APPENDIX I

NOISE TECHNICAL REPORT, JUNE 2014

Noise Technical Report

for

Pellissippi Parkway Extension
State Route 162
Blount County, Tennessee

PIN Number: 101423.00
Project Number: 05097-1226-04

Submitted to:

Prepared by:

Bowlby & Associates, Inc.

June 2014

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

This noise study was conducted in accordance with the FHWA noise standards, *Procedures for Abatement of Highway Traffic and Construction Noise*, *23 CFR 772* [1], the Tennessee Department of Transportation's *Policy on Highway Traffic Noise Abatement* [2]*, and* Section 5.3.4 (Noise) of the *Tennessee Environmental Procedures Manual* [3].

Five Build Alternatives were evaluated including: Alternative A, Alternative A with East Shift, Alternative A with West Shift, Alternative C, and Alternative D (Figures 1 and 2). Eighteen (18) noise analysis areas containing noise-sensitive land uses were identified that might be affected by the Build Alternatives (Table 4 and Figure 4).

The purpose of this analysis was to identify the number and locations of impacted noise-sensitive land uses in each Noise Analysis Area under each Build Alternative. Noise abatement in the form of noise barriers was evaluated for all impacted areas in accordance with TDOT's Noise Policy. Table 1 summarizes the number of impacts for each Noise Analysis Area for each Alternative. An indication of "n/a" means that the Noise Analysis Area is not affected by that Alternative.

As shown, Alternative A, Alternative A with East Shift, and Alternative D all result in a comparable number of noise impacts. The vast majority of the impacts are due to substantial increases in the existing sound levels. Alternative C is predicted to result in the fewest impacts at 65. However, approximately 26 residences will be taken under Alternative C. Alternative A with the West Shift is predicted to result in the most impacts at 105 due to the shift of the alignment closer to Area 4 (Kensington Place mobile home community). However, these additional impacts would be mitigated by the construction of a noise barrier for Area 4 as described below.

Noise barriers were evaluated to mitigate the predicted noise impacts in each Noise Analysis Area for each Alternative (Table 14). In order for noise barriers to be included in a project, they must be determined to be both feasible and reasonable in accordance with TDOT's Noise Policy.

The results of the noise barrier reasonableness analysis indicated that the area per benefited residence is substantially higher than the allowable area per benefited residence for all of the areas evaluated for Alternative A, Alternative A with the East Shift and Alternative C and for all but one area each for Alternative A with the West Shift and Alternative D.

Table 1: Impact Summary [1]

Noise Analysis Area	Alternative A	Alternative A with East Shift	Alternative A with West Shift	Alternative C	Alternative D
1	9	9	9	9	n/a
2	5	5	5	5	n/a
3	6	6	6	2	0
4	29	28	50	n/a	n/a
5	11	11	11	11	n/a
6	0	0	0	0	n/a
7	7	7	7	6	n/a
8	2	2	2	n/a	n/a
9	6	6	6	n/a	n/a
10	6	6	6	10	n/a
11	n/a	n/a	n/a	n/a	32
12	n/a	n/a	n/a	n/a	11 [2]
13	n/a	n/a	n/a	n/a	8
14	n/a	n/a	n/a	n/a	9
15	n/a	n/a	n/a	7	n/a
16	n/a	n/a	n/a	5	12
17	n/a	n/a	n/a	n/a	8
18	n/a	n/a	n/a	9 [3]	5
Total	***81***	***80***	***103***	***64***	***85***

(1) An "n/a" indicates that a Noise Analysis Area is not affected by that Alternative.
(2) Includes the Mt. Lebanon Baptist Church playground and baseball field.
(3) Includes the Misty Meadow Driving Range.

The high calculated areas per benefited residence are generally the result of 1) significant distances between the impacted residences and the Pellissippi Parkway Extension alignment, 2) low residential densities (large lots), 3) the requirement for long and tall barriers (high barrier areas) to provide a 7 dB noise reduction, and 4) the low number of benefits that can be achieved. The highest number of benefits that can be achieved by any barrier is eleven (11) with most barriers benefiting between two (2) and five (5) residences.

However, the area per benefited residence is lower than the allowable area per benefited residence for two locations: Area 4 for Alternative A with West Shift and Area 11 (Belfair Lane) for Alternative D.

As a result, noise barriers for these Areas have been determined to be preliminarily feasible and reasonable in accordance with TDOT's Noise Policy.

A noise barrier for Area 4 for Alternative A with West Shift is considered "likely" as design and engineering issues are not anticipated. However, a barrier for Area 11

(Belfair Lane) under Alternative D could pose sight distance and other design or construction issues that cannot be fully assessed at this time. These issues would need to be much more thoroughly evaluated if Alternative D were constructed. As a result, a barrier for this part of Area 11 (Belfair Lane) has been identified as "possible." The preliminary barrier locations are shown in Appendix G.

It is important to note that the noise analysis was based on functional project plans. Final noise abatement decisions will be made based on an updated evaluation of the Preferred Alternative using the final design plans for the project. This evaluation will likely be conducted as part of the right-of-way or construction reevaluation for the project.

Additionally, the viewpoints of the benefited property owners and residents will be solicited before final reasonableness determinations are made.

1.0 INTRODUCTION

This Type I project involves extending existing Pellissippi Parkway (State Route (SR) 162) from SR 33 to Lamar Alexander Parkway (US 321/SR 73) in the cities of Alcoa and Maryville and in unincorporated Blount County.

In April 2006, TDOT initiated an Environmental Impact Statement (EIS) for the project. A detailed noise technical study was conducted by Parsons Brinckerhoff (PB) in July 2009 [3], and its results were published in the Draft EIS (DEIS), circulated in 2010. Build Alternatives A, C, and D were evaluated for the DEIS as shown in Figure 1. The proposed typical cross-section is provided in Appendix A. Alternative A was subsequently selected as the Preferred Alternative.

Several events have occurred since the approval of the DEIS and the selection of Alternative A as the Preferred Alternative that have affected the noise analysis. First, an environmentally sensitive archaeological site eligible for the National Register was discovered north of Lamar Alexander Parkway. TDOT and PB identified two potential alignment shifts to Alternative A to avoid the site: the East and West Shift Alternatives as shown in Figure 2. Subsequent environmental studies resulted in the West Shift being selected.

Second, the traffic forecasts for the project have been updated.

Third, TDOT revised its noise policy and procedures in July 2011 to be consistent with new federal regulations.

As a result of these events, the noise study for the Preferred Alternative (Alternative A with West Shift) was updated in February 2014 [4, 5].

However, FHWA subsequently requested that the noise analyses for all of the DEIS Alternatives be updated for the Final Environmental Impact Statement (FEIS). Therefore, this report summarizes the potential noise effects of the following Alternatives on nearby noise-sensitive land uses using TDOT's Noise Policy effective July 2011 and the most recent traffic projections.

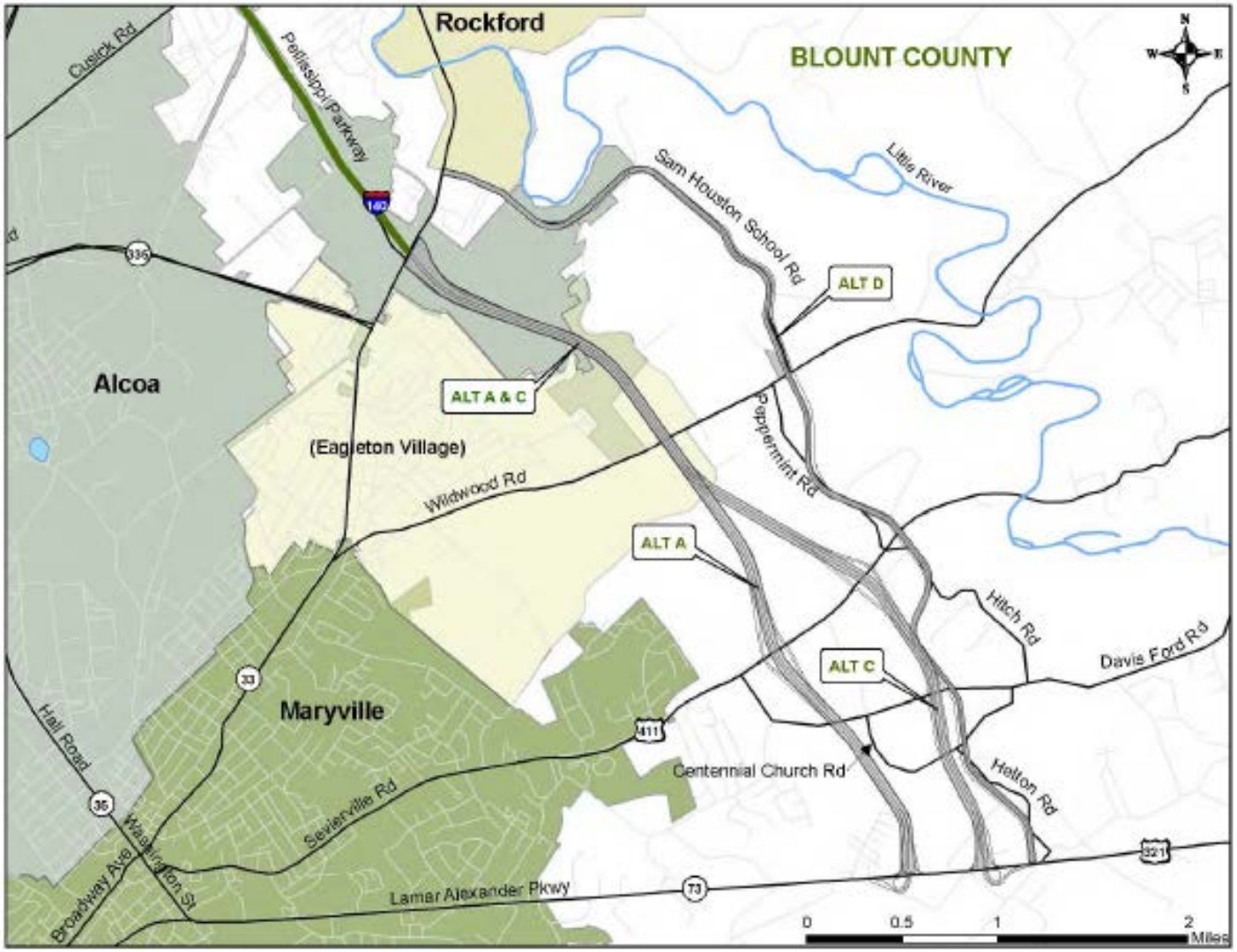

Figure 1: Build Alternatives

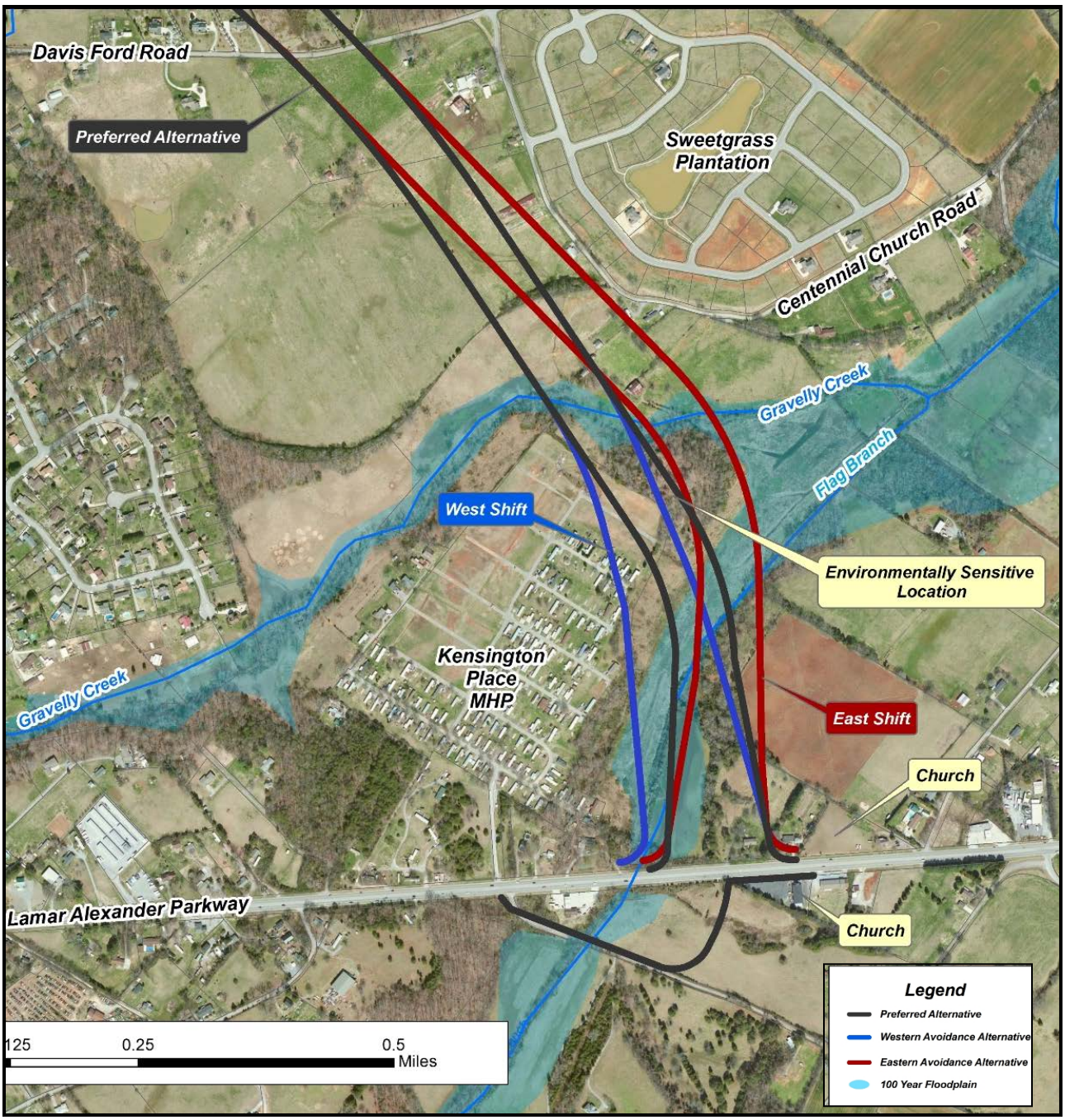

Figure 2: Alternative A with East Shift and West Shift

1.1 Alternative A with West Shift or East Shift

Alternative A extends 4.38 miles from SR 33 to US 321/SR 73, as a four-lane divided roadway with three proposed interchanges (with SR 33, US 411/Sevierville Road, and US 321/SR 73). The alignment begins on the east side of SR 33, opposite the existing half interchange of Pellissippi Parkway (I-140) and SR 33. From this terminus, the route follows a generally easterly and southeasterly path to Wildwood Road, passing through former farmlands that are now the site of the Pellissippi Place Research and Technology Park, currently under development. After crossing Wildwood Road, the route continues in a generally southerly direction, crossing Brown School Road, and crosses US 411/Sevierville Road east of the Davis Ford Road intersection with US 411. Alternative A with West Shift continues across Davis Ford Road and encroaches into the northeastern portion of the Kensington Place mobile home community. The route intersects US 321/SR 73 just east of Flag Branch.

Alternative A with East Shift continues across Davis Ford Road and shifts about 300 feet eastward toward Centennial Church Road, thus avoiding the Kensington Place mobile home community before to intersect with US 321/SR 73 east of Flag Branch.

The proposed typical section for the extension of Pellissippi Parkway along Alternative A with either shift consists of two 12-foot travel lanes in each direction, 12-foot outside shoulders, and a 48-foot depressed median with 6-foot inside shoulders. The proposed right-of-way is a minimum of 300 feet, requiring the purchase of new right-of-way. Depending upon the horizontal and vertical curve requirements, desired speed limits, and the slope of the existing land, actual right-of-way acquisition might be reduced or increased in some areas during the design phase of the project. The roadway is designed for traffic traveling at 60 miles-per-hour, although the posted speed may be lower.

Diamond interchanges connect the new roadway with SR 33 and US 411/Sevierville Road, and the roadway is proposed to terminate with a trumpet interchange at US 321/SR 73. All other road crossings are grade-separated without parkway access. The distance between the two proposed interchanges, with US 411/Sevierville Road and with US 321/SR 73, is about one mile. Due to this short distance, during the design phase for the Preferred Alternative, TDOT will consider the use of an auxiliary lane in each direction to assist traffic exiting and entering the proposed roadway.

Two cross routes that will have interchanges with the new roadway, SR 33 and US 411/Sevierville Road, will be improved to a five-lane urban section through the interchange area. The five-lane cross section on those two roadways will consist of two 12-foot lanes in each direction with a 12-foot continuous center turn lane.

1.2 Alternative C

Alternative C extends 4.68 miles from SR 33 to US 321/SR 73, as a four-lane divided roadway with three proposed interchanges (with SR 33, US 411/Sevierville Road and US 321/SR 73). The proposed typical section consists of two 12-foot travel lanes in each direction, 12-foot outside shoulders, and a 48-foot depressed median with 6-foot inside shoulders. The proposed right-of-way (ROW) is a minimum of 300 feet, requiring the purchase of a new ROW. Depending upon the horizontal and vertical curve requirements, desired speed

limits, and the slope of the existing land, actual ROW acquisition might be reduced or increased in some areas during the design phase of the project. The roadway is designed for traffic traveling at 60 miles-per-hour.

Alternative C's alignment begins on the east side of SR 33, opposite the existing half of the interchange of Pellissippi Parkway (I-140) and SR 33. From this terminus, the route follows a generally easterly and southeasterly path to Wildwood Road, passing through former farmlands that are now the site of the Pellissippi Place Research and Technology Park, currently under development. The corridor also runs west of Mount Lebanon Road through this area. After crossing Wildwood Road, the route continues in a generally southerly direction, crossing Brown School Road. At that point, Alternative C diverged to the east, and run in a southeasterly direction to intersect US 411/Sevierville Road about 0.6 mile east of the Preferred Alternative. Alternative C continued southeasterly to cross Davis Ford Road and proceeds southerly, crossing Centennial Church Road about 500 feet west of Helton Road. The alternative terminates at US 321/SR 73 in the vicinity of Hubbard School Road.

Diamond interchanges connect the new roadway with SR 33 and US 411/Sevierville Road, and the roadway is proposed to terminate with a trumpet interchange at US 321/SR 73. All other road crossings are grade-separated without access. The distance between the two proposed interchanges, with US 411/Sevierville Road and with US 321/SR 73, is about one mile. Due to this short distance, during the design phase for the Preferred Alternative, TDOT will consider the use of an auxiliary lane in each direction to assist traffic exiting and entering the proposed roadway.

Two cross routes that will have interchanges with the new roadway, SR 33 and US 411/Sevierville Road, will be improved to a five-lane urban section through the interchange area. The five-lane cross section on those two roadways will consist of two 12-foot lanes in each direction with a 12-foot continuous center turn lane.

1.3 Alternative D

Alternative D would upgrade an existing network of two-lane roads in the area (Sam Houston School Road, Peppermint Road, Hitch Road, and Helton Road) to serve as a two-lane connection between SR 33 and US 321/SR 73. Under this alternative, an improved two-lane roadway would be constructed using the existing roadway alignment where possible, while straightening curves, realigning intersections and using new locations to provide a continuous route with a 50 mile-per-hour design speed. The length of this corridor is 5.77 miles.

The proposed typical section for the upgraded two-lane network consists of one 12-foot travel lane in each direction with 10-foot outside shoulders. At major intersections, a center turn lane could be added as necessary. Bicyclists and pedestrians would use the paved shoulders.

The proposed ROW is a minimum of 150 feet, requiring the purchase of additional ROW. Depending upon the horizontal and vertical curve requirements, desired speed limits and the slope of the existing land, actual ROW acquisition might be reduced or increased in some areas during the design phase of the project.

The alternative generally follows Sam Houston School Road from SR 33 to Wildwood Road and continues across Wildwood Road on a new location before joining with Peppermint Road about 2,000 feet south of the current Peppermint Road/Wildwood intersection. This alignment avoids the existing offset intersections of Sam Houston School Road and Peppermint Road with Wildwood Road. The route uses Peppermint Road for about 1,800 feet before shifting to the east to intersect Hitch Road at its current intersection with Sevierville Road. The route uses Hitch Road for about 1,500 feet before shifting southwest to avoid substantial horizontal curves and a large residential subdivision. The route then follows a south/southeasterly course behind the subdivision and crosses Davis Ford Road to the west of Misty View Drive and subdivision. The alignment continues southerly crossing Centennial Church Road at Helton Road, then follows a course to the west of Helton Road and intersects with US 321/SR 73 about 250 feet west of the intersection of US 321/SR 73 and Old Walland Highway (Tuckaleechee Pike).

2.0 NOISE EVALUATION

This noise study was conducted in accordance with the FHWA noise standards, *Procedures for Abatement of Highway Traffic and Construction Noise*, *23 CFR 772*, the Tennessee Department of Transportation's *Policy on Highway Traffic Noise Abatement, and* Section 5.3.4 (Noise) of the *Tennessee Environmental Procedures Manual* and includes the following tasks:

- Identification of noise analysis areas: Identification of eighteen (18) areas containing existing land uses that are sensitive to highway traffic noise;
- Determination of existing sound levels: Measurement and prediction of existing sound levels at noise-sensitive land uses to characterize the existing noise environment in the project area;
- Determination of future sound levels: Prediction of future, design year, worst-hour sound levels for the No-Build and Build Alternatives;
- Determination of traffic noise impacts: Determination of noise impacts for each Alternative based on the increase in existing sound levels, as well as design year sound levels;
- Noise abatement evaluation: Evaluation of noise abatement for areas determined to be impacted by the each Alternative;
- Discussion of construction noise; and
- Information for local officials.

Each of these analysis steps is discussed below following a discussion of TDOT's criteria for determining noise impacts.

2.1 Criteria for Determining Impacts

2.1.1 Traffic Noise Terminology

Traffic noise levels are expressed in terms of the hourly, A-weighted equivalent sound level in decibels (dBA). A sound level represents the level of the rapid air pressure fluctuations caused by sources such as traffic that are heard as noise. A decibel is a unit that relates the sound pressure of a noise to the faintest sound the young human ear can hear.

The A-weighting refers to the amplification or attenuation of the different frequencies of the sound (subjectively, the pitch) to correspond to the way the human ear "hears" these frequencies. Generally, when the sound level exceeds the mid-60 dBA range, outdoor conversation in normal tones at a distance of three feet becomes difficult. Figure 3 shows some typical indoor and outdoor sound levels.

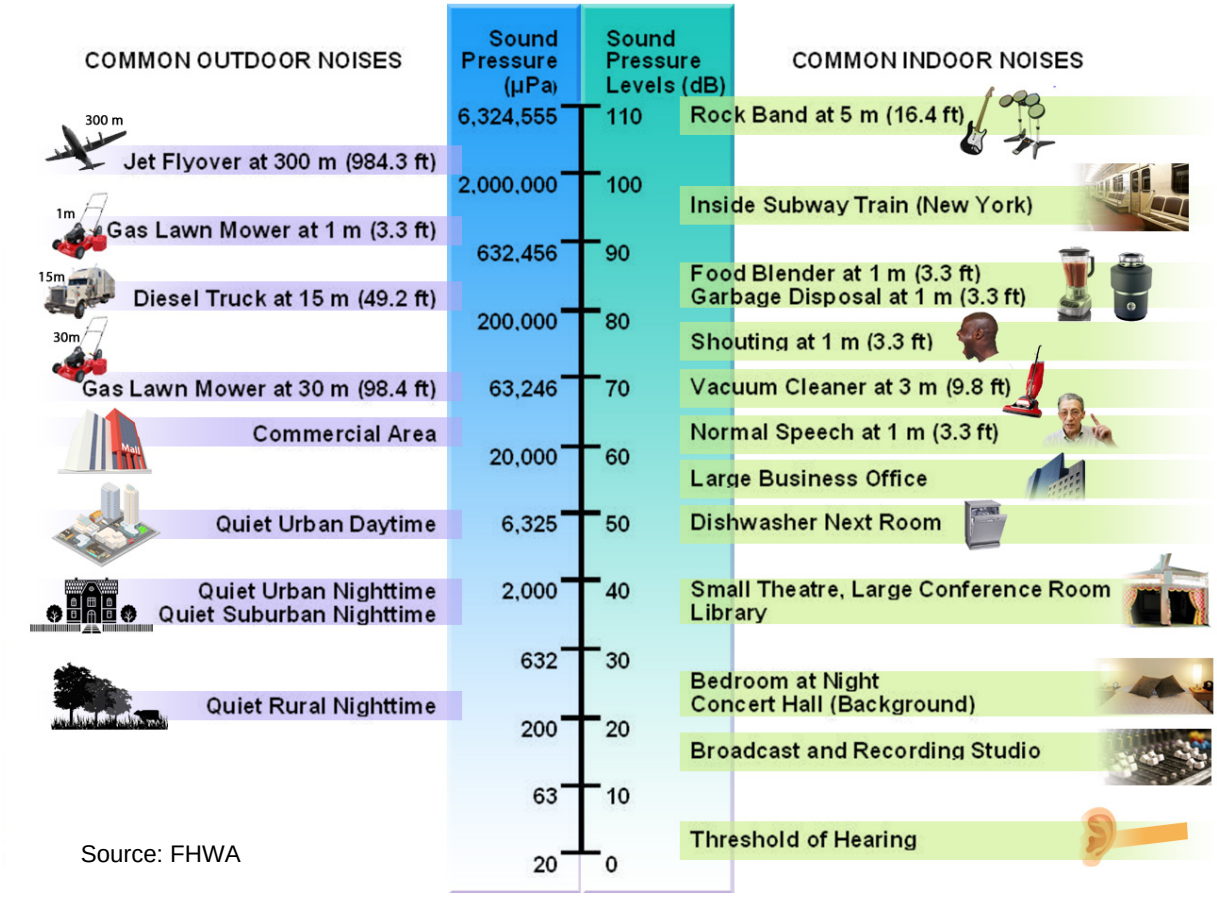

Figure 3: Typical Sound Levels

A 9-10 dB increase in sound level is typically judged by the listener to be twice as loud as the original sound while a 9-10 dB reduction is judged to be half as loud. Doubling the number of sources (i.e. vehicles) will increase the hourly equivalent sound level by approximately 3 dB, which is usually the smallest change in hourly equivalent A-weighted traffic noise levels that people can detect without specifically listening for the change.

Because most environmental noise fluctuates from moment to moment, it is standard practice to condense data into a single level called the equivalent sound level (L_{eq}). The L_{eq} is a steady sound level that would contain the same amount of sound energy as the actual time-varying sound evaluated over the same time-period. The L_{eq} averages the louder and quieter moments, but gives much more weight to the louder moments in the averaging. For traffic noise assessment purposes, L_{eq} is typically evaluated over the worst one-hour period and is defined as L_{eq} (1h).

The term insertion loss (IL) is generally used to describe the reduction in L_{eq} (1h) at a location after a noise barrier is constructed. For example, if the L_{eq} (1h) at a residence is 75 dBA before a barrier is constructed and the L_{eq} (1h) is 65 dBA after a barrier constructed, then the insertion loss would be 10 dB.

2.1.2 Noise Abatement Criteria (NAC)

Noise impact is determined by comparing future sound levels: (1) to a set of Noise Abatement Criteria (NAC) for a particular land use category, and (2) to existing sound levels.

The FHWA noise standards (contained in 23 CFR 772) and TDOT's noise policy state that traffic noise impacts require consideration of abatement when worst-hour sound levels approach or exceed the NAC listed in Table 2. TDOT's noise policy defines "approach" as one decibel below the NAC, or 66 dBA for Category B and C land uses.

The FHWA noise standards and TDOT's noise policy also define impacts to occur if there is a substantial increase in design year sound levels. Table 3 presents TDOT's criteria to define substantial noise increase.

2.2 Identification of Noise Analysis Areas

Eighteen (18) areas containing noise-sensitive land uses were identified in the project area. These "noise analysis areas" are described in Table 4 and shown in Figure 4.

As indicated, some of these areas may be affected by only one alternative while other areas might be affected by two or more alternatives. Each area were evaluated separately for each Alternative. Table 5 summarizes the Noise Analysis Areas that are affected by each Alternative.

Table 2: Noise Abatement Criteria in 23 CFR 772

Activity Category	L_{Aeq}(1h) dBA	Evaluation Location	Activity Description
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(1)	67	Exterior	Residential.
C(1)	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structure, radio stations, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structure, radio studios, recording studios, schools, and television studios.
E(1)	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D, or F.
F	–––	–––	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	–––	–––	Undeveloped lands that are not permitted.

(1) Includes undeveloped lands permitted for this activity category.

Table 3: Substantial Noise Level Increase

Existing Noise Level (dBA) (1)	Predicted Design Year Noise Level Increase (dB) (2)
42 or less	15 or more
43	14 or more
44	13 or more
45	12 or more
46	11 or more
47 or more	10 or more

(1) Worst hour noise level from the combination of natural and mechanical sources and human activity.
(2) Predicted design year noise level minus existing noise level.

Table 4: Noise Analysis Areas

Noise Analysis Area	Alternative(s)	Description	Activity Category	NAC (dBA)
1	A, C	Residences on Jackson Hills Drive, October Lane, and Luther Hills Drive.	B	67
2	A, C	Residences on Mt. Lebanon Road, Melody Lane and Wildwood Road.	B	67
3	A, East and West Shifts, C, D	Residences on Centennial Church Road and in the Sweetgrass Plantation subdivision.	B	67
4	A, East and West Shifts	Kensington Place mobile home community and single-family residences on Lamar Alexander Parkway.	B	67
5	A, C	Residences on East Brown School Road, Wildwood Road, Martha Neoma Street, and Talbott Lane.	B	67
6	A, C	Residences on Western Springs Drive and Old Knoxville Highway.	B	67
7	A, C	Residences on Saratoga Drive, the south side of Wildwood Road and East Brown School Road.	B	67
8	A	Residences on Sevierville Road (SR 35).p	B	67
9	A	Residences on Sevierville Road (SR 35) and Davis Ford Road.	B	67
10	A, East and West Shifts, C	Residences, the Morning Star Baptist Church, and the Rio Revolution Church on Lamar Alexander Parkway.	B, D	67, 52*
11	D	Residences on Sam Houston School Road and intersecting local roadways between SR 33 and Wildwood Road.	B	67
12	D	Residences on Wildwood Road, Peppermint Road, and Peppermint Hills Drive and the Mt. Lebanon Baptist Church baseball field and playground.	B, C	67
13	D	Residences on Peppermint Road, Peppermint Hills Drive, and Sevierville Road.	B	67
14	D	Residences on Hitch Road, Scarlet Drive, and Sevierville Road.	B	67
15	C	Residences Sevierville Road and Butler Road.	B	67
16	C, D	Residences on Melanie Drive, Davis Ford Road, Clayton Court, Misty View Drive and Helton Road and the Full Gospel Church.	B, D	67, 52*
17	D	Residences Helton Road and John Helton Road.	B	67
18	C, D	Residences John Helton Road, Hubbard Drive, Tuckaleechee Pike, and E Lamar Alexander Parkway and the Misty Meadow Driving Range.	B, E	67

** Interior*

Table 5: Noise Analysis Areas Affected by Alternatives

Alternative	Affected Noise Analysis Areas
A	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
A (East Shift)	3, 4, 10
A (West Shift)	3, 4, 10
C	1, 2, 3, 5, 6, 7, 10, 15, 16, 18
D	3, 11, 12, 13, 14, 16, 17, 18

As indicated in Table 4, the vast majority of noise-sensitive uses in the project area are Activity Category B residences. The Mt. Lebanon Baptist Church baseball field and playground on the south side of Wildwood Road in Noise Analysis Area 12 adjacent to Alternative D is the only Category C land use in the project area. Noise impacts will be identified and noise abatement will be considered for the Activity Category B residences and Activity Category C playground/baseball field if future sound levels are 66 dBA or higher, or if a substantial increase in existing sound levels is predicted.

The Misty Meadow Driving Range on John Helton Road on the north side of Lamar Alexander Parkway in Area 18 between Alternatives C and D is an Activity Category D commercial land use. Noise impacts will be identified and noise abatement will be considered for the driving range if future sound levels are 71 dBA or higher, or if a substantial increase in existing sound levels is predicted.

The Morning Star Baptist Church and the Rio Revolution Church in Area 10, and the Full Gospel Church in Area 16 do not have any exterior areas of frequent human use. Therefore, the Churches are Activity Category D land uses that must be assessed for interior impacts. Noise impacts will be identified and noise abatement will be considered if interior future sound levels are 51 dBA or higher, or if a substantial increase in existing sound levels is predicted.

There are no Category E land uses in the project area. However, there are some Category F properties located within the project limits. As indicated in Table 2, these land uses are not noise-sensitive and do not have an NAC. Therefore, they have not been included in the noise study.

Finally, there are tracts of Activity Category G undeveloped lands in the project area. These undeveloped lands are not noise-sensitive and have not been included in the noise analysis. However, noise impacts could occur in the future if noise-sensitive land uses are constructed near the proposed Pellissippi Parkway Extension. A discussion of future sound levels and the need for noise-compatible land use planning is provided later in this report.

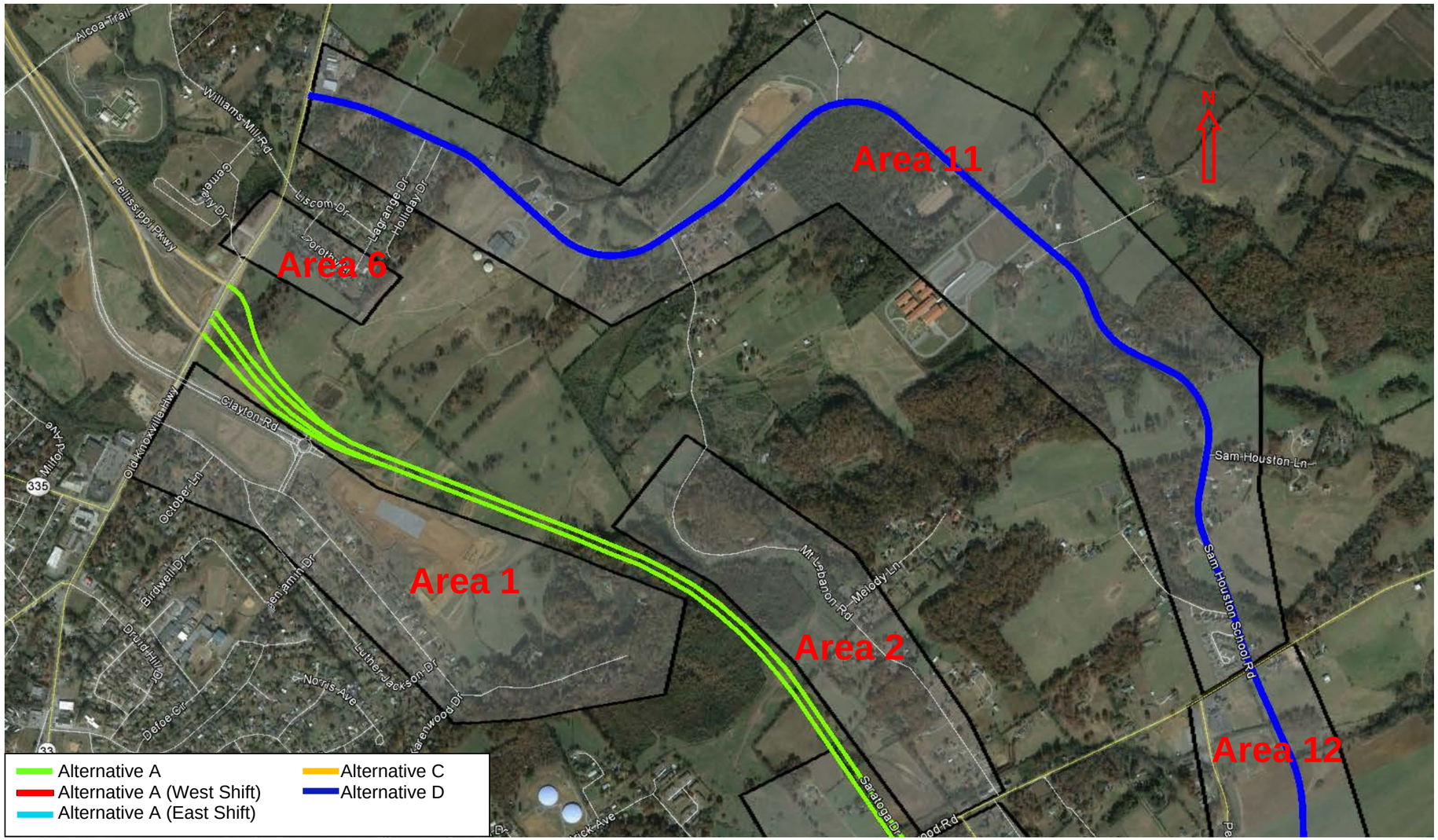

Figure 4: Noise Analysis Areas

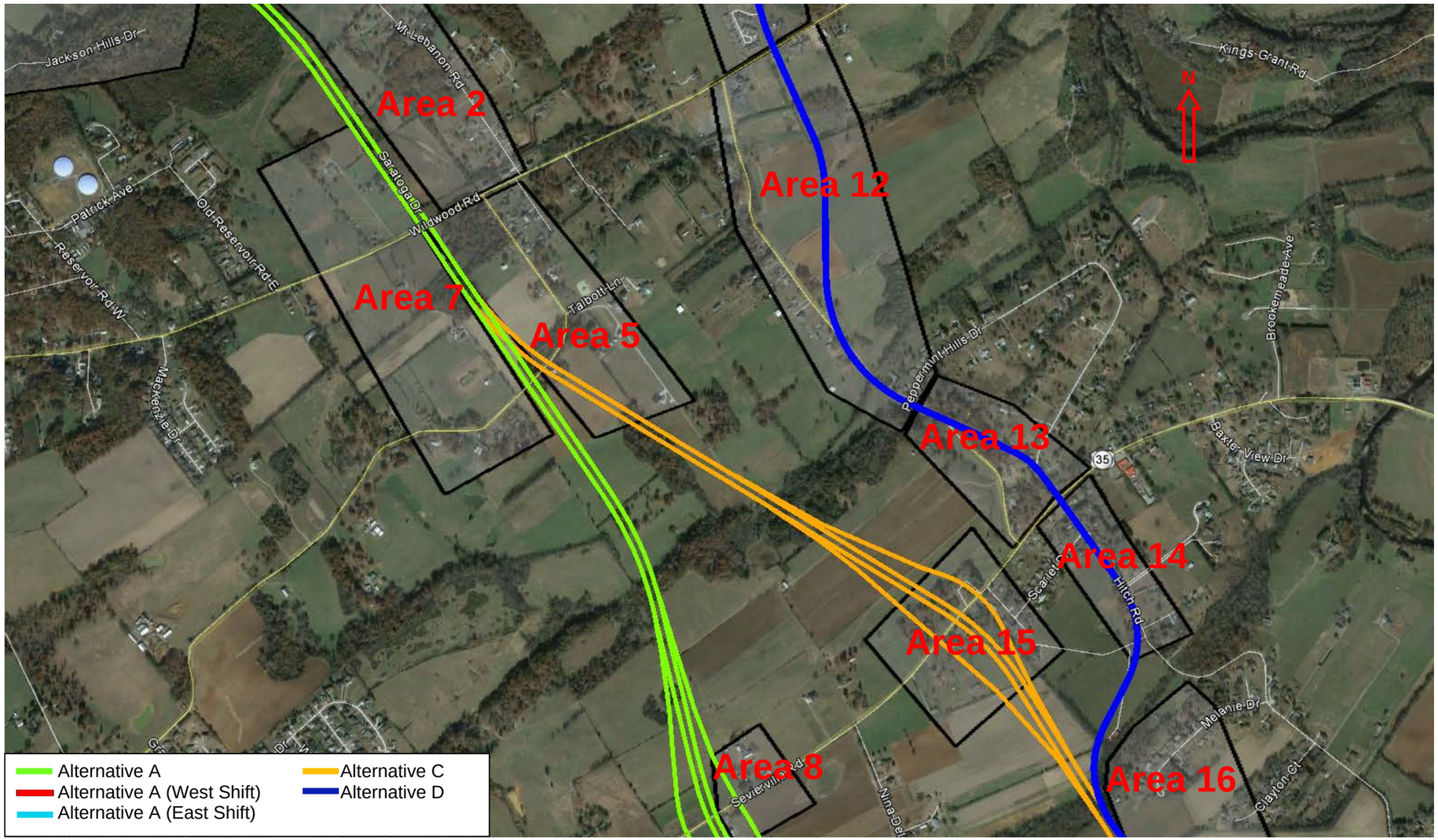

Figure 4: Noise Analysis Areas

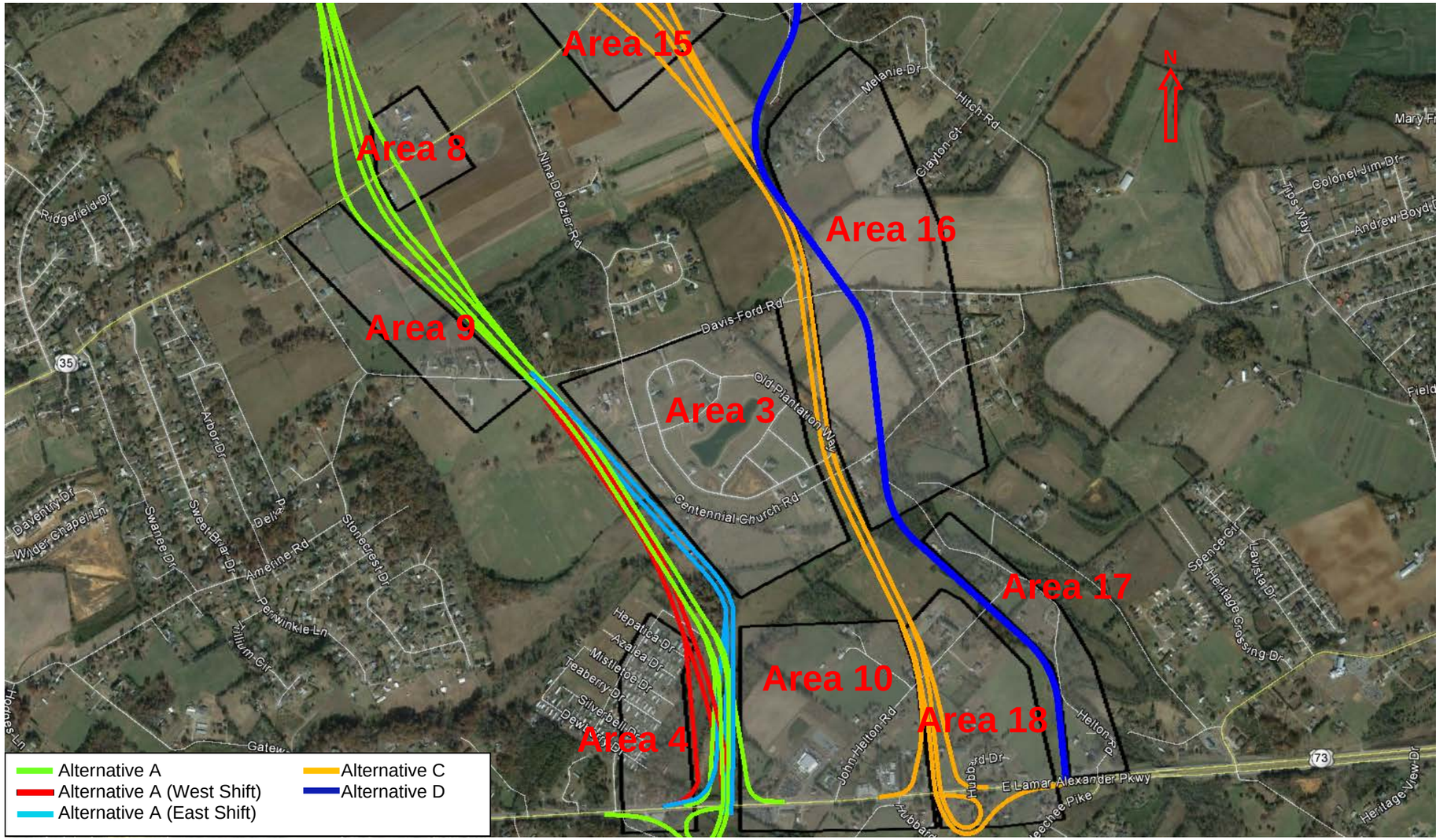

Figure 4: Noise Analysis Areas

2.3 Determination of Existing Sound Levels

Noise measurements were conducted by PB in 2008 for the previous noise study at several noise-sensitive land uses. A series of short-term (15-minute) noise measurements were conducted by PB at one-minute intervals to establish the existing noise environment within the proposed project corridor area. The noise measurement data collection sheets and drawings for the measurement locations from PB's previous noise study are provided in Appendix B.

The previous study noted that background noise (i.e. dog barking, sirens, etc.) during the measurements was noted, and the corresponding one-minute measurement intervals were eliminated and that the measurements were obtained during acceptable weather (no precipitation and relatively low winds) and dry road surface conditions. The representative monitoring locations consisted of mainly undeveloped farmland, residential locations, and the Morning Star Baptist Church.

Table 6 summarizes the existing sound levels at the measurement locations. As shown, many measurements were conducted during off-peak periods. Sound levels during the morning and afternoon periods would typically be higher than the reported off-peak sound levels at these locations.

It is important to note that sound levels vary throughout the day depending on the proximity to local roads and to other noise sources. Sound levels can also vary with environmental changes, including shifts in wind speed and direction and changes in the vertical temperature profile. As a result, the short-term measurement data provides only a snapshot of the existing noise environment at each measurement location.

The measured sound levels at many of the locations are below 50 dBA. These sound levels are typical of locations in areas with lightly traveled roads and no significant transportation or other major noise sources.

Sound levels at several other locations are between 50 and 60 dBA which are more indicative of proximity to more heavily traveled roads.

Higher noise levels of 64 and 67 dBA, respectively, were measured at 3412 Lamar Alexander Parkway and 3115 Sevierville Road, as those roads are heavily traveled.

A review of historic traffic data for the roads in the project area indicates that year 2013 traffic volumes were comparable to year 2008 traffic volumes. The 2013 average annual daily traffic (AADT) on US 321/SR 73 (Lamar Alexander Parkway) was 17,104 vehicles per day (vpd) and slightly lower than the 2008 AADT of 17,618 vpd. Similarly, the 2013 average annual daily traffic (AADT) on SR 33 was 15,448 vpd and just slightly higher than the 2008 AADT of 15,156 vpd. The 2013 AADT on Sevierville Road was 7,411 vpd and approximately 8% lower than the 2008 AADT of 8,187 vpd. These small traffic changes would have a negligible effect on sound levels. As a result, the sound levels measured in 2008 are considered to be representative of existing sound levels.

Table 6: Year 2008 Sound Levels at Measurement Locations

Location	Noise Analysis Area	Date	Period	Duration (minutes)	L_{eq}(1h) (dBA)
213 Jackson Hills Drive	1	10/28/08	8:10 - 8:25 AM	15	48
557 Jackson Hills Drive	1	10/28/08	8:55 - 9:10 AM	15	43
3330 Centennial Church Road	3	10/30/08	11:05 - 11:25 AM	15	42
626 Hepatica Drive	4	10/28/08	3:25 - 3:40 PM	15	40
1834 E Brown School Road	5	10/28/08	10:45 - 11:00 AM	15	40
3049 Wildwood Road	7	10/28/08	9:30 - 9:45 AM	15	41
1785 E Brown School Road	7	10/28/08	1:40 - 1:55 PM	15	43
3115 Sevierville Road	8	10/30/08	4:15 - 4:30 PM	15	64
3047 Davis Ford Road	9	10/28/08	2:30 - 2:45 PM	15	33
3412 Lamar Alexander Pkwy	10	10/28/08	4:00 - 4:15 PM	15	67
708 Sam Houston School Road	11	10/28/08	1:00 - 1:15 PM	15	42
229 Sam Houston School Road	11	10/29/08	8:30 - 8:45 AM	15	57
436 Sam Houston School Road	11	10/29/08	9:10 - 9:25 AM	15	55
909 Sam Houston School Road	11	10/29/08	9:55 - 10:10 AM	15	51
		10/29/08	5:00 - 5:15 PM	15	56
1036 Belfair Lane	11	10/29/08	10:35 - 10:50 AM	15	55
1514 Peppermint Road	12	10/29/08	1:00 - 1:15 PM	15	53
3324 Sevierville Road	14	10/29/08	1:40 - 1:55 PM	15	56
1225 Hitch Road	15	10/29/08	2:20 - 2:35 PM	15	46
		10/30/08	3:10 - 3:25 PM	15	39
3307 Melanie Drive	16	10/29/08	3:00 - 3:15 PM	15	47
		10/30/08	3:45 - 4:00 PM	15	36
839 Misty View Drive	16	10/29/08	3:35 - 3:50 PM	15	48
253 John Helton Road	17	10/30/08	9:15 - 9:30 AM	15	45
225 John Helton Road	18	10/30/08	10:15 - 10:30 AM	15	40

Existing noise levels at numerous additional receptors were also predicted by PB for the previous noise study using the FHWA Traffic Noise Model (TNM®) Version 2.5. The TNM model for existing conditions developed by PB was also updated using existing traffic volumes developed by Sain Associates, Inc. in December 2013 for Alternatives A, C and D and April 2014 for Alternative D. The updated traffic projections are summarized in Appendix C.

The modeled speeds were reviewed and modified, as necessary, to ensure that posted speeds were modeled in accordance with TDOT's Noise Procedures.

The modeled locations and elevations of the previously identified receptors were reviewed and modified as necessary, and the receivers were named using their street address in accordance with TDOT's Noise Procedures. Some additional receivers were also added.

No additional changes were made to the existing TNM model developed by PB. TNM plan views showing modeled TNM objects - including the locations of the modeled roadways and receivers - are provided in Appendix D.

It is also important to understand that the TNM model only predicts sound generated by vehicles on the modeled roadway network. There are other noise sources in the area that contribute to existing "background" sound levels including vehicles on local roads, driveways and parking lots; recreational uses; dogs barking; insect and bird noise; etc. Background sound levels can vary by hour, day and time of year. As shown in Table 6, many of the measured "background" sound levels in the area were between 39 and 48 dBA with only two of the short-term measurements below 39 dBA. Therefore, a background sound level of 40 dBA was used represent the existing "background" sound level.

The existing noise levels, including noise from the modeled roadway network and background noise, for the noise-sensitive land uses in Noise Analysis areas are summarized in Table 7. The predicted existing sound levels at each modeled receiver are provided in Appendix E.

2.4 Determination of Future Sound Levels

Traffic projections for the Build Alternatives for the design year 2040 were developed by Sain Associates, Inc. in December 2013 and April 2014. These projections include traffic volumes for the "design hour" which represents a theoretical worst case traffic condition. These design hour traffic projections were used for the noise analysis since they represent the highest number of vehicles expected to travel on the roadway network in a given hour and would, therefore, represent the worst (loudest) traffic noise hour. The design year traffic projections are summarized in Appendix C.

2.4.1 No-Build Alternative

The existing TNM model was updated using the design year 2040 traffic projections for the No-Build Alternative developed by Sain Associates. The sound levels for the No-Build Alternative are provided in Appendix E.

Table 7: Existing Sound Levels

Noise Analysis Area	Predicted Existing Sound Levels (dB)
1	41 - 54
2	41 – 52
3	42 – 48
4	42 – 64
5	41 – 52
6	45 – 59
7	41 – 55
8	61 – 65
9	43 – 61
10	45 – 68
11	43 – 66
12	46 – 63
13	46 – 62
14	45 – 63
15	44 – 60
16	41 – 50
17	43 – 63
18	44 – 65

2.4.2 Build Alternatives

Noise modeling of the each Build Alternative was completed using the FHWA TNM model. The program calculated design hour equivalent sound levels in design year 2040 for the noise-sensitive receptors in each Noise Analysis Area.

The TNM models that were developed by PB for the previous noise study were used for all noise analysis areas and Alternatives except for Areas 3 and 4 for the Alternative A with the East and West Shifts that were developed by Bowlby & Associates. As with the existing PB model, the modeled locations and elevations of the previously identified receptors were reviewed and modified as necessary, and the receivers were named using their street address in accordance with TDOT's Noise Procedures. Some additional receivers were also added.

The previous studies for the project [4, 5] noted that base maps and design files were exported from Micro-station as DXF design files and then imported into the FHWA TNM model. All TNM modeling files were created using the actual ground elevations of all existing roadways and receptor locations. The elevations of proposed roadways was estimated using available elevation data since roadway profiles have not yet been developed. The TNM modeling process was completed in accordance with TDOT's TNM Guidelines.

As stated above, the recent traffic projections for the design year 2040 were used for the noise analysis. These projections indicated design hour total truck volumes between 1% and 7% on the existing roadway network and 2% for the Pellissippi Parkway Extension. The percentage of trucks on several existing roads remains the same, showing no increase in trucks while the percentage of trucks on other existing roads is projected to increase. The traffic data is provided in Appendix C. The proposed design speed of 60 mph was modeled for the Pellissippi Parkway Extension.

TNM plan views showing modeled TNM objects - including the locations of the modeled roadways and receivers - are provided in Appendix D. The predicted design year sound levels for the modeled receptors in each Noise Analysis Area for each Alternative are provided in Appendix E.

2.5 Impact Determination Analysis

As noted previously, a location is impacted if 1) the predicted worst hour noise level approaches or exceeds the NAC or 2) there is a substantial increase in design year noise levels above existing noise levels.

The predicted impacts in each Noise Analysis area for each Alternative are summarized in Table 8 and discussed below. An indication of “n/a” means that the Noise Analysis Area is not affected by that Alternative. Tables showing the predicted existing and No-Build sound levels and the Build sound levels for each modeled receiver in each Area are shown in the tables in Appendix E for each Alternative. Receivers that are impacted are highlighted in the tables. Maps showing the locations of impacted receptors are also provided in Appendix E.

2.5.1 Alternative A

A total of 81 residences are predicted to be impacted - mostly by a substantial increase in design year noise levels. Only 18 of the 81 impacts are due to sound levels approaching or exceeding the NAC. Twenty-nine of the impacts are predicted in the Kensington Place mobile home community in Area 4. No impacts are predicted in Area 6 for the residences on Western Springs Drive and Old Knoxville Highway at the northern end of the project.

Five (5) residences would be taken under Alternative A: 3118 Wildwood Road in Area 5, 141 Saratoga Drive and 115 Saratoga Drive in Area 7, 3048 Sevierville Road in Area 8, and 3405 E Lamar Alexander Parkway in Area 10.

The predicted design year sound levels for the exterior areas of the Morning Star Baptist Church and the Rio Revolution Church in Area 10 are 74 and 70 dBA, respectively. Both Churches are air-conditioned and would be expected to operate under a “closed windows” condition. Application of a typical 25 dB reduction for building attenuation results in predicted interior sound levels of 49 dBA and 45 dBA, respectively. These levels are below the NAC of 52 dBA for Activity Category D land uses. As a result, the Churches are not predicted to be impacted under Alternative A.

Table 8: Impact Determination Analysis, Design Year 2040, Build Alternatives [(1)]

	Alternative A			Alternative A (East Shift)			Alternative A (West Shift)			Alternative C			Alternative D		
	Resi-dences	Cat. C/E	Total	Resi-dences	Cat. C/E	Total	Resi-dences	Cat. C/E	Total	Resi-dences	Cat. C/E	Total	Resi-dences	Cat. C/E	Total
Area 1	9	0	9	9	0	9	9	0	9	9	0	9	n/a	n/a	n/a
Area 2	5	0	5	5	0	5	5	0	5	5	0	5	n/a	n/a	n/a
Area 3	6	0	6	6	0	6	7	0	7	2	0	2	0	0	0
Area 4	29	0	29	28	0	28	50	0	50	n/a	n/a	n/a	n/a	n/a	n/a
Area 5	11	0	11	11	0	11	11	0	11	11	0	11	n/a	n/a	n/a
Area 6	0	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a
Area 7	7	0	7	7	0	7	7	0	7	6	0	6	n/a	n/a	n/a
Area 8	2	0	2	2	0	2	2	0	2	n/a	n/a	n/a	n/a	n/a	n/a
Area 9	6	0	6	6	0	6	6	0	6	n/a	n/a	n/a	n/a	n/a	n/a
Area 10	6	0	6	6	0	6	6	0	6	10	0	10	n/a	n/a	n/a
Area 11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	32	0	32
Area 12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	9	2	11
Area 13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8	0	8
Area 14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	9	0	9
Area 15	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7	0	7	n/a	n/a	n/a
Area 16	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5	0	5	12	0	12
Area 17	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8	0	8
Area 18	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8	1	9	5	0	5
Totals	***81***	***0***	***81***	***80***	***0***	***80***	***103***	***0***	***103***	***63***	***1***	***64***	***83***	***2***	***85***

(1) An "n/a" indicates that a Noise Analysis Area is not affected by that Alternative.

2.5.2 Alternative A with East Shift

The impacts for Alternative A with the East Shift are the same as for Alternative A for all of the Noise Analysis Areas except 3 and 4 where the alignment shifts toward the east north of Lamar Alexander Parkway.

A total of 80 residences are predicted to be impacted under Alternative A with the East Shift. Compared to Alternative A, one fewer residence would be impacted in Area 4 due to the east alignment shift away from the residences in the Kensington Place mobile-home community.

Six residences would be taken under this alternative – the same five residences taken under Alternative A along with 3266 Centennial Church Road in Area 3.

As with Alternative A, the Morning Star Baptist Church and the Rio Revolution Church in Area 10 are not predicted to be impacted.

2.5.3 Alternative A with West Shift

The impacts for Alternative A with the West Shift are the same as for Alternative A for all of the Noise Analysis Areas except 3 and 4 where the alignment shifts toward the west north of Lamar Alexander Parkway.

A total of 103 residences are predicted to be impacted under Alternative A with the West Shift. Compared to Alternative A, the increase in impacts is due to the west alignment shift toward the residences in the Kensington Place mobile home community in Area 4.

Eleven residences would be taken under this alternative – the same five residences taken under Alternative A along with six residences in Kensington Place.

As with Alternative A, the Morning Star Baptist Church and the Rio Revolution Church in Area 10 are not predicted to be impacted.

2.5.4 Alternative C

A total of 63 residences are predicted to be impacted under Alternative C – again, mostly by a substantial increase in design year noise levels. The impacts for Areas 1, 2, and 6 are similar to Alternative A, since the proposed alignments are the same in those areas. Although Alternative C shifts its alignment and avoids the impacts in Areas 4, 8, and 9; this reduction is somewhat offset by the additional impacts that would occur in Areas 15, 16, and 18.

Although the fewest number of impacts are predicted under Alternative C, approximately 26 residences would be taken under this alternative – 11 of which are in Area 15 near Sevierville Road and Butler Road.

The Misty Meadow Driving Range at 225 John Helton Rd is an Activity Category E use in Area 18, and it is predicted to be impacted by a substantial increase in design year noise

levels. Alternative C would also take a large portion of the property although the building would remain. As a result, the future use of this property under Alternative C is unknown.

As with Alternative A, the Morning Star Baptist Church and the Rio Revolution Church in Area 10 are not predicted to be impacted. The Full Gospel Church in Area 16 has a predicted exterior sound level of 60 dBA. The church is air-conditioned and would also be expected to operate under a "closed windows" condition. Application of a typical 25 dB reduction for building attenuation results in a predicted interior sound level well below the NAC of 52 dBA for Activity Category D land uses. As a result, the Full Gospel Church is also not predicted to be impacted.

2.5.5 Alternative D

A total of 83 residences are predicted to be impacted under Alternative D. Alternative D avoids any noise impacts in Areas 1 through 10 because of its shifted alignment. However, 32 residences along Sam Houston School Road in Area 11 area are predicted to be impacted - 18 of which have predicted noises level that approach or exceed the NAC.

Additionally, approximately 21 residences would be taken under Alternative D.

As with Alternative C, the Full Gospel Church is not predicted to be impacted. However, the baseball field and the playground at the Mt. Lebanon Baptist Church (Activity Category C) in Area 12 are predicted to be impacted by a by a substantial increase in design year noise levels.

2.6 Noise Abatement Evaluation

Abatement is generally evaluated when impacts are predicted to occur. Noise barriers were evaluated to reduce sound levels for the impacted residences in each area. In order for noise barriers to be included in a project, they must be determined to be both feasible and reasonable in accordance with TDOT's Noise Policy as discussed below.

2.6.1 Noise Barrier Feasibility

Feasibility means that: (1) the construction of a barrier would not be anticipated to pose any major design, construction, maintenance, or safety problems; and, (2) the noise barriers will provide a noise reduction (or insertion loss) of 5 dB reduction in design year highway traffic noise levels for the majority of the impacted first-row receptors.

Noise barriers can generally not be constructed where there are frequent driveway access points to adjacent properties. The impacted residences on Lamar Alexander Parkway and on several local road intersecting Lamar Alexander Parkway in Noise Analysis Areas 4, 10, and 18 have driveway access which precludes the consideration of noise barriers since they would eliminate and/or restrict access to Lamar Alexander Parkway from these properties as well as adjacent properties. Therefore, noise barriers for the impacted residences on or near Lamar Alexander Parkway are not feasible.

The unlimited access that would exist under Alternative D precludes the consideration of noise barriers at most locations under Alternative D. However, there are a few locations where

there might be sufficient length to construct a noise barrier without interfering with access although these issues would need be much more thoroughly evaluated if Alternative D were constructed. Noise barriers might be possible under Alternative D for the following impacted uses:

- residences on Belfair Lane and De Armond Lane on the west side of Alternative D north of Wildwood Road in Area 11;
- the Mt. Lebanon Baptist Church playground and baseball field on the west side of Alternative D south of Wildwood Road in Area 12; and
- residences on Melanie Drive and Misty View Drive on the east side of Alternative D south of Sevierville Road in Area 16.

Alternatives A, C, and D as well as the East and West Shift Alternatives involve a limited access facility. The construction of noise barriers along these alternatives would likely be possible if they were determined to be both acoustically feasible (provides a 5 dB IL for the majority on impacted first-row residences) and reasonable in accordance with TDOT's Noise Policy.

A TNM barrier analysis was conducted for each impacted Noise Analysis Area to determine whether noise barriers could be designed to provide a minimum 5 dB IL at the majority of impacted first-row residences (acoustic feasibility). The results are summarized in Table 9. As indicated, some Areas were divided into subareas where two separate noise barriers would be required that would be separated by a significant gap in the barrier.

Noise barriers are feasible for Areas 1 (North and South), 2, 3, 4 and 7 for Alternatives A and the East and West Shifts. Barriers are feasible for Areas1 (North and South), 2, 3, 5, 7, 15 East, 16 North and 18 for Alternative C. Barriers are feasible for Areas 11, 12, and 16 (North and South) for Alternative D.

Noise barriers for several other areas were not acoustically feasible because 5 dB IL could not be achieved at the majority of first-row impacted uses primarily due to significant distances between the uses and the proposed Alternative.

It is often difficult to achieve 5 dB or more IL at significant distances from a road because the sound level reduction (attenuation) that is provided by the intervening soft ground is lost when a barrier is constructed. The lost ground attenuation can be significant especially at greater distances. The barrier must "make up" for the lost ground attenuation and then provide an additional 5 dB noise reduction in order to be feasible. As a result, noise barriers are often not feasible for locations that are hundreds of feet or more fr om the road.

Table 9: Feasibility Analysis [1]

Noise Analysis Area	Alternative A	Alternative A with East Shift	Alternative A with West Shift	Alternative C	Alternative D
1 North	Yes	Yes	Yes	Yes	n/a
1 South	Yes	Yes	Yes	Yes	n/a
2	Yes	Yes	Yes	Yes	n/a
3	Yes	Yes	Yes	Yes	Not Impacted
4	Yes	Yes	Yes	n/a	n/a
5	No	No	No	Yes	n/a
6	Not Impacted	Not Impacted	Not Impacted	Not Impacted	n/a
7	Yes	Yes	Yes	Yes	n/a
8	No	No	No	n/a	n/a
9	No	No	No	n/a	n/a
10	No	No	No	Yes	n/a
11	n/a	n/a	n/a	n/a	Yes
12	n/a	n/a	n/a	n/a	Yes
13	n/a	n/a	n/a	n/a	No (Access)
14	n/a	n/a	n/a	n/a	No (Access)
15 West	n/a	n/a	n/a	No	n/a
15 East	n/a	n/a	n/a	Yes	n/a
16 North	n/a	n/a	n/a	Yes	Yes
16 South	n/a	n/a	n/a	n/a [2]	Yes
17	n/a	n/a	n/a	n/a	No (Access)
18	n/a	n/a	n/a	Yes	No (Access)

(4) An "n/a" indicates that a Noise Analysis Area is not affected by that Alternative.
(5) Only one residence is predicted to be impacted. Therefore, a barrier was not evaluated.

2.6.2 Noise Barrier Reasonableness

All noise barriers that were identified as feasible in Table 9 were evaluated for reasonableness in accordance with TDOT's Noise Policy. In order for a noise barrier to be reasonable, the following conditions must be met:

1. TDOT's noise reduction design goal must be achieved;
2. The required noise barrier area per benefited residence must be less than or equal to the allowable area per benefited residence; and
3. The benefited residents and/or property owners must support the construction of the noise barrier.

Each of these conditions is discussed in greater detail below.

Noise Reduction Design Goal

For a noise barrier to be considered reasonable, the noise barrier must provide at least a 7 dB noise reduction at 60% or more of the first-row benefited receptors. Table 10 summarizes the noise reduction design goal analysis for each barrier for each Alternative. As shown, the noise reduction design goal was achieved for all barriers except for Area 4 under Alternative A, Area 3 under Alternative C, and Area 12 under Alternative D.

The predicted design year sound levels and insertion losses for each barrier, and the preliminary noise barrier design table are provided in Appendix F. The calculations of the noise reduction design goal for each barrier are shown at the bottom of the sound levels tables.

Noise Barrier Area Per Benefited Residence

In order for a noise barrier to be reasonable, the noise barrier area per benefited residence must also be less than or equal to the allowable noise barrier area per benefited residence for each noise analysis area. All barriers that meet the noise reduction design goal were evaluated to determine if the actual noise barrier area per benefited residence was less that the allowable noise barrier area per benefited residence.

The allowable barrier area per benefited residence is calculated using the following equation:

Allowable Area per Benefited Residence =

Base Allowance	_____ square feet
+ Previous Type I Widening Allowance	_____ square feet
+ Design Year Noise Levels Allowance	_____ square feet
+ Noise Level Increase Allowance	_____ square feet
+ Noise Compatible Planning Allowance	_____ square feet
= Total Allowable Area per Benefited Residence	_____ square feet

The value for each allowance type is selected based on the criteria outlined in Table 11. The calculation of the allowable area per benefited residence for each potential barrier is summarized in Table 12. As shown, all of the areas except Area 11 under Alternative D receive the maximum 1,500 square foot base allowance since the project is on a new alignment. Sam Houston Road will be widened adjacent to the residences in Area 11 under Alternative D. Additionally, the residences on Belfair Lane and De Armond Lane were constructed in 2004 and 2005. Therefore, this area receives a 750 square foot base allowance. All of the Areas also receive the maximum 400 foot Noise Level Increase Allowance. As show, the resulting allowable area per benefited residence for most areas is 1,900 square feet due. Area 4 under Alternative A and Alternative A with the West Shift also receives a 100 square foot Design Year Noise Levels Allowance.

Table 10: Noise Reduction Design Goal Analysis

Noise Analysis Area	First-Row Benefited Receptors			Noise Reduction Design Goal Met?
	Total	Receiving 7 dB IL	Percent	
Alternative A				
1 North	3	2	66.7%	Yes
1 South	2	2	100%	Yes
2	3	3	100%	Yes
3	5	3	60%	Yes
4	1	3	33.3%	No
7	3	3	100%	Yes
Alternative A with East Shift				
1 North (Same as Alternative A)	3	2	66.7%	Yes
1 South (Same as Alternative A)	2	2	100%	Yes
2 (Same as Alternative A)	3	3	100%	Yes
3	5	5	100%	Yes
4	4	3	75%	Yes
5 (Same as Alternative A)	1	1	100%	Yes
7 (Same as Alternative A)	3	3	100%	Yes
Alternative A with West Shift				
1 (Same as Alternative A)	3	2	66.7%	Yes
2 (Same as Alternative A)	2	2	100%	Yes
3	5	4	80%	Yes

Noise Analysis Area	First-Row Benefited Receptors			Noise Reduction Design Goal Met?
	Total	Receiving 7 dB IL	Percent	
4	4	4	100%	Yes
5 (Same as Alternative A)	1	1	100%	Yes
7 (Same as Alternative A)	3	3	100%	Yes
Alternative C				
1 North (Same as Alternative A)	3	2	66.7%	Yes
1 South (Same as Alternative A)	2	2	100%	Yes
3	2	1	50%	No
5	2	2	100%	Yes
7	2	2	100%	Yes
10	2	2	100%	Yes
15	2	2	100%	Yes
16 North	2	2	100%	Yes
18	6	4	67%	Yes
Alternative D				
11	3	3	100%	Yes
12	2	0	0%	No
16 North	2	2	100%	Yes
16 South	7	5	71.4%	Yes

Table 11: Reasonableness Allowances

Allowance Type	Criteria	Allowance in square feet
Base Allowance	Residences pre-date the highway(1) or the project is on a new alignment.	1,500
	Residences post-date the highway(2) but were constructed before September 16, 2005. (3)	750
	Residences were constructed after September 16, 2005.(3)	250
Previous Type I Widening Allowance(4)	Residences pre-date a Type I widening project on the adjacent highway.	200
Design Year Noise Levels Allowance(5)	69 dBA or less	0
	70 – 74 dBA	100
	75 dBA or more	200
Noise Level Increase Allowance(6)(7)	0 – 4 dB	0
	5 – 9 dB	200
	10 or more dB	400
Noise Compatible Planning Allowance	The local government of the jurisdiction in which the project will be constructed has no policies to require that noise be considered in the land development process.	0
	The local government of the jurisdiction in which the project will be constructed has adopted official and enforceable policies to require that noise be considered as an integral component of the land development process.	100

(1) The majority (more than 50%) of residences existed before the original highway construction.
(2) The majority (more than 50%) of residences were constructed after the original highway construction.
(3) TDOT's previous noise policy became effective on September 16, 2005. FHWA's approval of this policy was contingent upon TDOT's completion of a public outreach program to 1) notify local jurisdictions of the changes in TDOT's new noise policy and 2) encourage them to consider noise compatible land use planning when noise-sensitive land uses are proposed adjacent to TDOT's highways. As a result, development that occurs after this date receives less consideration in the reasonableness analysis.
(4) The majority (more than 50%) of residences existed before the most recent Type I project that added through traffic lanes.
(5) Based on an average of the impacted first–row receivers' levels (design year noise levels for Type I projects and existing noise levels for Type II projects).
(6) An average of the increases from existing noise levels to design year noise levels for the Build Alternative at the impacted first-row receivers.
(7) Not applicable for Type II projects.

Table 12: Determination of Reasonableness Allowances

Area	*Base Allowance*	*Previous Type I Widening Allowance*	*Design Year Noise Levels Allowance*	*Noise Level Increase Allowance*	*Noise Compatible Planning Allowance*	*Total*
Alternative A						
1 North	1,500	0	0	400	0	1,900
1 South	1,500	0	0	400	0	1,900
2	1,500	0	0	400	0	1,900
3	1,500	0	0	400	0	1,900
4	1,500	0	0	400	0	1,900
7	1,500	0	0	400	0	1,900
Alternative A with East Shift						
1 North	1,500	0	0	400	0	1,900
1 South	1,500	0	0	400	0	1,900
2	1,500	0	0	400	0	1,900
3	1,500	0	100	400	0	2,000
4	1,500	0	0	400	0	1,900
7	1,500	0	0	400	0	1,900
Alternative A with West Shift						
1 North	1,500	0	0	400	0	1,900
1 South	1,500	0	0	400	0	1,900
2	1,500	0	0	400	0	1,900
3	1,500	0	0	400	0	1,900

Area	*Base Allowance*	*Previous Type I Widening Allowance*	*Design Year Noise Levels Allowance*	*Noise Level Increase Allowance*	*Noise Compatible Planning Allowance*	*Total*
4	1,500	0	100	400	0	2,000
7	1,500	0	0	400	0	1,900
Alternative C						
1 North	1,500	0	0	400	0	1,900
1 South	1,500	0	0	400	0	1,900
2	1,500	0	0	400	0	1,900
3	1,500	0	0	400	0	1,900
5	1,500	0	0	400	0	1,900
7	1,500	0	0	400	0	1,900
10	1,500	0	0	400	0	1,900
15	1,500	0	0	400	0	1,900
16	1,500	0	0	400	0	1,900
18	1,500	0	0	400	0	1,900
Alternative D						
11	750	0	0	400	0	1,150
16 North	1,500	0	0	400	0	1,900
16 South	1,500	0	0	400	0	1,900

The insertion loss for each modeled receiver was used to determine the total number of benefited residences. Benefited residences receive 5 dB or more of insertion loss due to construction of the barrier. The results of the noise barrier reasonableness analysis are summarized in Appendix F.

The Misty Meadow driving range in Area 18 that is impacted under Alternative C is a non-residential Activity Category E land use. Therefore, an equivalent number of residences must be calculated for it in accordance with the following equation from TDOT's Noise Procedures:

$$\text{Equivalent Residences} = \frac{\text{Number of Users}}{\text{(Number of People Per Residence)}} \times \text{Usage}$$

where:

Number of Users = Average Number of Users During Usage Times
Number of People Per Residence = 2.5 (Tennessee Average from Census)
Usage = (Hours Used Per Day/24 Hours) x (Days Used Per Year/365 Days)

As noted previously, Alternative C would take a large portion of the driving range property although the building would remain. As a result, the future use of this property under Alternative C is unknown. However, the driving range was assumed to continue to operate in its current capacity for the purpose of the noise barrier analysis.

Table 13 summarizes the resulting number of equivalent residences for the driving range. As shown, the number of tee boxes at the driving range was estimated at 40 and it was assumed that 40% of the tee boxes are typically being used. The range was assumed to operate from April through mid-October (190 days) for 14 hours per day. The resulting number of equivalent residences for the driving range is two residences.

Table 13: Equivalent Number of Residences for Driving Range

Number of Users	**16**
Maximum Number of Users (1)	40
Typical User Factor (2)	40%
Number of People Per Residence	**2.5** (3)
Usage	**0.30**
Hours Used Per Day	14
Days Used Per Year	190 (4)
Equivalent Residences	**2** (5)

(1) Approximate number of tee boxes.
(2) The typical number of users would be significantly less than the maximum number of users.
(3) Tennessee average from census.
(4) Facilities assumed to operate April through mid-October.
(5) Calculated value rounded up.

The results of the noise barrier reasonableness analysis indicated that the area per benefited residence is substantially higher than the allowable area per benefited residence for all of the areas evaluated for Alternative A, Alternative A with the East Shift and Alternative C and for all but one area each for Alternative A with the West Shift and Alternative D.

The high calculated areas per benefited residence are generally the result of 1) significant distances between the impacted residences and the Pellissippi Parkway Extension alignment, 2) low residential densities (large lots), 3) the requirement for long and tall barriers (high barrier areas) to provide a 7 dB noise reduction, and 4) the low number of benefits that can be achieved. As shown in Table 14, the highest number of benefits that can be achieved by any barrier is eleven (11) with most barriers benefiting between two (2) and five (5) residences.

However, the area per benefited residence is lower than the allowable area per benefited residence for two locations: Area 4 for Alternative A with the West Shift and Area 11 (Belfair Lane and De Armond Lane) for Alternative D. The locations of the barriers are shown in Appendix G.

A noise barrier could not be designed to protect the impacted residences on De Armond Lane in Area 11 because of the adjacent driveway and local road intersections. A barrier could be designed to protect the impacted residences on Belfair Lane. However, a barrier for this location could pose sight distance and other design or construction issues that cannot be fully assessed at this time. These issues would need be much more thoroughly evaluated if Alternative D were constructed.

Views of Benefited Residents and Property Owners

TDOT's Noise Policy and Procedures require that the views of the benefited property owners and residents be considered in making final noise abatement decisions.

If noise barriers are determined to be both feasible and reasonable based on the design plans for the project, TDOT will hold a public meeting to solicit the views of benefited property owners and residents. The meeting advertisement will include a note that a noise barrier is proposed and that public comments will be solicited and received at the meeting or hearing.

If significant opposition exists and there is not clear support for the construction of the proposed noise barrier, TDOT will conduct a certified mail survey to solicit the views of the benefited residents and/or property owners that would be protected by the barrier. If a majority of benefited residents/property owners oppose the construction of a noise barrier, then the barrier will not be included as a "likely" noise abatement measure. Benefited residents and/or property owners that do not respond will be contacted a second time. A final determination will be made based upon the total responses received after the second survey.

Responses from residents or owners of properties that are predicted to be impacted as well as benefited will be counted as two responses. Responses from residents or owners of properties that are predicted to be benefited but not impacted will be counted as one response. TDOT will conclude that a community desires the construction of a noise barrier unless a majority (at least 51%) of the impacted property owners and residents indicate that they do not want the proposed noise barrier.

Table 14: Noise Barrier Design Results and Reasonableness Analysis

Area	*Length (ft.)*	*Average Height (ft.)*	*Barrier Area (sq. ft.)*	*Benefited Residences*	*Area Per Benefited Residence (sq. ft.)*	*Allowable Area Per Benefited Residence (sq. ft.)*	*Reasonable ?(1)*
Alternative A							
1 North	2,600	20	52,000	4	13,000	1,900	No
1 South	1,600	11	17,000	2	8,500	1,900	No
2	4,266	17	70,528	5	14,106	1,900	No
3	2,700	20	53,800	6	8,967	1,900	No
7	4,503	18	81,056	4	20,264	1,900	No
Alternative A with East Shift							
1 North	2,600	20	52,000	4	13,000	1,900	No
1 South	1,600	11	17,000	2	8,500	1,900	No
2	4,266	17	70,528	5	14,106	1,900	No
3	2,562	14	35,136	8	4,392	2,000	No
4	1,870	22	41,628	11	3,784	1,900	No
7	4,503	18	81,056	4	20,264	1,900	No
Alternative A with West Shift							
1 North	2,600	20	52,000	4	13,000	1,900	No
1 South	1,600	11	17,000	2	8,500	1,900	No
2	4,266	17	70,528	5	14,106	1,900	No
3	2,594	19	49,142	11	4,467	1,900	No
4	1,268	16	19,646	11	1,786	1,900	Yes
7	4,503	18	81,056	4	20,264	1,900	No

Area	*Length (ft.)*	*Average Height (ft.)*	*Barrier Area (sq. ft.)*	*Benefited Residences*	*Area Per Benefited Residence (sq. ft.)*	*Allowable Area Per Benefited Residence (sq. ft.)*	*Reasonable ?(1)*
Alternative C							
1 North	2,600	20	52,000	4	13,000	1,900	No
1 South	1,600	11	17,000	2	8,500	1,900	No
2	4,266	17	70,528	5	14,106	1,900	No
5	1,500	15	22,800	2	11,400	1,900	No
7	3,880	24	90,996	7	12,999	1,900	No
10	1,200	21	24,656	2	12,328	1,900	No
15	1,765	16	28,010	3	9,337	1,900	No
16	2,100	19	39,000	4	9,750	1,900	No
18	2,921	17	50,212	7 (2)	7,173	1,900	No
Alternative D							
11	308	11	3,424	6	571	1,150	Yes
16 North	2,243	18	39,236	5	7,847	1,900	No
16 South	1,100	23	25,300	8	3,163	1,900	No

(1) Final determinations regarding reasonableness will be made during the design phase for the project.
(2) Five residences and two equivalent residences for the driving range.

2.6.3 Statement of Likelihood

A noise barrier has been determined to be preliminarily feasible and reasonable in accordance with TDOT's Noise Policy and is considered "likely" for Noise Analysis Area 4 (Kensington Place) if Alternative A with the West Shift is constructed.

A noise barrier for the impacted residences on Belfair Lane on the west side of Alternative D north of Wildwood Road in Area 11 was also identified as preliminarily feasible and reasonable. However, a barrier for this location could pose sight distance and other design or construction issues that cannot be fully assessed at this time. These issues would need be much more thoroughly evaluated if Alternative D were constructed. As a result, a barrier for this part of Area 11 has been identified as "possible."

However, the noise analysis was based on functional project plans. Final noise abatement decisions will be made based on an updated evaluation of the Preferred Alternative using the final design plans for the project. This evaluation will likely be conducted as part of the right-of-way or construction reevaluation for the project.

2.7 Construction Noise

It is expected that TDOT's construction specifications will apply to this project. As a result, construction procedures shall be governed by the *Standard Specifications for Road and Bridge Construction* as issued by TDOT and as amended by the most recent applicable supplements. The contractor will be bound by Section 107.01 of the Standard Specifications to observe any noise ordinance in effect within the project limits. Detoured traffic shall be routed during construction so as to cause the least practicable noise impact on noise-sensitive areas.

2.8 Information for Local Officials

There are tracts of undeveloped land adjacent to the proposed Pellissippi Parkway Extension. TDOT encourages the local governments with jurisdiction over these lands, as well as potential developers of these lands to practice noise compatibility planning in order to avoid future noise impacts. The following language is included in TDOT's noise policy:

> *"Highway traffic noise should be reduced through a program of shared responsibility. Local governments should use their power to regulate land development in such a way that noise-sensitive land uses are either prohibited from being located adjacent to a highway or that the developments are planned, designed and constructed in such a way that noise impacts are minimized."*

Two guidance documents on noise compatible land use planning are available from FHWA. [7, 8]

Tables 15 and 16 present design year sound levels for areas along the proposed Pellissippi Parkway Extension where vacant and possibly developable lands exist. Sound levels were predicted at distances between 50 and 800 feet from the edge of pavement of the near lane for the design year 2040. As indicated, sound levels within an approximate range between

100 and 200 feet from the edge of pavement of the nearest lane of the proposed Pellissippi Parkway Extension will approach or exceed the NAC of 66 dBA for Category B and C land uses. Noise-sensitive land uses should generally not be constructed in these areas unless noise mitigation measures are provided.

Table 15: Design Year 2040 Sound Levels for Undeveloped Lands, Alternatives A and C

Distance from Pellissippi Parkway[(1)]	***L_{eq} (1h) (dBA)[(2)]***
50 feet	77
100 feet	73
200 feet	68
300 feet	64
400 feet	60
500 feet	58
600 feet	57
700 feet	56
800 feet	55

(1) Perpendicular distance to the center of near lane.
(2) At-grade situation.

Table 16: Design Year 2040 Sound Levels for Undeveloped Lands, Alternative D

Distance from Pellissippi Parkway[(1)]	***L_{eq} (1h) (dBA)[(2)]***
50 feet	72
100 feet	69
200 feet	63
300 feet	60
400 feet	57
500 feet	54
600 feet	52
700 feet	51
800 feet	49

(1) Perpendicular distance to the center of near lane.
(2) At-grade situation.

The values in Tables 15 and 16 do not represent the predicted sound levels at all additional locations adjacent to and particular with the proposed project corridor. Sound levels may vary with changes in terrain and will be affected by the shielding of objects such as buildings. This information is being included to make local officials and planners aware of anticipated highway sound levels so that future development will be compatible with these levels.

Finally, TDOT currently has an active Type II Noise Barrier Program to facilitate the construction of "retrofit" noise barriers along existing highways. To be eligible for a Type II noise barrier, an area must meet the following criteria:

- The neighborhood must be located along a limited-access roadway;
- The neighborhood must be primarily residential;
- The majority (more than 50%) of residences in the neighborhood near the highway pre-dated the initial highway construction;
- A noise barrier for the neighborhood must not have been previously determined to be not reasonable or not feasible as part of a new highway construction or through-lane widening study (Type I project);
- Existing noise levels measured in the neighborhood must be above the Noise Abatement Criteria (NAC) of 66 dBA;
- A barrier must be feasible to construct and will provide substantial noise reduction; and
- A barrier must be reasonable (barrier area per benefited residence) in accordance with TDOT's noise policy. A residence is considered "benefited" if the noise barrier will reduce the traffic noise by at least 5 dB.

3.0 REFERENCES

[1] P*rocedures for Abatement of Highway Traffic and Construction Noise*, 23 CFR 772, Federal Highway Administration.

[2] *Policy on Highway Traffic Noise Abatement*, Tennessee Department of Transportation, July 13, 2011.

[3] *Procedures for Highway Traffic Noise Abatement*, Tennessee Department of Transportation, July 15, 2011.

[4] *Noise Technical Report Update, Pellissippi Parkway Extension State Route 162*, Parsons Brinckerhoff, Inc., June 2013.

[5] *Noise Technical Report Update for Preferred Alternative, Noise Analysis Areas 1, 2, 5, 6, 7, 8 and 9, Pellissippi Parkway Extension*, Parsons Brinckerhoff Inc., February 2014.

[6] *Noise Technical Report Update for Preferred Alternative, Noise Analysis Areas 3, 4 and 10, Pellissippi Parkway Extension*, Bowlby & Associates, February 2014.

[7] *The Audible Landscape: A Manual for Highway Noise and Land Use*, FHWA, November, 1974. http://www.fhwa.dot.gov/environment/audible/index.htm

[8] *Entering the Quiet Zone: Noise Compatibility Land Use Planning*, FHWA, May, 2002. http://www.fhwa.dot.gov/environment/noise/quietzon