



5.10 Highway Noise

5.10.1 Introduction

As Indiana's transportation system expands and the traffic volumes increase, the communities along these facilities experience higher levels of highway-related noise. Highway noise is a growing environmental concern, especially in high-density urban settings and outlying suburban areas. FHWA is cognizant of the potential for such adverse off-site effects associated with Type I projects as defined under the Federal-Aid Highway Act and has taken measures to assess these impacts and establish mitigation procedures as mandated by the Act. This I-69 project qualifies as a Type I project because it: (1) proposes to either construct a highway on a new location, or (2) significantly changes the alignment and/or number of through-traffic lanes of an existing highway.

FHWA requires that all states have an approved policy to identify and address highway traffic noise impacts. INDOT's noise policy (INDOT, 2007) was developed to implement the requirements of 23 CFR 772 and the noise-related requirements of the National Environmental Policy Act of 1969, and received FHWA approval on February 27, 2007. INDOT's policy is based on FHWA's "Highway Traffic Noise Analysis and Abatement: Policy and Guidance" (USDOT, 1995) and focuses on seven principal analysis steps:

1. Identification of Noise-Sensitive Land Uses
2. Determination of Existing Noise Levels
3. Prediction of Future Noise Levels
4. Identification of Traffic Noise Impacts
5. Identification and Consideration of Abatement
6. Consideration of Construction Noise
7. Coordination with Local Government Officials

The following discussion documents the project's compliance with FHWA and INDOT policies for highway noise impact assessment and abatement.

5.10.2 Impact Assessment Methodology

5.10.2.1 Ambient Noise Data Collection

Existing ambient noise levels were measured using a sound level meter to (1) establish existing noise levels, and (2) to validate the noise prediction model. Ambient noise levels were measured in March and September 2005 using the following equipment in accordance with the FHWA's report FHWA-PD-96-046. "Measurement of Highway-Related Noise."

- One Metrosonics db-307 Noise Dosimeter and Integrating Sound Level Meter, with 1/4-inch ceramic microphone, serial number 2643
- One foam microphone vibration isolator
- One Metrosonics cl-304 Acoustical Calibrator, serial number 5236



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Among its multiple functions, the sound level meter integrates noise levels on a continuous basis and produces an equivalent (average) sound level, known as the Leq, for any desired test duration. This equipment automatically samples and A-weights the noise level eight times per second. Sound levels were measured over a 10-minute period at each site. Average (Leq) and peak sound levels were recorded for each measurement. The sound level meter was calibrated before and after each sampling to ensure consistent results.

Existing ambient noise levels were measured during AM and PM peak traffic or peak noise periods (depending on the receiver) and under meteorologically acceptable conditions. The temperature ranged from about 45°F to 73°F. Winds were light and variable, thus having little effect on sound propagation over moderate distances. Traffic data were simultaneously recorded during the noise measurements and classified into five vehicle types—motorcycles, buses, automobiles, medium trucks (two-axles with six wheels), and heavy trucks (three or more axles)—for subsequent use in validating the TNM 2.5 noise prediction computer model for this project.

Existing ambient noise levels were measured at ten sites distributed along the Section 2 corridor. The locations of the noise measurements are shown in Figure 5.10-1 and described in Table 5.10-1.

Site No.	Site Description and Land Use Category Classification
M1	Receiver located about 800 ft east of CR 950E and 16 ft. north of CR 150S centerline. This site represents four residential receivers. Classified as land use category B.
M2	Receiver located 71 ft. west of CR1050E bridge (west of CR 000/CR 1050E intersection) and 10 ft. south of CR 1050E centerline. This site represents six residential receivers and a church. Classified as land use category B.
M3	Receiver located 372 ft. east of CR 1200E/CR 150N intersection and 10 ft. north of CR 150N centerline. This site represents two residential receivers. Classified as land use category B.
M4	Receiver located 30 ft. west of SR 57/private coal road intersection and 53 ft. south of SR 57 edge of pavement. This site represents four residential receivers in hilly terrain. Classified as land use category B.
M5	Receiver located east side of Bradfield Drive and 500 ft. south of CR 400W. This site represents eleven residential receivers. Classified as land use category B.
M6	Receiver located 26 ft. east of CR 475N and SE of CR 475N/SR 356 intersection. This site represents three residential receivers and associated farmland. Classified as land use category B.
M7	Receiver located at southeast quadrant of Horrall/Troy intersection. A single residence and farmland. Classified as land use category B.
M8	Receiver located 21 ft. north of CR 125E edge of pavement. This site represents three residential receivers. Classified as land use category B.
M9	Receiver located along west side of SR 57 50 ft. from edge of pavement and south of CR 100 intersection. This site represents two residential receivers. Classified as land use category B.
M10	Receiver located on CR 300W at old crossing of Patoka River, west of SR 57 bridge over Patoka River. Patoka River Historic District. Classified as land use category B.

Definitions of land use categories are presented in Table 5.10-2 on the following page.



Activity Category	dBA L _{eq} (h)	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: Code of Federal Regulations, Title 23 Part 772, Revised October 1997.

The 28.6-mile long Section 2 corridor lies between the Section 1 SR 64 interchange and the US 50 interchange (Section 3) east of Washington. It traverses gently rolling to level terrain and is primarily rural with scattered farmsteads and low density residential uses. The agricultural land uses are a mixture of pasture, tilled fields and forested lands. A part of the corridor follows a high-voltage overhead transmission line.

Table 5.10-3 presents the measured existing L_{eq} noise levels at the ten sites along with associated traffic volumes. Measured ambient noise reflects the rural environment noted above. In most areas, near existing roadways, highway traffic noise dominates the noise environment (e.g., site M4), while elsewhere (e.g., site M2), other sources such as trains and farm machinery are dominant. Measured ambient noise ranged from approximately 48 dBA to 69 dBA. Three sites (M2, M4 and M9) registered noise levels that approached or exceeded 67 dBA; the other seven had measured L_{eq} levels of less than 60 dBA. One of the three sites (M2) with an L_{eq} approaching or exceeding 67 dBA had no traffic volumes during the measurement period. Unique site-specific conditions (farm machinery, grain trucks, train noise) accounted for the unusually high measured L_{eq} at this site.

Site	Time	Traffic ¹		Measured L _{eq} (dBA)
		Autos	Trucks /Buses	
M1 – CR 125 S (E – W)	12:00 PM	12	0	57.5
M2 – CR 1050 E (N – S)	12:38 PM	0	0	68.7
M3 – CR 150 N	10:41 AM	4	0	52.3
M4 – Indiana 57	12:44 PM	252	68	67.5
M5 – CR 400 N (E – W)	8:56 AM	12	4	49.2
M6 – Indiana 356/CR 475 N	10:17 AM	120	12	52.1
M7 – Troy and Horrall	8:29 AM	84	12	58.1
M8 – CR 125 E (N – S)	4:06 PM	48	0	54.3
M9 – Near CR 150 N	2:40 PM	324	80	66.9
M10 – Patoka River	8:57 AM	134	92	47.9

¹ Traffic counts taken during the 15-minute measurement period were adjusted to represent a full hour of traffic movement

**5.10.2.2 TNM 2.5 Program**

The traffic noise analysis for this Tier 2 study was performed using the FHWA Traffic Noise Model (TNM), Version 2.5. The FHWA TNM was first released in March 1998. Version 2.5 of the model was released in April 2004. It is the latest approved version of the model.

FHWA's TNM 2.5 (TNM) estimates vehicle noise emissions based on reference energy mean emission levels for five classes of vehicles: motorcycles, automobiles and light trucks, buses, medium trucks, and heavy trucks. These mean emission levels are used in conjunction with other model inputs (such as roadway widths and elevations, receiver elevations and distances from the roadway(s), intervening terrain, and ground cover) that spatially define a three-dimensional environment. TNM uses this input data and its new acoustic algorithms to predict noise levels at the given receiver locations.

5.10.2.3 TNM 2.5 Validation

FHWA recommends comparing model-generated values to actual measured levels to account for any unique circumstances at a site before using the model to predict future noise levels. The model is validated on a site-specific basis by comparing existing noise levels with the model predictions for traffic counts obtained during noise measurement periods. The roadway alignment, traffic volume, receiver locations relative to the roadway, and intervening terrain features are replicated in the model based on field observations and base map topography. TNM 2.5 is then used to predict L_{eq} levels based on the observed base-year conditions.

The model is considered to be verified if the model results are within ± 3 dBA of the field measurements recorded at the site for the same conditions. In rural situations where there is no nearby traffic or traffic volumes are very low even under peak hour conditions, validation of TNM 2.5 by this method is not possible since non-traffic ambient noises not accounted for in the model (e.g. birds chirping, rustling leaves, air conditioners, etc.) are the predominant noise component, rather than roadway traffic.

5.10.2.4 Determination of Highway Noise Impacts

Future noise levels for the No-Build and Build alternatives were modeled using the TNM 2.5 computer program. The noise impact analysis associated with the No-Build and Build alternatives was based on average daily traffic (ADT) and design hourly volume (DHV) projections for the year 2030. (See Section 3.1, Alternative Development Overview, for a discussion of I-69 Tier 2 traffic modeling methodology.) Proposed I-69, Section 2 traffic in the year 2030 is projected to range from 23,500 vehicles per day (VPD) to 27,500 VPD.

Traffic noise impacts occur when either of two conditions is met: 1) predicted levels approach or exceed the Noise Abatement Criteria (NAC); or, 2) predicted traffic noise levels substantially exceed the existing noise level. The INDOT Highway Traffic Noise Policy approved by FHWA and made effective on February 26, 2007, defines "approach or exceed" to mean that future levels are higher than 1 dBA $L_{eq}(h)$ below the appropriate NAC. "Substantially exceed" means the predicted traffic noise levels exceed existing noise levels by 15 dBA or more. Severe noise impacts are defined as exceeding the NAC by greater than 15 dBA.



5.10.2.5 Abatement Assessment

Noise abatement will be considered for the preferred alternative for all receivers that are predicted to experience highway noise impacts as defined in Section 5.10.2.4 for the design year, 2030. INDOT has developed criteria consistent with FHWA guidelines to determine the feasibility and reasonableness of noise abatement measures for all major highway projects (*INDOT's 2007 Traffic Noise Policy*). The term “feasible” means that it is structurally and acoustically possible to reduce noise at a given receiver by at least 7 dBA. The term “reasonable” means that based on consideration of several factors (including the number of benefited receivers, the severity of the noise impact, the timing of development near a project, and the views of impacted residents), INDOT believes that abatement of traffic noise impacts is warranted.

In 23 CFR Part 772, FHWA has identified a number of measures to abate or eliminate noise impacts. A noise abatement measure is any positive action taken to reduce the impact of traffic noise on an activity area. The primary means of mitigation mitigating noise impacts, as identified by FHWA, are:

- Traffic management measures (e.g., traffic control devices and signing to prohibit certain vehicle types, modified speed limits, and exclusive land designations).
- Alteration of horizontal and vertical alignments.
- Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely impacted by traffic noise.
- Construction of noise barriers (including landscaping for aesthetics) whether within or outside the highway right-of-way.
- Noise insulation of public use or non-profit institutional structures.
- Coordination among local authorities to govern future development along the selected corridor.

5.10.3 Analysis

5.10.3.1 Ambient Noise Results

Table 5.10-4 presents measured and modeled noise levels for ten sites proximate to the new roadway and/or with substantial traffic volumes. A comparison of existing measured noise levels against modeled levels under the same conditions shows that the model results were within ± 3 dBA of the measured result at all sites except two (M1 and M9). All sites where the modeled vs. measured noise difference is 3 dBA or less have existing highway traffic as the predominant ambient noise source. In contrast, model results for Sites M1 and M9 are more than 3 dBA below the measured result, indicating that non-roadway noise not included in the model is the predominant noise source in the area, rather than vehicles on existing roadways. Site M2 represents an anomalous noise environment, since there was no highway traffic during the measurement period. Thus, no comparison between modeled vs. measured noise can be made.

Table 5.10-4 shows that existing measured L_{eq} noise levels range from 48 dBA at Site M10 to 69 dBA at Site M2. All the sites sampled were designated as Activity Category “B”, and thus all have the same 67 dBA NAC. As defined by the INDOT Highway Traffic Noise Policy, noise levels approach the NAC if the resultant level is within 1 dBA of the Noise Abatement Criterion (NAC) for the appropriate activity category identified in Table 5.10-2. Therefore, the existing



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noise levels at sites M2, M4, and M9 are at or exceed the NAC category B. However, in the case of M9, the TNM results ($L_{eq} = 57$ dBA) for the traffic volumes observed at the time of the sampling suggests that the 67 dBA noise level experienced at this site is more a function of non-highway sources (in this case barking dogs) than highway traffic.

Table 5.10-4 TNM/Ambient Noise Levels (dBA L_{eq})

Site No.	Activity Category/ Noise Abatement Criterion	Existing Measured L_{eq} (dBA)	Existing Modeled L_{eq} (dBA)	Measured Minus Modeled L_{eq} (dBA)	Dominant Noise Source at Site
M1	B/67	58	52	6	Ambient noise is the dominant noise source at this location. Coal Plant noise in the background. Primarily residential.
M2	B/67	69	Not Applicable	-	Ambient noise is the dominant noise source at this location. Farm machinery, grain trucks and train in the background. No highway traffic during measurement period. Residential and farmland plus one church.
M3	B/67	52	54	2	Traffic noise is the dominant noise source at this location. Residential site.
M4	B/67	68	69	1	Traffic noise is the dominant noise source at this location. Residential site in hilly terrain.
M5	B/67	49	52	3	Traffic noise is the dominant noise source at this location. Noise from chirping birds in the background. Residential site.
M6	B/67	52	52	0	Traffic noise is the dominant noise source at this location. Residential and farmland.
M7	B/67	58	60	2	Traffic noise is the dominant noise source at this location. Residential and farmland.
M8	B/67	54	56	2	Traffic noise is the dominant noise source at this location. Residential site.
M9	B/67	67	57	10	Ambient noise is the dominant noise source at this location. Noise from barking dog during ambient measurement. Primarily residential.
M10	B/67	48	48	0	Traffic noise from SR 57 is the dominant noise source at this location. Patoka River bridge area.

5.10.3.2 Design Year Noise Results

This section provides a comparison of the design year noise results for the No-Build Condition with those of the build alternatives. Table 5.10-5 summarizes the data associated with these results.

Future No-Build Condition. The results of the noise analysis conducted for the No-Build condition (see Table 5.10-5) indicate that year 2030 L_{eq} noise levels would range from 52 dBA at Site M1 to 70 dBA at Site M2 without the project. Future noise levels are expected to differ from existing measured levels by up to +4 dBA L_{eq} . The reason that modeled design year no-build noise levels are shown to be lower than measured existing levels at some sites is attributed to the fact that non-roadway generated noise contributed more to the overall noise environment (and therefore the measured noise levels) than traffic noise. A comparison of modeled existing noise levels to modeled no-build levels indicates noise levels increase for most sites.



Build Alternative A. For Alternative A, which is the preferred alternative in the vicinity of each of the noise monitoring sites, projected noise levels were developed for each specific receiver (typically a residence) at each monitoring site. Since some of the receivers are at different distances from the future highway, the projected noise levels vary also, and are shown in the table. The results of the noise analysis conducted for Alternative A indicate that year 2030 L_{eq} noise levels would range from 47 dBA at Site M1 to 75 dBA at one residence at Site M6. These levels represent a difference from No-Build noise levels of between -8 dBA (Site M4) and +10 dBA (Site M6). This alternative is predicted to result in a perceptible decrease (≥ 3 dBA) in noise levels at two modeled sites (M4 and M8) and a perceptible increase at four modeled sites (M3, M5, M6 and M7) compared to No-Build conditions. Reductions in noise levels from the No Build scenario result from I-69 drawing traffic off of existing routes that are the dominant noise sources at those monitoring sites and diverting that traffic to I-69 which is at a greater distance from those specific sites.

Table 5.10-5 Summary of Future Noise Levels (dBA L_{eq}) – Future No-Build Condition and Build Alternatives

Site No.	Number of Receivers Represented	Existing Measured Noise ¹	Noise Abatement Criterion	Substantial Increase Criterion ²	2030 Noise Levels (L_{eq}) ³		
					No-Build	Alt. A ⁴	Alt. B
					M1	4	58
M2	7	69	67	84	70	1 @ 72 5 @ 71 1 @ 70	1 @ 74 4 @ 73 1 @ 70 1 @ 68
M3	2	52	67	67	55	1 @ 63 1 @ 58	1 @ 63 1 @ 58
M4	4	68	67	83	65	1 @ 57 3 @ <57	4 @ 70
M5	11	49	67	64	56	1 @ 61 10 @ <61	5 @ 61 6 < 61
M6	3	52	67	67	65	1 @ 75 2 @ ≤ 68	1 @ 70 2 @ 68
M7	1	58	67	73	62	1 @ 66	1 @ 66
M8	3	54	67	69	58	1 @ 55 2 @ <55	2 @ 69 1 < 65
M9	2	67	67	72	55	Remote from project – No receivers nearby	Remote from project – No receivers nearby
M10	1	48	67	63	60	1 @ 62	1 @ 64

¹These noise levels represent both highway traffic and non-highway noise, e.g., birds, insects, air conditioners, as measured in the field.

²“Substantial” means the predicted traffic noise levels exceed existing noise levels by 15 dBA or more.

³These noise levels represent design-year model results attributed solely to highway traffic.

⁴The preferred alternative with respect to noise consists entirely of Alternative A subsections at the locations shown in the table.

Yellow highlights indicate noise levels that approach or exceed the applicable noise abatement criterion or substantially exceed the existing noise level.



Build Alternative B. The results of the noise analysis conducted for Alternative B indicate that year 2030 L_{eq} noise levels would range from 44 dBA at Site M9 to 74 dBA at Site M2. These levels represent a difference from no-build noise levels ranging between -11 dBA (Site M9) and +11 dBA (Site M8). This alternative is predicted to result in a perceptible decrease in noise levels at one modeled site and a perceptible increase at eight modeled sites compared to No-Build conditions.

5.10.3.3 Identification of Predicted Traffic Noise Impacts

The noise impacts identified for the no-build and build alternatives, including the preferred alternative, are described below and summarized in Table 5.10-6.

No-Build Alternative. One modeled site (M2), accounting for six residential receivers and one church, is predicted to experience noise levels exceeding the 67 dBA L_{eq} NAC in 2030.

Build Alternative A. Three modeled sites (M2, M6 and M7) accounting for ten residential receivers and one church, are predicted to experience L_{eq} noise levels exceeding the 67 dBA NAC in 2030. Of the sites impacted, Site M6, representing three residences, would experience a substantial increase in noise, i.e., ≥ 15 dBA increase over existing L_{eq} levels.

Build Alternative B. Six modeled sites (M2, M4, M6, M7, M8 and M10) accounting for 17 residential receivers, one church and the Patoka River Historic District bridge area have L_{eq} noise levels approaching or exceeding the 67 dBA absolute NAC or the 15 dBA substantial increase threshold. Of the sites impacted, Sites M6 and M10, representing three residences and one historic district, would experience a substantial increase over existing noise levels.

Preferred Alternative. The preferred alternative reflects a combination of eight subsections of the Alternative A and one subsection of Alternative B. As they relate to the noise analysis, the specific subsections that comprise the preferred alternative include sensitive receivers found only with Build Alternative A. No sensitive receivers are proximate to the Build Alternative B subsection that is included in the preferred alternative. Thus, the impact analysis and mitigation presented for Build Alternative A are the same as for the preferred alternative.

Table 5.10-6: Noise Level Impacts – No Build Condition and Build Alternatives				
Receiver Type	No. of Affected Receiver Types, by Alternative (2030)			
	No-Build	Alternative A	Alternative B	Preferred Alternative
Residences	6	10	17	10
Churches	1	1	1	1
Schools	0	0	0	0
Parks	0	0	0	0
Historic Sites	0	0	0	0
Nat'l. Historic District	0	0	1	0
Landmarks	0	0	0	0
Commercial	0	0	0	0
Total	7	11	19	11



It is important to note that each specific location where noise was measured (Sites M1 through M10) represents a relatively uniform noise environment that generally includes more than one sensitive receiver. The specific number of receivers present at each site is noted in Table 5.10-5. Because of varying site characteristics and varying distances from the proposed roadway, each sensitive receiver may have slightly different predicted noise levels. The specific predicted noise levels attributable to the preferred alternative (Alternative A) at each of the sensitive receivers are shown in Table 5.10-5. Note that at Site M9, no noise modeling was performed as the site is quite remote (over one mile) from the preferred alignment.

By means of yellow highlights, Table 5.10-5 indicates those groups of sensitive receivers which are expected to be affected by future noise levels that approach or exceed the applicable noise abatement criterion or that substantially exceed the existing noise levels with either the No-Build alternative or one of the Build alternatives. As this table shows, there are three site locations where sensitive receptors are expected to be impacted by the preferred alternative (Alternative A) – Sites M2, M6 and M7. At site M2, six residences and a church will be impacted; at site M6, three residences; and at site M7, a single residence. In summary, Alternative A impacts 10 residences and a church. At sites M1, M3, M4, M5, M8, M9 and M10, projected future year noise levels are not expected to reach or exceed the noise abatement criteria with Alternative A.

Alternative B would impact a total of six site locations – the same three locations impacted by Alternative A, plus sites M4, M8 and M10. These three additional locations include four residences, three residences, and the historic district, respectively. Alternative B will thus impact a total of 19 receptors – 17 residences, a church, and the historic district. With Alternative B, sites M1, M3, M5 and M9 are not projected to reach or exceed the noise abatement criteria. The total number and specific type of sensitive receivers impacted by each of the alternatives is summarized in Table 5.10-6.

5.10.4 Mitigation

Possible mitigation measures were considered for sites where noise impacts associated with the preferred alternative were predicted for the year 2030 (sites M2, M6 and M7). The feasibility and reasonableness of providing noise mitigation at each were assessed. For the purposes of assessing noise mitigation strategies, “feasible” means that it is structurally and acoustically possible to reduce noise occurring at a receiver by at least 7 dBA $L_{eq}(h)$ for the majority (50%+1) of the impacted first row receivers in the design year. “Reasonable” means that INDOT believes abatement of traffic noise impacts is prudent based on all of the following factors, as defined in their current Noise Policy:

- Cost effectiveness. Abatement will be considered cost effective if the estimated cost of constructing abatement divided by the number of benefited receivers existing prior to the time of construction is \$30,000 or less. Barrier cost should be arrived at by applying a square footage cost (determined by INDOT to be \$20 per square foot) to the square footage of the noise barrier. Benefited receivers include those sites which are predicted to



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experience at least a 5 dBA $L_{eq}(h)$ reduction at the noisiest hour conditions, and may include receivers that are not impacted.

- Severe noise impacts (those where the predicted $L_{eq}(h)$ exceeds the NAC by greater than 15 dBA) may merit abatement beyond the standard cost criteria and may include measures that are not normally considered.

The views of impacted and benefited receivers. Residents and businesses that qualify for noise abatement (i.e., cost effective) will be given the opportunity to express their opinion and may elect to decline such mitigation if they believe the potential negative impacts of noise barriers (i.e., unsightliness, shortened daylight, poor air circulation, degradation by weather, reduced safety, vandalism, and restriction of access for emergency vehicles) outweigh the positive benefits.

5.10.4.1 Noise Abatement Strategies

The following discussion summarizes the appropriateness of the various noise abatement strategies.

Traffic Management Measures. Traffic management measures were not considered reasonable and feasible for abating noise impacts for any receiver. Measures such as installation of additional traffic control devices, prohibition of vehicle types, time-use restrictions, speed limit reductions, and exclusive lane designations would be adversely detrimental to the proposed project's ability to function as a freeway and major north-south route.

Alteration of Horizontal and Vertical Alignments. The final design of the preferred alternative may include shifting the alignment both vertically and horizontally, wherever feasible, to minimize impacts on adjacent land uses. Both vertical and horizontal alignments may be altered to minimize noise impacts where other factors are not prohibitive, although such measures would not be enough to completely mitigate noise impacts.

Acquisition of Property Rights or Acquisition of Property. The purchase of property and/or buildings for noise barrier construction or the creation of a "buffer zone" to reduce noise impacts was considered. The amount of property required for this option to be effective would create significant additional impacts (*e.g.*, in terms of residential displacements) which were determined to outweigh the benefits of land acquisition. This measure would likely also be cost-prohibitive.

Noise Insulation of Public Use or Nonprofit Institutional Structures. This noise abatement measure option is not relevant because it applies to public institutional use buildings. Since no public use or institutional structures are anticipated to have interior noise levels exceeding FHWA's interior NAC, this noise abatement option will not be applied.

Coordination Among Local Planning Authorities. Since a portion of the proposed project would be located on a new roadway, the potential does exist for local officials and developers to help minimize adverse noise impacts through the use of careful land use planning. With regard to currently undeveloped land, the creation of a "buffer zone" or locating noise sensitive



developments a reasonable distance away from the project would help minimize future noise impacts. Local planning authorities will be provided with the 66 dBA noise contour mapping and can utilize it to develop noise compatible land uses outside the 66 dBA buffer zone. This mapping will be provided in the Final EIS for this project. Copies of this EIS will be provided to Gibson, Pike and Daviess county officials and to the Washington and Petersburg municipal officials for use in noise-sensitive land use planning.

Construction of Noise Barriers. The construction of noise barriers between the shoulder and the right-of-way limits is generally one of the more feasible and/or reasonable abatement measures available. A typical noise barrier along a freeway is shown in Figure 5.10-2. The feasibility and reasonableness of noise abatement were evaluated (Section 5.10.4.2) for those receivers (M2, M6 and M7) experiencing a noise impact from the preferred alternative.

5.10.4.2 Noise Mitigation Assessment

Using INDOT's Traffic Noise Policy, noise barriers were evaluated at sites (M2, M6 and M7) where impacts were identified for the preferred alternative. All the receivers were residences, except at M2 which included a church among the representative receivers. Review of the affected receivers and their environs suggests that noise barriers are feasible at all locations, i.e., it is structurally and acoustically possible to achieve a 7 dBA reduction in the L_{eq} at these locations. To test for the reasonableness of noise barrier mitigation, barriers were modeled at identified receivers where impacts were predicted using TNM 2.5. Barrier lengths were estimated based on land use and topographic constraints visible from aerial photography, and model runs were made for two barrier height scenarios: 10 and 12 feet. Table 5.10-7 summarizes the results of the noise barrier analysis.

Noise barriers ten to twelve feet tall at sites M2, M6 and M7 will achieve at most a 5 dBA reduction in L_{eq} . Barrier heights would need to be at least 15 feet to meet the 5 dBA reduction reasonableness criterion for the majority of affected receivers. Further, the costs associated with each reduction substantially exceed INDOT's \$30,000 cost per benefited receiver criterion. At site M2, a 12-foot-high barrier for the six residential receivers would cost about \$372,000, or \$62,000 per benefited receiver, but would only provide a noise reduction of about 2 dBA. For the church, the cost is estimated at about \$125,000. At site M6, the cost for a 12-foot barrier for the three residential receivers would total approximately \$94,000, or about \$31,000 per residence - slightly more than the \$30,000 cost criterion, and would provide an estimated noise level reduction of approximately 4 dBA. While this barrier does not appear to meet either the noise level reduction criterion or the cost criterion, it is very close to both and will be evaluated further when more detailed design information is available. The single residence at site M7 could realize an approximate 5 dBA noise reduction, but at a cost of \$158,000.

Therefore, in terms of reasonableness none of the noise barrier scenarios analyzed appear to be prudent at this time, and no mitigation is currently being recommended. This conclusion will be reevaluated during the final design phase, when more precise engineering designs and updated cost estimates are available.



Table 5.10-7: Noise Barrier Analysis			
Affected Receiver Location	2030 Noise¹		
	Without Barrier	With Barrier	
		12 FT	10 FT
M2	72	70	71
M6	68	64	66
M7	68	63	64

¹Noise levels are $L_{eq}(h)$ in dBA.

5.10.4.3 Construction Noise Impacts

In addition to permanent impacts, there will be temporary impacts during highway construction. Project construction would result in short term noise impacts from construction vehicles, driving of piles, blasting (if necessary), etc. Refer to Section 5.12, *Construction Impacts*, for more information about probable impacts and suggested abatement measures.

5.10.5 Summary

The noise analysis predicts that for the preferred alternative three noise monitoring sites – M2, M6 and M7 - representing 10 residences and one church may potentially experience noise impacts which either approach or exceed the Noise Abatement Criteria. Average noise levels for the build alternatives would be higher than those predicted for the No-Build Alternative at most of the receivers, because highway traffic on new alignment is generally greater in traffic volume and closer to receivers than under the existing and No-Build scenarios.

At this time, the construction of noise barriers has been determined to not be “reasonable” for all sites where the NAC is exceeded. The cost to provide protection at these sites exceeds INDOT’s current cost per benefited receiver criterion. The feasibility and reasonableness of constructing noise barriers for the preferred alternative will be re-evaluated during the final design process.