construction, such as foundations or guardrails) is divided by the number of benefited receptors. INDOT’s Traffic Noise Analysis Procedures provide a material and design cost of $25,000 per barrier, or $25,000 per foot. This cost is considered to be cost-effective.

How Does a Noise Barrier Work?

One way of effecting this is by planting vegetation. Trees, hedges, or vines can reduce noise by 5 dB. However, it is not feasible to plant enough trees and vegetation along a highway to achieve such a reduction. A wide strip of trees with thick undergrowth can lower noise levels. Ninety feet of dense vegetation on the opposite side of the highway can decrease highway traffic noise. A wide strip of trees with little benefit for homes on a hillside overlooking a highway or for buildings which can see over the barrier. A noise barrier can achieve a 5 dB noise level reduction when the line-of-sight from the house to the highway is broken. After it breaks the line-of-sight, it can achieve approximately 1.5 dB of additional noise level reduction for each meter of barrier height.

To effectively reduce the noise coming around its ends, a barrier should be at least eight times as long as the distance from the receiver to the barrier.

What is a Reasonable Noise Barrier?

The cost of constructing a noise barrier is a significant factor in determining if a barrier is considered to be reasonable or not. To determine cost-effectiveness, the estimated cost of construction (including installation and additional necessary construction, such as foundations or guardrails) is divided by the number of benefited receptors. INDOT’s Traffic Noise Analysis Procedures provide a material and design cost of $25,000 per barrier, or $25,000 per foot. This cost is considered to be cost-effective.

How Does a Noise Barrier Look Like?

Noise barriers typically consist of concrete panels placed between steel supports. The height and location of a barrier is determined by the TNM analysis. The color and texture of vegetation and INDOT seeks the input of all property owners to balance the residents’ needs with the noise reduction benefits that the barrier will provide.

Effective noise barriers typically reduce noise levels by 5 to 10 dB, which reduces the loudness of traffic noise by as much as one-half. Noise barriers do not completely eliminate noise, but rather reduce overall noise levels. The closer you are to the barrier, the greater reduction in noise is achieved. Noise barriers reduce the sound from a busy highway by either absorbing the sound, transmitting it, reflecting it back across the highway, or forcing it to take a longer path to receivers. A noise barrier must be tall enough and long enough to block traffic noise from the receiver to which it is protected. Noise barriers provide very little benefit for homes on a hillside overlooking a highway or for buildings which can see over the barrier. A noise barrier can achieve a 5 dB noise level reduction when the line-of-sight from the house to the highway is broken. After it breaks the line-of-sight, it can achieve approximately 1.5 dB of additional noise level reduction for each meter of barrier height.

To effectively reduce the noise coming around its ends, a barrier should be at least eight times as long as the distance from the receiver to the barrier.

Does a Barrier Increase Noise on the Opposite Side of the Highway?

Residents adjacent to a highway sometimes believe that their noise levels have increased because of construction of a barrier on the opposite side of the highway. However, field studies have shown that this is not true. If all the noise striking a noise barrier were reflected back to the other side of the highway, the increase would be theoretically limited to 3 dB. In practice, not all of the acoustical energy is reflected back. Some of the energy goes over the barrier, some is reflected to points other than the homes on the opposite side, some is scattered by vegetation, and some is blocked by vehicles on the highway. Additionally, some of the reflected energy is lost due to the longer path that it must travel. Measurements made to quantify this reflective impact have never shown an increase of greater than 1-2 dB. This increase is not perceptible to the average human ear.
When is a Noise Barrier Considered?

The FHWA Traffic Noise Model (TNM) measures traffic noise factors to generate a 3-D model that can predict noise levels during the noisiest hour of the day. Based on noise levels predicted with and without a proposed project, the model identifies where noise impacts occur and mitigation should be considered.

What is a Noise Barrier?

Noise barriers are solid obstructions built between the highway and homes or resistances along a highway.

Noise barriers require long, uninterrupted segments to be effective. As such, if there are existing roadway access points and/or driveways, it is not feasible to construct effective noise barriers. Engineering feasibility also takes into account topography, drainage, safety, barrier height, utility, and access and maintenance needs, which may include right-of-way considerations. In situations where engineering considerations make noise barriers unfeasible, the noise analysis will explicitly state the reasons (topography, drainage, safety, or other factors).

INDOT requires that noise barriers achieve a minimum 5 dB(A) reduction at a majority (greater than 50 percent) of the impacted noise receptors (those that would receive a reduction of at least 5 dB(A)). If a barrier cannot achieve this acoustic goal, it is not considered to be acoustically feasible.

What is a Reasonable Noise Barrier?

The cost of constructing a noise barrier is a significant factor in determining if a barrier is considered to be reasonable or not. To determine cost-effectiveness, the estimated cost of construction (including installation and additional necessary construction, such as foundations or guardrails) is divided by the number of benefited receptors. INDOT’s Noise Analysis Procedures consider a material and design cost of $25,000 or less per benefited receptor to be cost-effective. Development in which a majority (more than 50 percent) of the receptors was in place prior to the initial construction of the roadway in its current state will receive additional consideration for noise abatement. The criteria for cost-effectiveness in these cases is 20 percent greater ($30,000 per benefited receptor).

INDOT continues to monitor advances in technologies in addition to evaluating other methods of addressing traffic noise and its related impacts.

INDOT uses $30,000 per foot to estimate noise barrier construction cost. A cost per benefited receptor of $25,000 or less is considered cost-effective. The cost per benefited receptor rises to $30,000 if a majority of benefited homes were built prior to initial construction of the roadway in its current state.

What is a Noise Survey and Why is it Important?

After a noise barrier is determined to be feasible, a noise survey helps determine if it is reasonable or not. A noise survey is gathering input from impacted residents, businesses, and other stakeholders in close proximity to a proposed barrier.

A noise survey is a general questionnaire to respondents to solicit basic information, including their name, address, preferences regarding a barrier, and any general comments they wish to provide. The survey is mailed to each benefited resident. If the property owner is different from the current resident, both the owner and resident are surveyed. The concerns and opinions of the property owner and the resident will be balanced with other considerations in determining whether a barrier is appropriate.

The noise survey includes a response postcard, a brief description of the project, barrier locations under consideration, and information on the basics of traffic noise. All responses or opinions regarding barriers must be expressed in writing to INDOT, by either letter, email or the response postcard.

Proposed noise barriers can cause conflicts in mixed-use developments, as barriers to protect residences may block line-of-sight to adjacent businesses. If a barrier is proposed to block traffic noise from a business, the business will be solicited for input to determine its concerns about line-of-sight. If a mutually satisfactory compromise cannot be reached between businesses and residences, the barrier may end at the property line dividing the two areas.

What Does a Noise Barrier Look Like?

Noise barriers typically consist of concrete panels placed between steel supports. The height and location of a barrier is determined by the TNM analysis. The color and texture can vary, and INDOT seeks the input of adjacent property owners.

How Does a Noise Barrier Work?

Noise barriers reduce the sound from a busy highway by either absorbing the sound, transmitting it, reflecting it back across the highway, or forcing it to take a longer path to receivers. A noise barrier must be tall enough and long enough to block traffic noise from the area that is to be protected. Noise barriers provide very little benefit for homes on a roadside over looking or across buildings that rise above the barrier. A noise barrier cannot achieve a 5 dB(A) noise level reduction if not tall enough to break the line-of-sight from the highway to the home or receiver. After it breaks the line-of-sight, it can achieve approximately 1.5 dB of additional noise level reduction for each meter of barrier height.

To effectively reduce the noise coming around its ends, a barrier should be at least eight times as long as the distance from the receiver to the barrier.

Does a Barrier Increase Noise on the Opposite Side of the Highway?

Residents adjacent to a highway sometimes believe that their noise levels have increased because of construction of a barrier on the opposite side of the highway. However, field studies have shown that this is not true. If all the noise striking a noise barrier were reflected back to the other side of the highway, the increase would be theoretically limited to 3 dB. In practice, not all of the acoustical energy is reflected back. Some of the energy goes over the barrier, some is reflected to points other than the homes on the opposite side, some is scattered by vegetation, and some is blocked by vehicles on the highway. Additionally, some of the reflected energy is lost due to the longer path that it must travel. Measurements made to quantify this reflective impact have never shown an increase of greater than 1-2 dB. This increase is not perceptible to the average human ear.

What if I Don't Want a Noise Barrier?

Although owners of residential property generally support barrier construction, some commercial property owners may prefer not to have a barrier adjacent to their property. For example, a business that relies on highway visibility to attract customers may prefer a barrier, despite the noise reduction benefit. Prior to approving construction of a barrier, INDOT surveys affected property owners to gauge their interest, and a majority of those owners must support construction.

Can Trees Act as a Noise Barrier?

Vegetation, if it is high enough, wide enough, and dense enough that it cannot be seen over or through, can decrease highway traffic noise. A wide strip of trees with thick undergrowth can lower noise levels. Ninety feet of dense vegetation can reduce noise by 5 dB. However, it is not feasible to plant enough trees and other vegetation along a highway to achieve such a reduction. As it pertains to noise, trees and other vegetation can be planted for psychological and aesthetic benefit, but not to physically lessen noise levels.

Who Maintains a Noise Barrier?

INDOT constructs noise barriers only on INDOT property and is responsible for maintaining them.

Your Input Matters

INDOT strives to understand the needs of residents and businesses that may be impacted by traffic noise. Public input is an important consideration when determining whether noise abatement is appropriate for an area. For more information, contact your local district.

INDOT Offices

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<tr>
<th>DISTRICT</th>
<th>ADDRESS</th>
<th>PHONE NUMBER</th>
<th>EMAIL ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORT WAYNE</td>
<td>500 Fort Wayne Boulevard West Fort Wayne, IN 46808</td>
<td>Toll Free: 1-855-463-6984 <a href="mailto:eastcentral@indot.in.gov">eastcentral@indot.in.gov</a></td>
<td></td>
</tr>
<tr>
<td>VINCENNES</td>
<td>208 W. Main Street Vincennes, IN 47591</td>
<td>Toll Free: 1-800-279-5759 <a href="mailto:swincommunications@indot.in.gov">swincommunications@indot.in.gov</a></td>
<td></td>
</tr>
<tr>
<td>SEYMOUR</td>
<td>1832 N. US 41 Seymour, IN 47274</td>
<td>Toll Free: 1-877-305-7611 <a href="mailto:secommunications@indot.in.gov">secommunications@indot.in.gov</a></td>
<td></td>
</tr>
<tr>
<td>GREENFIELD</td>
<td>4305 South Broadway Greenfield, IN 46140</td>
<td>Toll Free: 1-855-463-6984 <a href="mailto:eastcentral@indot.in.gov">eastcentral@indot.in.gov</a></td>
<td></td>
</tr>
<tr>
<td>LaPorte</td>
<td>315 E. Boyd Blvd LaPorte, IN 46350</td>
<td>Toll Free: 1-855-463-6984 <a href="mailto:LaPorteDistrictCommunications@indot.in.gov">LaPorteDistrictCommunications@indot.in.gov</a></td>
<td></td>
</tr>
<tr>
<td>Fort Wayne</td>
<td>5333 Hzelfeld Road Fort Wayne, IN 46808</td>
<td>Toll Free: 1-800-279-3255 <a href="mailto:NEinformation@indot.in.gov">NEinformation@indot.in.gov</a></td>
<td></td>
</tr>
<tr>
<td>Indianapolis, IN 46204</td>
<td>Toll Free: 1-888-942-6368 <a href="mailto:tollfree@indot.in.gov">tollfree@indot.in.gov</a></td>
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INDOT Office of Public Involvement

100 North Senate Avenue, Room 604 INDIANAPOLIS, IN 46204 Toll Free: 1-866-469-1396 publicinvolvement@indot.in.gov
INDOT’s Goal for Noise Reduction

INDOT’s goal for substantial noise reduction is to provide at least a 7 dB(A) reduction for first-row receivers in the year the barrier is constructed. However, conflicts with adjacent properties may make it impossible to achieve substantial noise reduction at all impacted receptors. Therefore, the noise reduction design goal for Indiana is 7 dB(A) for a majority (greater than 50 percent) of the first-row receivers.

Highway Traffic Noise Barriers:

- Can reduce the loudness of traffic noise by as much as one-half
- Do not completely block all traffic noise
- Can be effective regardless of the material used
- Must be tall and long with no openings
- Are most effective within 200 feet of a highway (usually the first row of homes)
- Are designed to be visually appealing
- Are designed to preserve aesthetic values and scenic vistas
- Do not increase noise levels perceptibly on the opposite side of a highway
- Substantially reduce noise levels for people living next to highways

Indiana citizens play an important role in shaping decisions that affect their communities.

The Indiana Department of Transportation recognizes that providing information and eliciting public input on transportation decisions is crucial to fulfilling its mission to plan, build and maintain facilities that best meet Indiana’s needs.

What is Noise?

Noise is defined as unwanted sound and can come from man-made and natural sources. Sound levels are measured in decibels (dB) and typically range from 40 to 100 dB.

Because human hearing is limited in detecting very high and low frequencies, “A-weighting” is commonly applied to sound levels to better characterize their effects on humans. A-weighted sound levels are expressed as dB(A).

What Causes Traffic Noise?

The level of highway traffic noise depends on three factors:

- Volume of traffic
- Speed of traffic
- Number of multi-lane vehicles

As any of these factors increase, noise levels increase. Traffic noise can also be increased by defective mufflers and steep inclines that require truck engines to labor. Traffic noise can be decreased by distance, terrain, vegetation, or man-made obstacles.

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Who Regulates Highway Noise? What is the Noise Impact Level?

The Federal Highway Administration (FHWA) has developed regulations regarding noise analysis on federally funded highway projects, and INDOT has outlined its implementation guidance in its Traffic Noise Policy.

The policy establishes two criteria for identifying an impact resulting from a project:

1. Ascertaining where future predicted noise levels would approach or exceed a set of Noise Abatement Criteria (NAC) established in the FHWA regulations. For outdoor uses in residential areas, the NAC is 67 dB(A). INDOT defines “approaching the NAC” as within 1 dB (66 dB(A)) for residential areas. Therefore, locations where future noise levels are predicted to be 66 dB(A) or higher are considered “impacted.”

2. Ascertaining locations where noise levels are expected to increase by 15 dB(A) or more over existing levels.