NOISE IMPACT ANALYSIS TECHNICAL REPORT

I-81 Corridor Improvement Study- Tier 2
I-77/I-81 Overlap

Wythe County

PROJECT: 0077-098-104, P-100

UPC: 51441
From: Exit 72 (I-77)
To: Exit 81 (I-77)

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Executive Summary

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA), is conducting a location study to evaluate alternatives to meet existing and future travel needs along the I-77/I-81 overlap section. To facilitate this action, VDOT and FHWA completed a Tier 1 Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) in 2007. This resulted in a second tier study, this Environmental Assessment (EA).

Two candidate build alternatives (CBA) are under evaluation for the I-81/I-77 Overlap Improvement Study. CBA A, the new alignment alternative, maintains the existing corridor for I-77 traffic only, and removes I-81 traffic to a four lane alignment on new location, with improvements at interchanges. CBA B, the widening alternative, widens the existing I-81/I-77 corridor from six to eight lanes, with improvements at the interchanges. Noise impact along the Candidate Build Alternatives was assessed in accordance with procedures and criteria approved by FHWA and VDOT.

Table 1 shows the number of sites predicted to experience noise impact with each condition evaluated. For comparison purposes, the table also shows the number of sites in the corridor predicted to experience noise impact in the 2008 Existing and 2035 No Build conditions.

Table 1: Total Number of Predicted Impacted Sites

Condition	Number of Sites Predicted to Reach NAC	Number of Sites Predicted to Experience Substantial Increase	Total Number of Sites Predicted to Experience Noise Impact
Existing (2008)	51	N/A	51
No Build (2035)	59	N/A	59
CBA A (2035)	52	7	59
CBA B (2035)	41	1	42

Fewer sites are impacted in the design year build alternatives as compared to the design year no-build alternative due primarily to proposed property displacements.

Along new-alignment roadways, substantial increases from the existing to build case noise level commonly occur. Seven (7) of the impacted sites are predicted to experience this type of noise impact for the CBA A alternative, where the project alternative passes through areas that are remote from major noise sources and that have relatively low existing noise levels. One (1) of the impacted sites is predicted to experience substantial increase impact for the CBA B alternative.

Noise abatement by means of noise barriers was evaluated wherever noise impact was predicted to occur. For each candidate build alternative, Table 2 summarizes the protected sites, the total surface area of the barriers, and the estimated total barrier cost, for all barriers combined, based on a unit cost of $30 per square foot.

Table 2: Noise Barrier Summary

Candidate Build Alternative	Number of Sites Protected and Benefited	Total Surface Area (sq. ft.) of Noise Barriers	Total Estimated Cost
CBA A	9	122,140	$3,664,200
CBA B	20	208,320	$6,249,600

This information is preliminary and should be considered to be very approximate since the project is not developed to a stage where a reliable cost estimate can be provided in regard to determining cost effectiveness. Once the selected alternative has received design approval, a later study will determine the final barrier cost estimates, feasibility, and reasonableness of proposed noise abatement.

This study is in compliance with the State Noise Abatement Policy effective January 1997. In July 2011, the noise policy was revised to be in compliance with new federal regulations. The final design noise analysis for the selected build alternative will be completed in compliance with the new noise policy.

Construction activity may cause intermittent fluctuations in noise levels. During the construction phase of the project, all reasonable measures will be taken to minimize noise impact from these activities.

1. Introduction

1.1 Project Description

The I-81/I-77 Overlap Improvement Study evaluates alternatives for improving the roadway system capacity to improve operating conditions in Wythe County, Virginia. CBA A, the new alignment alternative, would remove I-81 traffic to a new 4-lane facility on new location, which would also eliminate the wrong-way concurrency with the overlap of I-77 South also signed as I-81 North. CBA B, the widening alternative, would widen the existing 6-lane roadway to an 8-lane facility with improvements at interchanges.

The corridor begins in the west at I-77 interchange 72, and ends in the east at I-77 interchange 81. Figure 1 illustrates the project from a regional perspective, while Figure 2 depicts the study area within which alternatives will be evaluated.

Figure 1: Regional Location Map

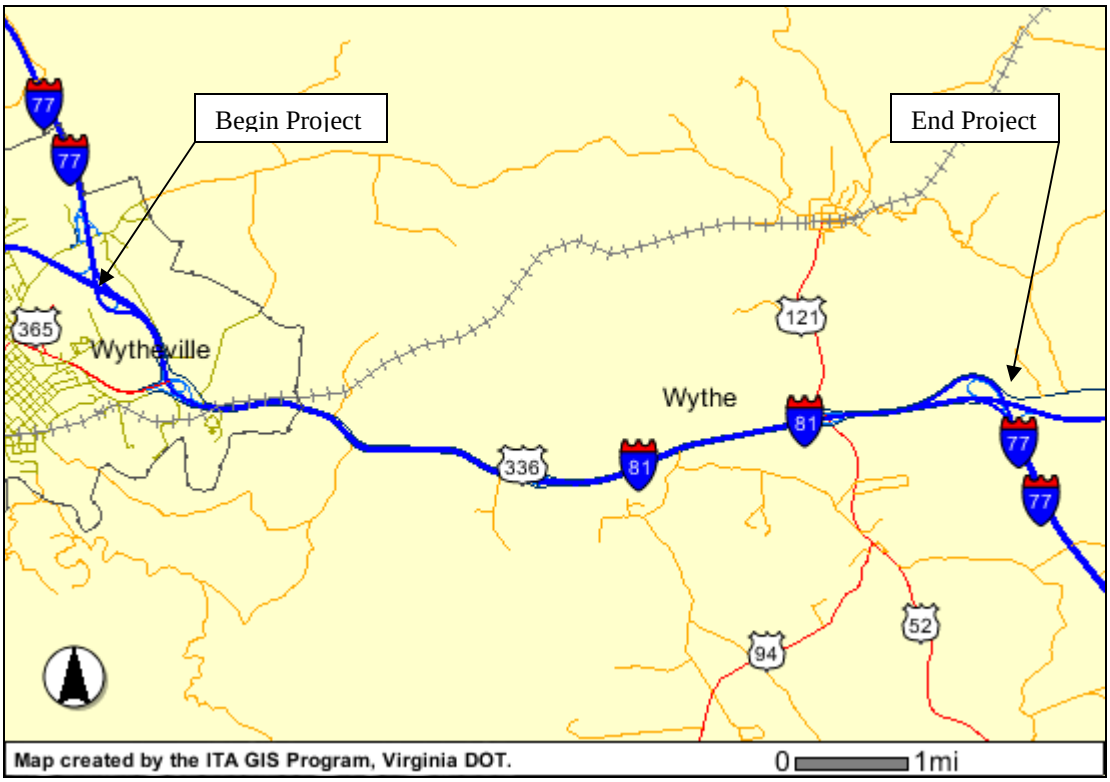

Figure 2: Study Area Map

1.2 Existing Condition

The existing I-77/I-81 corridor is a six-lane facility. The corridor has residences, churches, and commercial land uses adjacent to both sides of the roadway. Most sites are accessed through frontage roads that parallel the interstate. The corridor has areas of steep terrain and dense vegetation. Noise monitoring was completed at ten (10) sites in the corridor, to serve as both noise model validation for sites in close proximity to the road, and to represent existing noise levels in areas further from the roadway. The monitoring results are discussed in Section 3 of this report.

1.3 Alternatives Considered

In accordance with National Environment Policy Act (NEPA) requirements, alternatives considered for the I-81/I-77 Overlap Improvement Study include the No-Build, and the two Candidate Build Alternatives: CBA A and CBA B. Each alternative has been evaluated with respect to its potential impacts and its ability to address the project's purpose and need.

1.3.1 No-Build

Consistent with the requirements of the NEPA and related FHWA guidelines, full consideration is given to the environmental consequences of taking no action to meet future travel demand. The No-Build Alternative, while having no direct construction costs, would result in other economic, environmental, and quality of life impacts that can be expected from the continuation of roadway system deficiencies. While the No-Build alternative does not meet the project needs for traffic, safety, and roadway infrastructure improvements, it provides a baseline condition with which to compare the improvements and consequences associated with the Candidate Build Alternatives.

1.3.2 CBA A

CBA A would maintain the existing 6-lane roadway for I-77 traffic, and remove the I-81 traffic to a separate 4-lane facility. It would also modify the interchanges for ease of entry and exit to the separate facility. This alternative would result in property displacements, as it is designed on new location. The existing roadway, the new alignment alternative, and noise sensitive sites are shown in the figures in Appendix A.

1.3.3. CBA B

CBA B would widen the existing 6-lane roadway to an 8-lane facility. It would also modify the interchanges for ease of entry and exit to the combined facility. The widening would occur outside the existing footprint, in order to accommodate the additional lanes, and thus would also shift the frontage roads. This alternative would result in property displacements. The project roadway with the widening alternative and noise sensitive sites are shown in the figures in Appendix B.

2. Guidelines and Criteria

The potential noise impact of the proposed alternatives for the I-81/I-77 Overlap Improvement Project has been assessed in accordance with FHWA guidelines published in Volume 7, Chapter 7, Section 2 of the Federal Aid Policy Guide (FAPG 7-7-2) and with the State Noise Abatement Policy. In order to determine the degree of impact of highway traffic noise on human activity, the Noise Abatement Criteria (NAC), Table 1, established by FAPG 7-7-2 is used. The NAC, listed in Table 1 for various activities, represent the upper limit of acceptable traffic noise conditions and also a balancing of that which may be desirable with that which may be achievable. The NAC applies to areas having regular human use and where lowered noise levels are desired. They do not apply to the entire tract of land on which the activity is based, but only to that portion where the activity takes place.

The NAC is given in terms of the hourly, A-weighted, equivalent sound level in decibels (dBA). The A-weighted sound level is a single number measure of sound intensity with weighted frequency characteristics that correspond to human subjective response to noise. However, since most environmental noise fluctuates from moment to moment, it is common practice to condense all of this information into a single number called the equivalent sound level (Leq). The Leq is the value of a steady sound level that would represent the same sound energy as the actual time-varying sound evaluated over the same time period. For highway traffic noise assessment, Leq is typically evaluated over a one-hour time period, and is denoted as Leq(h).

The noise impact assessment is made using the guidelines listed in Table 3. Noise-sensitive land uses potentially affected by this project are in Category B and consist of residences and places of worship, and Category C, which consists of commercial sites. In situations where there are no exterior activities that would be affected by traffic noise (such as may occur at places of worship or schools), noise impact is assessed with respect to the FHWA NAC for Activity Category E. If, for a given activity, the design year noise levels “approach or exceed” the NAC, then the activity is impacted and a series of abatement measures must be considered. The VDOT State Noise Abatement Policy defines “approach” as 1 dBA less than the NAC.

There is another criterion for assessing noise impact provided in the Federal guidelines. A receiver can be noise impacted if the design year build noise levels are substantially higher than existing levels. The VDOT State Noise Abatement Policy defines a substantial increase as 10 dBA or more, even though the levels may not reach the NAC.

If traffic noise impact is identified as a result of the project, then consideration of noise abatement measures is necessary. The final decision on whether or not to provide noise abatement along a project corridor will take into account the feasibility of the design and overall cost weighted against the environmental benefit.

Noise levels in the project study area were determined for the Existing (2008) condition, the design-year (2035) No-build condition, and the design year (2035) Build condition for both candidate build alternatives.

Table 3: FHWA Noise Abatement Criteria

Hourly A-Weighted Sound Level Decibels (dBA)		
Activity Category	**Leq(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 land, 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: 23 CFR Part 772		

3. Existing Noise Conditions

To assess existing noise conditions within the I-81/I-77 Overlap Improvement project study area, short term noise monitoring was conducted at ten (10) sites on September 14 and 15, 2009. During the noise monitoring, a windshield survey of noise-sensitive land uses and identification of major sources of acoustical shielding was conducted to supplement the mapping provided. A more thorough noise monitoring session will be conducted during the final design stage with the selected alternative, to better establish existing noise levels for more remote sites.

Noise monitoring was conducted in the vicinity of noise-sensitive land uses in both of the alternative corridors near the proposed project alignment. The noise monitoring characterized existing noise levels in the study area but were not necessarily conducted during the loudest hour of the day. Therefore, the loudest hour existing noise levels were computed with an FHWA approved noise prediction model at all noise sensitive locations in the study area, using appropriate traffic data as input. Along with the monitoring data, the computed estimates of existing noise levels are used as the baseline against which probable future noise levels are compared and potential impacts assessed. A validation exercise was carried out to evaluate the accuracy of the noise prediction model, and is presented in Section 3.2.

The location of each noise monitoring site in relation to the project build alternatives is shown on the graphics located in Appendix A and B.

3.1 Short-Term Noise Monitoring

The purpose of noise monitoring is to gather data that is used to develop a comparison between the monitoring results and the output obtained from the noise prediction model. This exercise is performed to validate the model so that it can be used with confidence to determine the worst-hour noise levels and predict the future noise levels.

Short-term noise measurements of 10 to 20 minutes duration were obtained at a total of ten (10) sites on September 14 and 15, 2009 in the project corridor. These short-term measurements were conducted with a Larson Davis System 824 noise meter, a Type I (precision) instrument. Prior to

noise monitoring, the noise meter was calibrated using CAL200 precision acoustic calibrator. Readings were in the A-weighted scale and were reported in decibels (dBA). The data collection procedure involved the Leq measurements in consecutive 10 seconds intervals. This method allows individual time intervals that include noise events unrelated to traffic noise (such as aircraft overflights) to be excluded from consideration. Data collected by the noise meter included time, average noise level (Leq), maximum noise level (Lmax), and instantaneous peak noise level (Lpk) for each interval. Hourly average noise levels (Leq (h)) were derived at each location from the 10 minute (or 20 minute, depending with the site) Leq values. Additional data collected at each monitoring location included atmospheric conditions such as wind speed humidity and ambient temperature. A summary of the short-term noise monitoring results is presented in Table 4. For each site, the table lists the assigned site number, the location and a description of the associated land use, the project alternative corridor in which the site falls, the monitored sound level, and the dominant sources of noise at each site. Ten (10) minute (or 20 minute) traffic data (vehicle volume composition and speed) were also recorded on all roadways which were visible from the monitoring site and significantly contributed to the overall noise level. Traffic was grouped into one of the three categories: automobiles, medium trucks and heavy trucks, per VDOT procedure. The 10 minute (or 20 minute, depending on the site) traffic data were converted to one hour traffic data for validation of the model. The field data sheets are presented in Appendix C.

The monitored Leq in the study corridor ranged from 44 dBA at Sites M1 and M10 to 66 dBA at Sites M2 and M5. The dominant noise sources in the study area were traffic on the existing highway, frontage roads, exit ramps, and local roads. Very few time intervals reflected noise sources other than roadway traffic. These intervals, which consisted of noise from distant lawn mower, local traffic, and people talking in the vicinity, were later excluded from the measured Leq calculation.

Table 4: Short-term Noise Monitoring Summary

Site	Location	Land-use Description	Alternative Corridor	Dominant Sources of Noise	Leq (dBA)
M1	Cassell Rd	Residential-apartments	CBA B	Ambient	44
M2	Lithia Rd	Commercial-Hotel	CBA B	I-77/I-81	66
M3	Malin Dr	Commercial-Restaurant	CBA B	I-77/I-81	63
M4	Echo Valley Rd	Seventh Day Adventist Church	CBA B	I-77/I-81	64
M5	Needmore St	Residential	CBA B	I-77/I-81	66
M6	Lincoln Dr	Residential	CBA B	I-77/I-81	56
M7	Keesling School Rd	Residential	CBA A	Frontage Road	51
M8	Breezy Estates Dr	Jubilee Baptist Church	CBA B	I-77/I-81	62
M9	Steer Dr	Residential	CBA A	I-77/I-81	56
M10	Bob Spring Rd	Residential-apartments	CBA A	Ambient	44

3.2 Noise Model Validation

The modeling process began with model validation, as per VDOT requirements. This was accomplished by comparing the monitored noise levels and the noise levels generated by computer model, using traffic volumes and speeds that were observed during the monitoring process. This validation ensured that reported changes between the existing and future conditions were due to changes in traffic conditions and not discrepancies between monitoring and modeling techniques. A difference of 3 dBA or less between the monitored and modeled levels is considered acceptable, since this is the limit of change detectable by a typical human ear.

The model validation was performed for the existing traffic conditions. However, since no 24-hour monitoring was performed to obtain the existing loudest hour, the existing noise levels obtained during the 10 (or 20 depending with the site) minute monitoring sessions were not reported as the project's existing noise levels. Instead, existing worst case hour noise levels obtained from TNM after model validation were used as the existing noise levels for the project area for validated sites.

A summary of the model validation is provided in Table 5. As shown, for the validated sites, difference between the modeled and the monitored noise levels ranges from -1 to +3 dBA, which is within the acceptable ±3 dBA. However site M3 did not validate, likely due to the numerous terrain features and complex roadway geometry in the area, which were not included in the preliminary design files. With the majority of the sites validated, the existing condition model is considered to be validated for the observed site conditions.

Model validation was not conducted at sites M1, M7 and M10, due to the distance of the sites from the existing roadways. In these areas, which are distant from existing roadways, the monitored noise level is used to represent the existing noise level for the site.

Table 5: Noise Model Validation

Site	Monitored Noise Level (dBA)	Computed Noise Level (dBA)	Difference (Computed-Monitored)	Comment
M1	44			N/A due to Distance
M2	66	69	3	Validated
M3	63	67	4	Not Validated
M4	64	66	2	Validated
M5	66	69	3	Validated
M6	56	55	-1	Validated
M7	51			N/A due to Distance
M8	62	61	-1	Validated
M9	56	59	3	Validated
M10	44			N/A due to Distance

4. Noise Model and Projections

4.1 Highway Noise Computation Model

A review of the project corridor has established roadway traffic as the dominant source of noise for the build alternative. Since roadway noise can be determined accurately through computer modeling techniques for areas that are dominated by road traffic, both existing and design year traffic noise calculations have been performed using the Federal Highway Administration's Traffic Noise Model (FHWA TNM®) Version 2.5. FHWA TNM ® was developed and sponsored by the U. S. Department of Transportation and John A. Volpe National Transportation Systems Center, Acoustics facility. The TNM computer model can account for such factors as ground absorption, roadway geometry, receiver distance, shielding from local terrain and structures, vehicle volume, operating speed, and volumes of medium trucks (vehicles with 2 axles and 6 tires) and heavy trucks.

4.2 Traffic Data for Traffic Noise Computations

Traffic data for traffic noise computations were supplied as hourly volumes and operating speeds by roadway segment for the 2008 Existing condition, and design-year 2035 No-build and Build alternatives. Separate medium and heavy truck percentages were provided by roadway segment and by alternative. As required by FHWA and VDOT, the noise analysis was performed for the loudest hour of the day. Noise levels have been predicted for that hour of the day when the vehicle volume, operating speed, and number of trucks (vehicles with 3 or more axles) combine to produce the worst noise conditions. The worst noise hour used in this study was 4 to 5 p.m.

An active rail line is within the project corridor. Rail traffic data was supplied by Norfolk Southern. Rail traffic noise levels were predicted using the Federal Transit Administration's (FTA) Freight Rail Noise Model. The output from the rail noise model was then applied to a TNM roadway. The TNM roadway was placed along the rail alignment, and contained autos and heavy trucks which would produce a similar noise level to the rail traffic. For the analysis, it was

assumed that the rail traffic data and track alignments were the same for the existing, no build, and both proposed build conditions.

4.3 Computed Existing and Future Noise Levels

Noise impact assessment has been performed for all noise sensitive properties within the project corridor. Noise levels in the study area have been determined for the existing condition, the no-build condition, and the design year (2035) build condition for both build alternatives. A total of one hundred twenty two (122) noise sensitive sites were evaluated for purposes of noise prediction. For reporting purposes, the project area was divided into areas of common noise environment, referred to as Noise Sensitive Areas (NSA). The prediction sites are annotated by the NSA. The prediction sites that are representative of the measurement sites are shown also with an "M" prefix in Table 6, and are shown adjacent to the measurement site in the graphics in Appendices A and B.

Assessment of traffic noise impact requires three comparisons:

(1) The noise levels under existing conditions must be compared to those under design year build conditions. This comparison shows the change in noise levels that will occur between the existing year and the design year if the project is constructed, to determine if the substantial increase impact criteria has been met.

(2) The noise levels under design year no-build conditions must be compared to those under design year build conditions. This comparison shows how much of the change in noise levels can actually be attributed to the proposed project.

(3) The noise levels under design year build conditions must be compared to the applicable NAC. This comparison determines if the impact criteria has been met under future build conditions and can be used to assist in noise compatible land use planning.

Table 6 shows the computed loudest-hour noise levels at the prediction sites. All noise levels computed were the A-weighted equivalent sound level, or Leq, in dBA (Section 2 provides a

discussion of this descriptor). The loudest hour noise levels were computed with TNM for the design-year Candidate Build Alternatives, and for the Existing condition and No-build alternative.

Table 6: Computed Existing and Future Noise Levels

Site Number	Land Use	Modeled Noise Level (dBA)				Noise Abatement Criteria (dBA) *	Abatement Considered CBA A	Abatement Considered CBA B
		Existing	2035 No Build	2035 Build CBA A	2035 Build CBA B			
NSA A – Exit 71 to Exit 73								
A1	Residence	55	58	56	58	65		
A2	Residence	54	57	55	56	64		
A3	Residence	54	56	54	56	64		
A4	Residence	54	56	54	55	64		
A5	Residence	53	55	53	55	63		
A6	Residence	52	54	52	54	62		
A7	Residence	50	53	50	52	60		
A8	Residence	64	65	N/A	N/A	66		
A9	Residence	64	65	N/A	N/A	66		
A10	Residence	64	65	N/A	62	66		
A11	Residence	63	64	N/A	60	66		
A12	Residence	62	63	N/A	60	66		
A13	Residence	59	60	N/A	59	66		
A14	Residence	56	57	N/A	57	66		
A15	Residence	58	59	N/A	58	66		
A16	Residence	59	61	N/A	60	66		
A17	Residence	54	56	N/A	57	64		
A18	Residence	54	55	N/A	56	64		
A19	Residence	53	55	N/A	56	63		
A20	Residence	53	55	N/A	55	63		
A21	Residence	53	55	N/A	55	63		
A22	Residence	53	55	N/A	55	63		
A23	Residence	54	55	56	55	64		
A24	Residence	53	54	N/A	55	63		
A25 (M1)	Residence	44	54	56	54	54	Not Feasible	Not Feasible
A26 (M10)	Residence	44	53	58	53	54	Not Feasible	
A27	Residence	51	52	61	53	61	Barrier A1 under consideration	

Site Number	Land Use	Modeled Noise Level (dBA)				Noise Abatement Criteria (dBA) *	Abatement Considered CBA A	Abatement Considered CBA B
		Existing	2035 No Build	2035 Build CBA A	2035 Build CBA B			
A28	Residence	50	52	63	53	60	Barrier A1 under consideration	
A29	Commercial	51	53	65	53	61	Barrier A1 under consideration	
A30	Commercial	61	63	63	64	71		
A31	Commercial	65	67	N/A	69	71		
A32	Commercial	69	71	69	72	71		No Outdoor Activity
A33	Commercial	67	69	67	70	71		
A34	Hotel	73	75	72	75	66	No Outdoor Activity	No Outdoor Activity
A35 (M2)	Hotel	69	71	68	N/A	66	No Outdoor Activity	No Outdoor Activity
A36	Commercial	65	67	65	68	71		
NSA B-Exit 73 to Quarry								
B1	Commercial	62	64	63	65	71		
B2	Hotel	69	71	69	71	66		No Outdoor Activity
B3 (M3)	Commercial	69	71	69	71	71		No Outdoor Activity
B4	Residence	57	59	59	63	66		
B5	Residence	63	65	66	66	66	Not Feasible	Not Feasible
B6	Commercial	66	67	66	69	71		
B7 (M4)	Seventh Day Adventist Church	68 (43)	70 (45)	68 (43)	71 (46)	66 (51)	No Outdoor Activity	No Outdoor Activity
B8	Residence	58	59	58	61	66		
B9	Residence	58	60	59	62	66		
B10	Residence	59	61	59	63	66		
B11	Residence	60	62	61	64	66		

Site Number	Land Use	Modeled Noise Level (dBA)				Noise Abatement Criteria (dBA) *	Abatement Considered CBA A	Abatement Considered CBA B
		Existing	2035 No Build	2035 Build CBA A	2035 Build CBA B			
B12	Residence	64	66	64	68	66	Not Evaluated (>1000 ft)	Barrier B1 under consideration
B13	Residence	59	61	60	62	66		
B14	Residence	73	75	73	N/A	66	Barrier A2 under consideration	
NSA C – Quarry to Exit 77								
C1	Residence	73	75	73	N/A	66	Not Evaluated (>1000 ft)	
C2	Residence	64	66	65	69	66		Not Feasible
C3	Residence	66	69	67	69	66	Not Evaluated (>1000 ft)	Not Feasible
C4	Residence	68	70	68	70	66	Not Evaluated (>1000 ft)	Not Feasible
C5	Commercial	73	75	73	76	71	No Outdoor Activity	No Outdoor Activity
C6	Residence	72	75	72	N/A	66	Barrier A3 under consideration	
C7	Residence	72	75	72	75	66	Barrier A3 under consideration	Barrier B2 under consideration
C8	Residence	72	74	72	74	66	Barrier A3 under consideration	Barrier B2 under consideration
C9	Residence	72	75	73	75	66	Not Feasible	Not Feasible
C10 (M9)	Residence	61	63	63	65	66		
C11	Residence	67	70	68	71	66	Barrier A4 under consideration	Barrier B3 under consideration
C12	Residence	63	65	63	67	66		Not Feasible
C13	Church	67 (42)	69 (44)	67 (42)	68 (43)	66 (51)	Not Evaluated (>1000 ft)	No Outdoor Activity

Site Number	Land Use	Modeled Noise Level (dBA)				Noise Abatement Criteria (dBA) *	Abatement Considered CBA A	Abatement Considered CBA B
		Existing	2035 No Build	2035 Build CBA A	2035 Build CBA B			
C14	Residence	70	72	70	73	66	Not Evaluated (>1000 ft)	Barrier B4 under consideration
C15	Residence	72	74	72	N/A	66	Not Evaluated (>1000 ft)	
C16	Residence	73	75	73	N/A	66	Not Evaluated (>1000 ft)	
C17 (M5)	Residence	73	76	74	N/A	66	Not Evaluated (>1000 ft)	
C18	Residence	67	69	67	70	66	Not Evaluated (>1000 ft)	Barrier B4 under consideration
C19	Residence	68	71	69	72	66	Not Evaluated (>1000 ft)	Barrier B4 under consideration
C20	Residence	67	69	67	71	66	Not Evaluated (>1000 ft)	Barrier B4 under consideration
C21	Residence	68	70	68	71	66	Not Evaluated (>1000 ft)	Barrier B4 under consideration
C22	Commercial	70	72	70	72	71		Barrier B4 under consideration
C23	Residence	70	72	70	74	66	Not Evaluated (>1000 ft)	Barrier B4 under consideration
C24	Commercial	69	71	69	N/A	71		
C25	Residence	55	57	60	57	65		
C26	Residence	70	73	71	73	66	Not Feasible	Not Feasible
C27	Residence	53	55	58	55	63		
NSA D- Exit 77 to Exit 80								
D1	Residence	72	74	72	75	66	Not Evaluated (>1000 ft)	Not Feasible

Site Number	Land Use	Modeled Noise Level (dBA)				Noise Abatement Criteria (dBA) *	Abatement Considered CBA A	Abatement Considered CBA B
		Existing	2035 No Build	2035 Build CBA A	2035 Build CBA B			
D2	Residence	73	75	73	76	66	Not Evaluated (>1000 ft)	Not Feasible
D3	Residence	72	74	72	74	66	Not Evaluated (>1000 ft)	Not Feasible
D4	Residence	55	57	57	58	66		
D5 (M6)	Residence	57	59	58	59	66		
D6	Residence	59	62	60	62	66		
D7	Residence	55	57	57	58	65		
D8 (M8)	Jubilee Baptist Church	64 (39)	66 (41)	64 (39)	68 (43)	66 (51)		No Outdoor activity
D9	Commercial	74	76	74	76	71	Not Evaluated (>1000 ft)	No Outdoor activity
D10	Commercial	70	72	70	72	71		No Outdoor activity
D11	Residence	73	75	73	75	66	Not Evaluated (>1000 ft)	Barrier B5 under consideration
D12	Residence	76	78	76	N/A	66	Not Evaluated (>1000 ft)	
D13	Residence	68	71	68	72	66	Not Evaluated (>1000 ft)	Barrier B7 under consideration
D14	Residence	72	75	72	77	66	Not Evaluated (>1000 ft)	Barrier B6 under consideration
D15	Residence	71	73	70	75	66	Not Evaluated (>1000 ft)	Barrier B6 under consideration
D16	Residence	72	74	72	76	66	Not Evaluated (>1000 ft)	Barrier B6 under consideration
D17	Residence	73	75	73	77	66	Not Evaluated (>1000 ft)	Barrier B6 under consideration

Site Number	Land Use	Modeled Noise Level (dBA)				Noise Abatement Criteria (dBA) *	Abatement Considered CBA A	Abatement Considered CBA B
		Existing	2035 No Build	2035 Build CBA A	2035 Build CBA B			
D18	Residence	73	75	73	N/A	66	Not Evaluated (>1000 ft)	
D19	Residence	73	75	73	77	66	Not Evaluated (>1000 ft)	Barrier B6 under consideration
D20	Residence	73	75	73	N/A	66	Not Evaluated (>1000 ft)	
D21	Residence	72	74	72	76	66	Not Evaluated (>1000 ft)	Barrier B6 under consideration
D22	Residence	74	76	74	N/A	66	Not Evaluated (>1000 ft)	
D23	Residence	74	76	74	N/A	66	Not Evaluated (>1000 ft)	
D24	Residence	73	75	73	N/A	66	Not Evaluated (>1000 ft)	
D25	Residence	75	77	74	N/A	66	Not Evaluated (>1000 ft)	
D26	Residence	72	75	72	76	66	Not Evaluated (>1000 ft)	Barrier B6 under consideration
D27	Residence	74	76	74	N/A	66	Not Evaluated (>1000 ft)	
D28	Residence	74	76	74	N/A	66	Not Evaluated (>1000 ft)	
D29	Residence	74	76	74	N/A	66	Not Evaluated (>1000 ft)	
D30	Residence	74	76	74	N/A	66	Not Evaluated (>1000 ft)	
D31	Residence	55	57	60	58	65		
D32	Residence	49	51	62	51	59	Barrier A5 under consideration	
D33	Residence	49	51	58	51	59		
D34	Residence	49	51	59	51	59	Not feasible	

Site Number	Land Use	Modeled Noise Level (dBA)				Noise Abatement Criteria (dBA) *	Abatement Considered CBA A	Abatement Considered CBA B
		Existing	2035 No Build	2035 Build CBA A	2035 Build CBA B			
NSA E- Exit 80 to Exit 81								
E1	Commercial	71	73	71	N/A	71	Not Evaluated (>1000 ft)	
E2	Residence	71	73	71	74	66	Not Evaluated (>1000 ft)	Barrier B8 under consideration
E3	Residence	49	50	53	49	59		
E4	Residence	53	53	53	54	63		
E5 (M7)	Residence	51	58	55	56	61		
E6	Residence	58	59	56	57	66		
E7	Residence	58	59	56	56	66		
E8	Residence	57	58	56	56	66		
E9	Residence	57	58	56	56	66		
E10	Residence	54	55	54	54	64		
E11	Residence	57	58	58	57	66		
Number of Noise Impacts								
		51	**59**	**59**	**42**			
Noise Level Ranges								
	Minimum	44	50	50	49			
	Maximum	76	78	76	77			
N/A	Indicates the site would be displaced with the associated alternative							
	Indicates Noise Impact due to approaching or exceeding the applicable NAC							
(#)	Indicates Interior Noise Levels							
*	Noise Abatement Criteria from applicable FHWA Noise Abatement Criterion, or substantial increase criterion, whichever is worse							

5. Noise Impact Assessment

The results of the impact assessment indicate that the design year (2035) build condition noise levels for both build alternatives are predicted to increase (from No-Build conditions). One hundred twenty two (122) receptor sites in five NSA were investigated for noise impacts. Ten (10) of the prediction sites were used to model the ten (10) monitoring sites. The sites evaluated include one hundred one (101) residential receptor sites, three (3) churches, fifteen (15) commercial properties, and three (3) hotels.

The existing year (2008) noise levels for all studied sites range from 44 to 76 dBA. For the design year no-build condition, noise levels are predicted to range from 50 to 78 dBA. For the design year CBA A build condition, noise levels are predicted to range from 50 to 76 dBA, and for the design year CBA B build condition, noise levels are predicted to range from 49 to 77 dBA.

Fifty two (52) sites are predicted to have noise levels that approach or exceed the NAC in the design year CBA A build condition, and forty two (42) sites are predicted to have noise levels that approach or exceed the NAC in the design year CBA B build condition. Additionally, seven (7) impacts in the CBA A case, and one (1) impact in the CBA B case are due to a substantial increase between existing and build design year noise levels. Noise levels are predicted to approach or exceed the NAC at fifty nine (59) sites in the no-build condition, and at fifty one (51) sites in the existing condition. Fewer sites are impacted in the design year build alternatives as compared to the design year no-build alternative due primarily to proposed property displacements.

5.1 Existing Conditions

Fifty one (51) sites (exterior) are predicted to have noise levels that approach or exceed the NAC in the existing condition. The noise levels for all studied sites are predicted to range from 44 to 76 dBA for the existing condition.

NSA A –Exit 71 to Exit 73 *(Appendix A and B, Sheets 1, 2, 3)*

NSA A is located along both sides of the roadway at the western end of the project, between exits 71 and 73. NSA A contains thirty six (36) study sites, A1 to A36, representing twenty eight (28) residential sites, two (2) hotels, and six (6) commercial sites. Monitoring sites M1, M2 and M10 are located in NSA A. Due to distance from the roadway, the monitored levels for sites M1 and M10 are used to represent the existing noise level. Existing noise levels within NSA A range from 44 to 73 dBA. Noise impact is predicted to occur under the existing condition at two (2) sites, A34 and A35, representing two (2) hotels. The hotels do not have evidence of outdoor activity, therefore noise abatement is not warranted for these sites.

NSA B- Exit 73 to Quarry *(Appendix A and B, Sheets 3, 4)*

NSA B is located along both sides of the roadway, east of exit 73, and extending to the quarry. NSA B contains fourteen (14) study sites, B1 to B14, representing nine (9) residential sites, one (1) church, one (1) hotel, and three (3) commercial sites. Monitoring sites M3 and M4 are located in NSA B. The existing modeled noise levels are predicted to range from 57 to 73 dBA. Noise impact is predicted to occur under the existing condition at three (3) sites, B2, B7, and B14.

Site B7, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Site B2 represents a hotel, which does not have evidence of outdoor activity. Therefore, noise abatement is not warranted for this site.

NSA C – Quarry to Exit 77 *(Appendix A Sheets 5, 6, 6A, Appendix B Sheets 5, 6)*

NSA C is located along both sides of the roadway, between the quarry and exit 77. NSA C contains twenty seven (27) study sites, C1 to C27, representing twenty three (23) residential

sites, one (1) church, and three (3) commercial sites. Monitoring sites M5 and M9 are located in NSA C. The existing modeled noise levels are predicted to range from 53 to 73 dBA. Noise impact is predicted to occur under the existing condition at twenty (20) sites, C1, C3 - C9, C11, C13 - C21, C23 and C26.

Site C5 represents a commercial site, which does not have evidence of outdoor activity. Therefore, noise abatement is not warranted for this site.

Site C13, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

NSA D- Exit 77 to Exit 80 *(Appendix A Sheets 7, 7A, 8, 8A, Appendix B Sheets 7, 7A, 8)*
NSA D is located along both sides of the roadway between exits 77 and 80. NSA D contains thirty four (34) study sites, D1 to D34, representing thirty one (31) residential sites, one (1) church, and two (2) commercial sites. Monitoring sites M6 and M8 are located in NSA D. The existing modeled noise levels are predicted to range from 49 to 76 dBA. Noise impact is predicted to occur under the existing condition at twenty four (24) sites, D1 - D3, D9, and D11 - D30.

Site D8, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Site D9 represents a commercial site, which does not have evidence of outdoor activity. Therefore, noise abatement is not warranted for this site.

NSA E- Exit 80 to Exit 81 *(Appendix A Sheets 9, 9A, 10, Appendix B Sheets 9, 10)*
NSA E is located along both sides of the roadway from exit 81 to the eastern end of the project. NSA E contains eleven (11) study sites, E1 to E11, representing ten (10) residential sites and one (1) commercial property. Monitoring site M7 is located in NSA E. Due to distance from the roadway, the monitored levels for site M7 are used to represent the existing condition. Existing modeled noise levels are predicted to range from 49 to 71 dBA. Noise impact is predicted to occur under the existing condition at two (2) sites, E1 and E2.

Site E1 represents a commercial site, which does not have evidence of outdoor activity. Therefore, noise abatement is not warranted for this site.

5.2 No Build Alternative

Fifty nine (59) sites (exterior) are predicted to have noise levels that approach or exceed the NAC in the design year no-build condition. The noise levels for all studied sites are predicted to range from 50 to 78 dBA for the design year no-build condition.

NSA A –Exit 71 to Exit 73 *(Appendix A and B, Sheets 1, 2, 3)*
NSA A is located along both sides of the roadway at the western end of the project, between exits 71 and 73. NSA A contains thirty six (36) study sites, A1 to A36, representing twenty eight (28) residential sites, two (2) hotels, and six (6) commercial sites. Monitoring sites M1, M2 and M10 are located in NSA A. Design Year no-build modeled noise levels are predicted to range from 52 to 75 dBA. Noise impact is predicted to occur under the no-build condition at three (3) sites, A32, A34 and A35.

Site A32 represents a commercial site, and A34 and A35 represent hotels, all of which do not have evidence of outdoor activity. Therefore, noise abatement is not warranted for these sites.

NSA B- Exit 73 to Quarry *(Appendix A and B, Sheets 3, 4)*

NSA B is located along both sides of the roadway, east of exit 73, and extending to the quarry. NSA B contains fourteen (14) study sites, B1 to B14, representing nine (9) residential sites, one (1) church, one (1) hotel, and three (3) commercial sites. Monitoring sites M3 and M4 are located in NSA B. Design Year no-build modeled noise levels are predicted to range from 59 to 75 dBA. Noise impact is predicted to occur under the no-build condition at five (5) sites, B2, B3, B7, B12 and B14.

Site B2 represents a hotel, and site B3 represents a commercial site, both of which do not have evidence of outdoor activity. Therefore, noise abatement is not warranted for these sites.

Site B7, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

NSA C – Quarry to Exit 77 *(Appendix A Sheets 5, 6, 6A, Appendix B Sheets 5, 6)*

NSA C is located along both sides of the roadway, between the quarry and exit 77. NSA C contains twenty seven (27) study sites, C1 to C27, representing twenty three (23) residential sites, one (1) church, and three (3) commercial sites. Monitoring sites M5 and M9 are located in NSA C. Design Year no-build modeled noise levels are predicted to range from 55 to 76 dBA. Noise impact is predicted to occur under the no-build condition at twenty three (23) sites, C1 - C9, C11, C13 - C24, and C26.

Site C5 represents a commercial site, which does not have evidence of outdoor activity. Therefore, noise abatement is not warranted for this site.

Site C13, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church

is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

NSA D- Exit 77 to Exit 80 *(Appendix A Sheets 7, 7A, 8, 8A, Appendix B Sheets 7, 7A, 8)*
NSA D is located along both sides of the roadway between exits 77 and 80. NSA D contains thirty four (34) study sites, D1 to D34, representing thirty one (31) residential sites, one (1) church, and two (2) commercial sites. Monitoring sites M6 and M8 are located in NSA D. Design Year no-build modeled noise levels are predicted to range from 51 to 78 dBA. Noise impact is predicted to occur under the no-build condition at twenty six (26) sites, D1 - D3, and D8 - D30.

Site D8, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Sites D9 and D10 represent commercial sites, which do not have evidence of outdoor activity. Therefore, noise abatement is not warranted for these sites.

NSA E- Exit 80 to Exit 81 *(Appendix A Sheets 9, 9A, 10, Appendix B Sheets 9, 10)*
NSA E is located along both sides of the roadway from exit 81 to the eastern end of the project. NSA E contains eleven (11) study sites, E1 to E11, representing ten (10) residential sites and one commercial property. Monitoring site M7 is located in NSA E. Design Year no-build modeled noise levels are predicted to range from 50 to 73 dBA. Noise impact is predicted to occur under the no-build condition at two (2) sites, E1 and E2.

Site E1 represents a commercial site, which does not have evidence of outdoor activity. Therefore, noise abatement is not warranted for this site.

5.3 CBA A

Fifty two (52) sites are predicted to have noise levels that approach or exceed the NAC in the design year CBA A, new alignment alternative build condition. Additionally, seven (7) sites are predicted to experience a substantial increase in noise levels from the existing case to the build case. The noise levels for all studied sites are predicted to range from 50 to 76 dBA for the design year CBA A build condition.

NSA A –Exit 71 to Exit 73 *(Appendix A Sheets 1, 2, 3)*

NSA A is located along both sides of the roadway at the western end of the project, between exits 71 and 73. NSA A contains thirty six (36) study sites, A1 to A36, representing twenty eight (28) residential sites, two (2) hotels, and six (6) commercial sites. However, sixteen (16) residential sites, A8 through A22, A24, and one (1) commercial site, A31, would be displaced with CBA A. Monitoring sites M1, M2 and M10 are located in NSA A. Design Year Build CBA A modeled noise levels are predicted to range from 50 to 72 dBA. Noise impact is predicted to occur under the CBA A build condition at seven (7) sites, A25 - A29, A34, and A35. Five (5) of the noise impacts, A25 - A29, are due to a substantial increase in noise levels from the existing condition.

Sites A34 and A35 represent hotels. Neither site has evidence of outdoor activity; therefore noise abatement is not warranted for these sites.

Noise abatement for the impacted sites in NSA A is warranted and is discussed in the Noise Abatement section of this report.

NSA B- Exit 73 to Quarry *(Appendix A Sheets 3, 4)*

NSA B is located along both sides of the roadway, east of exit 73, and extending to the quarry. NSA B contains fourteen (14) study sites, B1 to B14, representing nine (9) residential sites, one

(1) church, one (1) hotel, and three (3) commercial sites. Monitoring sites M3 and M4 are located in NSA B. Design Year Build CBA A modeled noise levels are predicted to range from 58 to 73 dBA. Noise impact is predicted to occur under the CBA A build condition at four (4) sites, B2, B5, B7, and B14.

Site B2 represents a hotel. The site has no evidence of outdoor activity; therefore noise abatement is not warranted for this site.

Site B7, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Noise abatement for the impacted sites in NSA B is warranted and is discussed in the Noise Abatement section of this report.

NSA C – Quarry to Exit 77 *(Appendix A Sheets 5, 6, 6A)*

NSA C is located along both sides of the roadway, between the quarry and exit 77. NSA C contains twenty seven (27) study sites, C1 to C27, representing twenty three (23) residential sites, one (1) church, and three (3) commercial sites. Monitoring sites M5 and M9 are located in NSA C. Design Year Build CBA A modeled noise levels are predicted to range from 58 to 74 dBA. Noise impact is predicted to occur under the CBA A build condition at twenty (20) sites, C1, C3 -C9, C11, C13 -C21, C23 and C26.

Site C5 represents a commercial site that does not have evidence of outdoor activity. Therefore noise abatement is not warranted for this site.

Site C13, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church

is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Noise abatement for impacted sites in NSA C is warranted and is discussed in the Noise Abatement section of this report. However, at thirteen (13) of these sites, C1, C3, C4, C13 - C21, and C23, the noise impact is due to the existing alignment rather than CBA A, therefore noise abatement will not be evaluated for these sites.

NSA D- Exit 77 to Exit 80 *(Appendix A Sheets 7, 7A, 8, 8A)*

NSA D is located along both sides of the roadway between exits 77 and 80. NSA D contains thirty four (34) study sites, D1 to D34, representing thirty one (31) residential sites, one (1) church, and two (2) commercial sites. Monitoring sites M6 and M8 are located in NSA D. Design Year Build CBA A modeled noise levels are predicted to range from 57 to 76 dBA. Noise impact is predicted to occur under the CBA A build condition at twenty six (26) sites, D1 - D3, D9, D11 - D30, D32 and D34. Two (2) of the noise impacts, D32 and D34, are due to a substantial increase in noise levels from the existing condition.

Site D8, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Noise abatement for NSA D is warranted and is discussed in the Noise Abatement section of this report. However, at twenty four (24) of the sites, D1 - D3, D9, and D11 - D30, the noise impact is due to the existing alignment rather than CBA A, therefore noise abatement will not be evaluated for these sites.

NSA E- Exit 80 to Exit 81 *(Appendix A Sheets 9, 9A, 10)*

NSA E is located along both sides of the roadway from exit 81 to the eastern end of the project. NSA E contains eleven (11) study sites, E1 to E11, representing ten (10) residential sites and one (1) commercial property. Monitoring site M7 is located in NSA E. Design Year Build CBA A modeled noise levels are predicted to range from 53 to 71 dBA. Noise impact is predicted to occur under the CBA A build condition at two (2) sites, E1 and E2. For both sites, the noise impact is due to the existing alignment rather than CBA A. Therefore, noise abatement will not be evaluated for these sites.

5.4 CBA B

Forty one (41) sites (exterior) are predicted to have noise levels that approach or exceed the NAC in the design year build condition for CBA B, the widening alternative. Additionally, one (1) site is predicted to experience a substantial increase in noise levels. The noise levels for all studied sites are predicted to range from 49 to 77 dBA for the design year CBA B build condition.

NSA A –Exit 71 to Exit 73 *(Appendix B, Sheets 1, 2, 3)*

NSA A is located along both sides of the roadway at the western end of the project, between exits 71 and 73. NSA A contains thirty six (36) study sites, A1 to A36, representing twenty eight (28) residential sites, two (2) hotels, and six (6) commercial sites. However, two (2) residential sites, A8 and A9, and one (1) hotel site, A35, would be displaced with CBA B. Monitoring sites M1, M2 and M10 are located in NSA A. Design Year Build CBA B modeled noise levels are predicted to range from 52 to 75 dBA. Noise impact is predicted to occur under the CBA B build condition as a result of exceeding the NAC at two (2) sites, A32 and A34. Noise impact is also predicted to occur at one (1) site, A25, as a result of meeting the substantial increase impact criterion.

Site A32 represents a commercial site, and site A34 represents a hotel. Neither site has evidence of outdoor activity, therefore noise abatement is not warranted for these sites.

NSA B- Exit 73 to Quarry *(Appendix B, Sheets 3, 4)*

NSA B is located along both sides of the roadway, east of exit 73, and extending to the quarry. NSA B contains fourteen (14) study sites, B1 to B14, representing nine (9) residential sites, one (1) church, one (1) hotel, and three (3) commercial sites. However one (1) residential site, B14 would be displaced with CBA B. Monitoring sites M3 and M4 are located in NSA B. Design Year Build CBA B modeled noise levels are predicted to range from 61 to 71 dBA. Noise impact is predicted to occur under the CBA B build condition at five (5) sites, B2, B3, B5, B7, and B12.

Site B2 represents a hotel, which does not have evidence of outdoor activity. Site B3 represents a commercial property, which does not have evidence of outdoor activity. Therefore, noise abatement is not warranted for these sites.

Site B7, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Noise abatement for the impacted sites in NSA B is warranted and is discussed in the Noise Abatement section of this report.

NSA C – Quarry to Exit 77 *(Appendix B Sheets 5, 6)*

NSA C is located along both sides of the roadway, between the quarry and exit 77. NSA C contains twenty seven (27) study sites, C1 to C27, representing twenty three (23) residential sites, one (1) church, and three (3) commercial sites. However, five (5) residential sites, C1, C6,

C15, C16, and C17, and one commercial site, C24, would be displaced with CBA B. Monitoring sites M5 and M9 are located in NSA C. Design Year Build CBA B modeled noise levels are predicted to range from 55 to 76 dBA. Noise impact is predicted to occur under the CBA B build condition at eighteen (18) sites, C2 - C5, C7 - C9, C11 - C14, C18 - C23, and C26.

Site C5 represents a commercial site which does not have evidence of outdoor activity. Therefore, noise abatement is not warranted for this site.

Site C13, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Noise abatement for the impacted sites in NSA C is warranted and is discussed in the Noise Abatement section of this report.

NSA D- Exit 77 to Exit 80 *(Appendix B Sheets 7, 7A, 8)*

NSA D is located along both sides of the roadway between exits 77 and 80. NSA D contains thirty four (34) study sites, D1 to D34, representing thirty one (31) residential sites, one (1) church, and two (2) commercial sites. However, eleven (11) residential sites, D12, D18, D20, D22 - D25, and D27 - D30, would be displaced with CBA B. Monitoring sites M6 and M8 are located in NSA D. Design Year Build CBA B modeled noise levels are predicted to range from 51 to 77 dBA. Noise impact is predicted to occur under the CBA B build condition at fifteen (15) sites, D1 - D3, D8 - D11, D13 - D17, D19, D21, and D26.

Site D8, representing the church, does not have evidence of outdoor activity, therefore the church interior was evaluated under NAC Activity Category E. Since the exterior for the church is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the church interior as a result of the building is predicted to be 25 dBA (FHWA

"Highway Traffic Noise Analysis and Abatement Policy and Guidance," June 1995). Therefore the indoor noise level in the church is not predicted to experience noise impact.

Sites D9 and D10 represent commercial sites which do not have evidence of outdoor activity. Therefore, noise abatement is not warranted for these sites.

Noise abatement for the impacted sites in NSA D is warranted and is discussed in the Noise Abatement section of this report.

NSA E- Exit 80 to Exit 81 *(Appendix B Sheets 9, 10)*

NSA E is located along both sides of the roadway from exit 81 to the eastern end of the project. NSA E contains eleven (11) study sites, E1 to E11, representing ten (10) residential sites and one (1) commercial property. However, one (1) site, E1, would be displaced with CBA B. Monitoring site M7 is located in NSA E. Design Year Build CBA B modeled noise levels are predicted to range from 49 to 74 dBA. Noise impact is predicted to occur under the CBA B build condition at one (1) site, E2. Noise abatement for this site is warranted and is discussed in the Noise Abatement section of this report.

6. Noise Abatement

Design year noise levels have been predicted to approach or exceed the VDOT NAC in a number of areas throughout the project corridor. Therefore, per VDOT's State Noise Abatement Policy, noise abatement considerations are warranted for these areas. Noise abatement alternatives were considered to reduce noise levels in the areas identified with design year noise impacts, and potential mitigation measures were evaluated for feasibility and reasonableness.

VDOT guidelines recommend a variety of mitigation measures that should be considered in response to transportation-related noise impacts. While noise barriers and/or earth berms are generally the most effective form of noise mitigation, additional mitigation measures exist which have the potential to provide considerable noise reductions, under certain circumstances. Mitigation measures considered for this project include:

- Construction of noise barriers;
- Construction of earth berms;
- Acoustical insulation of public use and non-profit facilities;
- Alignment modifications;
- Traffic Management; and
- Property acquisition for severely impacted residential sites

6.1 Alignment Modification and Traffic Management

The alteration of the horizontal and vertical alignment has been considered to reduce or eliminate the impacts created by the proposed project. However, the alteration of vertical alignment is not feasible for this project as the existing terrain features do not allow for placing the entire roadway into a cut. Shifting the horizontal alignment away from the impacts is not feasible because CBA B occurs in the existing roadway footprint, and CBA A is a new shifted roadway, with the existing roadway remaining in place.

Traffic management measures that have been considered in conjunction with this project include reduced speeds and truck restrictions. Truck restrictions are not practical since this facility is

designated as a major route which serves truck traffic. Reducing speeds will not be an effective noise mitigation measure since a substantial decrease in speed is necessary to provide adequate noise reduction. Typically, a 10 mph reduction in speed will result in only a 2 dBA decrease in noise level, which would not eliminate all impacts.

6.2 Sound Barriers

Noise walls and earth berms are often implemented into the highway design in response to the identified noise impacts. The effectiveness of a freestanding (post and panel) noise barrier and an earth berm of equivalent height are relatively consistent; however an earth berm is perceived as a more aesthetically pleasing option. The use of earth berms is not always an option due to the excessive space they require adjacent to the roadway corridor. At a standard slope of 2:1, every one-foot in height would require four feet of horizontal width. This requirement becomes more complex in urban settings where residential properties often abut the proposed roadway corridor. In these situations, implementation of earth berms can require significant property acquisitions to accommodate noise mitigation. The cost associated with the acquisition of property to construct a berm can significantly increase the total costs to implement this form of noise mitigation.

Availability of fill material to construct the berm also needs to be considered. On proposed projects where proposed grading yields excess waste material, earth berms are often cost effective mitigation options. On balance or borrow projects the implementation of earth berms is often an expensive solution due to the need to identify, acquire, and transport the material to the project site.

For the purposes of this study, only noise barriers were evaluated. However, earth berms may be considered a viable mitigation option throughout the project area, and would be evaluated further where possible in the final design stage with the selected alternative.

As a general practice, noise barriers are most effective when placed at a relatively high point between the roadway and the impacted noise sensitive land use. To achieve the greatest benefit

from a potential noise barrier, the goal of the barrier should focus on breaking the line-of-sight (to the greatest degree possible) from the roadway to the receiver. In roadway fill conditions, where the highway is above the natural grade, noise barriers are typically most effective when placed on the edge of the roadway shoulder or on top of the fill slope. In roadway cut conditions, where the roadway is located below the natural grade, barriers are typically most effective when placed at the top of the cut slope. Engineering and safety issues have the potential to alter these typical barrier locations.

The effectiveness of a noise barrier is measured by examining the barrier's capability to reduce future noise levels. Noise reduction is measured by comparing design year pre- and post-barrier noise levels. This difference between unabated and abated noise levels is known as insertion loss (IL). The following discussion presents potential mitigation measures for each of the impacted noise sensitive land uses.

According to VDOT guidelines, potential mitigation measures must also be assessed for feasibility and reasonableness. Noise barrier feasibility deals specifically with acoustical and engineering considerations such as:

- Noise barriers must reduce design year noise levels by 5 dBA for impacted sites;
- The barrier cannot deny access to local vehicular and/or pedestrian travel; and
- There cannot be significant engineering and/or safety problems associated with the barrier which preclude construction of the barrier (engineering, safety, and utility conflicts)

Noise barrier reasonableness is determined by assessing multiple issues including:

- The number of units protected;
- The desires of those citizens affected by the barrier;
- A comparison of existing and future noise levels;
- Total barrier cost and cost per protected and benefited property;
- Barrier constructability and maintainability; and
- Barrier impacts to utilities and drainage

Typically, the limiting factor related to barrier reasonableness is cost per protected dwelling unit, where a protected and/or benefited receptor receives at least a 5 dBA reduction in noise level. VDOT's current approved cost is $30,000 per protected and/or benefited residence.

When a barrier exceeds the State Noise Abatement Policy's cost-effectiveness criteria, third party funding is required for the barrier to continue towards construction. FHWA and VDOT contribute the first $30,000 for each protected or benefited property. The remainder must come from any source other than FHWA or VDOT. Final approval of all barriers will take into account the views of the impacted property owners. The final determination of a barrier's cost effectiveness will be based on the following:

- For residential properties, a barrier is cost effective when the cost does not exceed $30,000 per protected or benefited residential unit.
- An impacted property is considered protected when it receives a noise reduction of at least 5 decibels.
- Should a non-impacted property receive 5 dBA or more of noise reduction then the property will be considered benefited and included in the cost per protected site equation.

For non-residential properties such as parks, schools, and churches, the $30,000 cost criterion does not apply. The determination is based on cost, severity of impact (both in terms of noise levels and the size of the impacted area and the activity it contains), and amount of noise reduction.

Any sound barriers identified in this document must satisfy final feasibility and reasonableness criteria to be constructed. Therefore, the sound wall design parameters and cost identified in this document are preliminary and should not be considered final. Final design parameters, feasibility, and cost effectiveness cannot be determined as the sound wall cost estimate must be based upon an approved road design alignment and include all required materials and installation costs. If the sound barriers are determined to be feasible, the affected public will be given an opportunity to decide whether they are in favor of construction of the sound barrier.

A final determination as to the construction of barriers will be made for the selected build alternative after the public hearing process. Before final decisions and approvals can be made to

construct a sound barrier, a detailed evaluation will be performed, and input from the impacted property owners must be obtained. All feasible sound barriers will be reviewed by the Joint VDOT/FHWA Noise Abatement Committee, which will make recommendations to the Chief Engineer for approval. Approved barriers will be incorporated into the road project plans.

Due to the areas of steep terrain throughout the project corridor, noise barriers were not considered a viable mitigation option for many of the impacted sites. In many areas the terrain provides a natural barrier, while in others, terrain prevents the construction of a feasible noise barrier.

For CBA A, five (5) noise barriers are considered feasible. For CBA B, eight (8) barriers are considered feasible. Each barrier is discussed in detail below.

6.3 Details of Evaluated Barriers

Details of each of the evaluated barriers are given in Table 7. Details include the applicable build alternative and segment, length, height, total surface area in square feet, range of computed noise reduction, cost, and the number of sites protected and benefited. Graphical depictions of each barrier location as colored lines along the roadways are included in the figures located in Appendix A for CBA A, and Appendix B for CBA B.

6.3.1 CBA A Noise Barriers

While noise impacts occur along the new alignment, many noise impacts under the CBA A build condition occur along the existing roadway alignment, which will continue to serve I-77 traffic. However, no construction is anticipated along the existing roadway as part of CBA A. Only the interchanges at the beginning and end of the project would be affected. Noise barriers are only evaluated in conjunction with roadway construction projects. Therefore, noise barriers were evaluated only within 1000 feet of the roadway construction. Noise impacts along the existing alignment that are outside of the 1000 feet limit were not evaluated for noise abatement. Therefore, impacted sites in NSA D and E were not evaluated for abatement, and only selected sites within NSA A, B, and C fell within the 1000 feet criterion.

Barrier A1 *(Appendix A, Sheet 3)*

Barrier A1 protects impacted sites A27, and A28. Barrier A1 would extend along the New Alignment I-81 Southbound lanes approximately from station 2196+00 to 2212+00, a length of 1,582 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 31,640 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $949,200. The barrier provides 5 to 9 dB of noise reduction to three (3) sites, representing two (2) residential properties and one (1) commercial property. The cost per protected property would be $316,400. This exceeds the cost effectiveness criterion, however because the barrier benefits a commercial site, the reasonableness would be determined by the Noise Abatement Committee.

Barrier A2 *(Appendix A, Sheet 4)*

Barrier A2 protects impacted site B14. Barrier A2 would extend along the existing corridor I-77 Southbound lanes, west of the quarry, between the roadway and the frontage road, for an approximate length of 757 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 15,140 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $454,200. The barrier provides 8 dB of noise reduction to one (1) site, representing one (1) residential property. The cost per protected property would be $454,200. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Barrier A3 *(Appendix A, Sheet 5)*

Barrier A3 protects impacted sites C6, C7, and C8. Barrier A3 would extend along the existing corridor I-77 Northbound lanes, between the roadway and the frontage road, for an approximate length of 771 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 15,420 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $462,600. The barrier provides 7 to 8 dB of noise reduction to three (3) sites, representing three (3) residential properties. The cost per protected property would be $154,200. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Barrier A4 *(Appendix A, Sheet 5)*

Barrier A4 protects impacted site C11. Barrier A4 would extend along the existing corridor I-77 Northbound lanes, west of Exit 77, between the roadway and the frontage road, for an approximate length of 1,497 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 29,940 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $898,200. The barrier provides 5dB of noise reduction to one (1) site. The cost per protected property would be $898,200. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Barrier A5 *(Appendix A, Sheet 7A)*

Barrier A5 protects impacted site D32. Barrier A5 would extend along the New Alignment I-81 Southbound lanes approximately from station 2430+00 to 2445+00, a length of 1,500 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 30,000 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $900,000. The barrier provides 5 dB of noise reduction to one (1) site, representing one (1) residential property. The cost per protected property would be $900,000. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

6.3.2 CBA B Noise Barriers

Barrier B1 *(Appendix B, Sheet 3)*

Barrier B1 protects impacted site B12. Barrier B1 would extend along the I-81 Northbound lanes east of the rail line, between the roadway and the frontage road approximately from station 3051+00 to 3063+00, for a length of 1,223 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 24,460 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $733,800. The barrier provides 5 to 7 dB of noise reduction to two (2) sites, a church and residence. The cost per protected property would be $366,900. However, because the barrier benefits the church exterior, the reasonableness of this barrier would be determined by the Noise Abatement Committee.

Barrier B2 *(Appendix B, Sheet 5)*

Barrier B2 protects impacted sites C7 and C8. Barrier B2 would extend along the I-81 Southbound lanes, opposite the quarry, between the roadway and the frontage road, approximately from station 4161+00 to 4172+00, for a length of 1,097 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 21,940 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $658,200. The barrier provides 9 dB of noise reduction to two (2) sites, representing two (2) residential properties. The cost per protected property would be $329,100. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Barrier B3 *(Appendix B, Sheet 5)*

Barrier B3 protects impacted site C11. Barrier B3 would extend along the I-81 Southbound lanes west of Exit 77, between the roadway and the frontage road, approximately from station 4197+00 to 4210+00, for a length of 1,300 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 26,000 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $780,000. The barrier provides 6 dB of noise reduction to one (1) site, representing one (1) residential property. The cost per protected property would be $780,000. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Barrier B4 *(Appendix B, Sheet 5, 6)*

Barrier B4 protects impacted sites C14, and C18 - C23. Barrier B4 would extend along the I-81 northbound lanes between the roadway and frontage road west of Exit 77 approximately from station 3182+00 to 3202+00, for a length of 2,012 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 40,240 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $1,207,200. The barrier provides 7 to 10 dB of noise reduction to eight (8) sites, representing one (1) church, one (1) commercial site with outdoor activity, and six (6) residential properties. The cost per protected property would be $150,900. However, the barrier protects a commercial site and benefits the church exterior, which are not subject to the cost effectiveness criterion. The reasonableness of this barrier would be evaluated by the Noise Abatement Committee.

Barrier B5 *(Appendix B, Sheet 7)*

Barrier B5 protects impacted site D11. Barrier B5 would extend along the I-81 Southbound lanes between the roadway and the frontage road, west of Exit 80, approximately from station 4318+00 to 4324+00, a length of 591 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 11,820 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $354,600. The barrier provides 7 dB of noise reduction to one (1) site, representing one (1) residential property. The cost per protected property would be $354,600. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Barrier B6 *(Appendix B, Sheet 7, 8)*

Barrier B6 protects four (4) of seven (7) impacted residences, D15, D16, D19, and D21. Using the preliminary design data, it was not feasible to protect the other three (3) properties. However, this barrier would receive further consideration during the final design stage. Barrier B6 would extend along the I-81 Northbound lanes, west of Exit 80, between the roadway and frontage road, approximately from station 3290+00 to 3312+00, a length of 2,209 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 44,180 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $1,325,400. The barrier provides 5 to 7 dB of noise reduction to four (4) sites, representing four (4) residential properties. The cost per protected property would be $331,350. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Barrier B7 *(Appendix B, Sheet 8)*

Barrier B7 protects impacted site D13. Barrier B7 would extend along the I-81 Southbound lanes between the roadway and the frontage road, west of Exit 80, approximately from station 4346+00 to 4355+00, a length of 900 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 18,000 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $540,000. The barrier provides 7 dB of noise reduction to one (1) site, representing one (1) residential property. The cost per protected property would be

$540,000. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Barrier B8 *(Appendix B, Sheet 9)*

Barrier B8 protects impacted site E2. Barrier B8 would extend along the I-81 Northbound lanes, east of Exit 80, between the roadway and frontage road, approximately from station 3377+00 to 3388+00, a length of 1,084 feet. The barrier would be a uniform height of 20 feet, resulting in a surface area of 21,680 square feet. Using a cost estimate of $30 per square foot, this results in a total cost of $650,400. The barrier provides 6 dB of noise reduction to one (1) site, representing one (1) residential property. The cost per protected property would be $650,400. This exceeds the cost effectiveness criterion, and so would not be considered further unless third party funding becomes available.

Table 7: Details of Evaluated Noise Barriers by Alternative

Barrier	Barrier Length (ft)	Barrier Height (ft)	Surface Area (sq. ft.)	Range Noise Reduction (dB)	Total Cost ($) ($30/s.f.)	Sites Protected (Benefited)	Cost Per Protected Property ($)
CBA A							
A1	1,582	20	31,640	5-9	949,200	2(1)	316,400*
A2	757	20	15,140	8	454,200	1	454,200
A3	771	20	15,420	7-8	462,600	3	154,200
A4	1,497	20	29,940	5	898,200	1	898,200
A5	1,500	20	30,000	5	900,000	1	900,000
Total	**6,107**		**122,140**		**$3,664,200**	**9**	
CBA B							
B1	1,223	20	24,460	5-7	733,800	1(1)	366,900*
B2	1,097	20	21,940	9	658,200	2	329,100
B3	1,300	20	26,000	6	780,000	1	780,000
B4	2,012	20	40,240	7-10	1,207,200	7(1)	150,900*
B5	591	20	11,820	7	354,600	1	354,600
B6	2,209	20	44,180	5-7	1,325,400	4	331,350
B7	900	20	18,000	7	540,000	1	540,000
B8	1,084	20	21,680	6	650,400	1	650,400
Total	**10,416**		**208,320**		**$6,249,600**	**20**	

* Indicates that the reasonableness would be determined by the Noise Abatement Committee

6.4 Property Acquisition for Severely Impacted Residential Sites

There may be situations where severe traffic noise impacts exist or are expected and the abatement measures listed above are physically infeasible or economically unreasonable. In these instances, noise abatement measures other than those listed above may be proposed for Type I projects by the highway agency and approved by the Federal Highway Division Administrator on a case-by-case basis.

The FHWA allows the States the flexibility to propose innovative noise abatement measures when severe traffic noise impacts are anticipated and normal abatement measures are physically infeasible or economically unreasonable. In these instances, the Federal Highway Division Administrator may approve a State's request for unusual or extraordinary abatement measures on a case-by-case basis. When considering extraordinary abatement measures, the State must demonstrate that the affected activities experience traffic noise impacts to a far greater degree than other similar activities adjacent to highway facilities, e.g., residential areas with absolute noise levels of 75 dBA Leq(h) or more, residential areas with noise level increases of 30 dBA or more over existing noise levels. Examples of extraordinary abatement measures would be the noise insulation of private residences or the purchase of private dwellings from willing sellers.

In the design year build case for CBA A, one (1) residential site, D12, is predicted to experience an absolute noise level greater than 75 dBA. In the design year build case for CBA B, twelve (12) residential sites are predicted to experience an absolute noise level greater than or equal to 75 dBA. A noise barrier is not feasible for five (5) of these sites, C7, C9, D1, D2, and D11. A noise barrier is not cost reasonable for the other seven (7) sites, D14, D15, D16, D17, D19, D21, and D26. During the final design stages, coordination with the local FHWA Administrator would be prudent to discuss the potential purchase of these residential properties experiencing severe impacts.

7. Noise Contours

Noise contours are lines of equal noise exposure that parallel the roadway noise source, and diminish in intensity with distance. For the design year (2035) for each build alternative, the location of the 66 dBA noise contour line was determined for areas along the project corridor for the purpose of characterizing the noise environment in the study area. Due to terrain features and differing traffic in the corridor, there are areas where the contour varies in distance from the roadway. The approximate noise contours are illustrated in the graphics for each build alternative. They are shown in Appendix A for CBA A, and in Appendix B for CBA B. Any Category B noise sensitive properties within the noise contours should be considered noise impacted if no sound barrier is present to reduce noise levels.

8. Construction Noise

Land uses that will be sensitive to traffic noise will also be sensitive to construction noise. A method of controlling construction noise is to establish the maximum level of noise that construction operations can generate. In view of this, VDOT has developed and FHWA has approved a specification that establishes construction noise limits. This specification can be found in VDOT's 2007 *Road and Bridge Specifications*, Section 107.16(b.3), "Noise". The contractor will be required to conform to this specification to reduce the impact of construction noise on the surrounding community.