Virginia Department
Of Transportation

Highway Traffic Noise Impact Analysis
Guidance Manual

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Table of Contents

1.0 Purpose 1

2.0 Policy Statements 1

2.1 Federally-Funded Type I Highway Traffic Noise Projects 1

2.2 Federally-Funded Type II Highway Traffic Noise Projects 3

2.3 Federally Funded Type III Highway Traffic Noise Projects 3

3.0 Qualifications Necessary to Perform Noise Analysis 3

4.0 Time-Related Factors and Their Effects on Noise Studies 4

4.1 Effects of Revisions to Noise Guidance 4

4.2 Using Different Traffic Noise Models and Versions 4

4.3 Using Different Versions of the FHWA Noise Model 5

5.0 Questions Regarding This Manual 5

6.0 Noise Analysis Procedures 5

6.1 Scoping 5

6.1.1 Narrative Analysis 6

6.1.2 Screening Analysis 7

6.1.3 Detailed Analysis 7

6.2 Consideration of Areas Sensitive to Traffic Noise 7

6.2.1 Common Noise Environment (CNE) Determination 7

6.2.2 Undeveloped and Developing Lands: Permitted 9

6.3 Determination of Existing Conditions 10

6.3.1 Selecting Receptor Sites for Monitoring and Modeling 10

6.3.2 Worst Noise Hour 11

6.3.3 Existing Noise Level Monitoring 12

6.3.4 Monitor Similar and Unique Conditions 12

6.3.5 Existing Noise Barriers and Privacy Fences 12

6.3.6 In-Kind Barrier Replacement 13

6.4 Noise Modeling (Prediction of Existing and Future Conditions) 14

6.4.1 FHWA Model 14

6.4.2 Limitations 14

6.4.3 Traffic Speed Determination 14

6.4.4 Model Validation Purpose 15

6.4.5 Model Validation Procedure 16

6.4.6 Determining Existing Worst Noise Hour(s) 17

6.4.7 Future “No-Build” Conditions 18

6.4.8 Future “Build” Conditions 18

7.0 Determining Highway Traffic Noise Impacts and Establishing Abatement Requirements 19

Table of Contents

7.1 Criteria for Detailed Highway Traffic Noise Abatement Measures 19
7.2 Highway Traffic Noise Abatement Measures..... 19
7.3 Noise Abatement Determination..... 21
7.3.1 Phase 1 – Warranted Criterion..... 21
7.3.2 Land Use Activity Category A 22
7.3.3 Land Use Activity Category B..... 23
7.3.4 Land Use Activity Category C..... 23
7.3.5 Land Use Activity Category D (Interior)..... 24
7.3.6 Land Use Activity Category E..... 25
7.3.7 Land Use Activity Category F 25
7.3.8 Land Use Activity Category G 26
7.3.9 Phase 2 – Feasibility Criteria for Noise Barriers 26
7.3.10 Phase 3 – Reasonableness Criteria for Noise Barriers..... 27
7.3.10.1 Viewpoints of the benefited receptors..... 27
7.3.10.2 Cost-effectiveness 27
7.3.10.3 Noise Reduction Design Goals 28
7.3.10.4 Category C Land Use Activity Areas..... 29
8.0 Completing the Warranted, Feasible, and Reasonable Worksheets 29
9.0 Highway Traffic Noise Barrier Design: Commitments 30
9.1 Highway Traffic Noise Barrier Goals (Barrier Optimization)..... 30
9.1.1 Highway Traffic Noise Abatement Commitments 31
9.1.2 Abatement Measure Reporting 32
10.0 Additional Considerations for Final Design Highway Traffic Noise Barrier Analysis 32
10.1 Final Design Considerations and Measures..... 32
10.2 Date of Public Knowledge..... 34
10.3 Desires of Those Individuals Impacted by Highway Traffic Noise 34
10.4 Applications for Absorptive Noise Barriers 34
10.5 Design-Build Projects 35
11.0 Construction Noise Consideration 35
12.0 Public, Locality, and Agency Involvement.....36
12.1 Degree and Type of Involvement 36
12.2 Local Officials 37
12.3 Affected Receptors/Community 37
12.4 Voting Procedures..... 38
12.4.1 Voting on the Construction of the Noise Barrier..... 38
12.4.2 Aesthetics..... 40
12.4.3 Third-Party Funding Options..... 40

Table of Contents

13.0 Reporting Results of Highway Traffic Noise Analyses 41
13.1 Environmental Clearance Reporting 41
13.1.1 NEPA Reevaluations 41
13.1.2 Highway Traffic Noise Analysis Project File 42
13.1.3 Section 106 43
13.1.4 Section 4(f) 43
13.1.5 Title VI and Environmental Justice 44
13.2 Highway Traffic Noise Report: Format, Content, and Processing 44
13.2.1 Highway Traffic Noise Report Format and Content 44
13.2.2 Highway Traffic Noise Report Processing 46
13.2.3 Extenuating Circumstances 47
Appendix A Definitions and Guidance on Terms 48
Appendix B Frequently Asked Questions 54
Appendix C Title 23 Code of Federal Regulations, Part 772 58
Appendix D State Noise Abatement Policy 70
Appendix E Activity Category C and D Calculation 71
Appendix F Warranted, Feasible, and Reasonable Worksheet.....73
Appendix G Chief Engineer Concurrence Memorandum.....75
Appendix H Single Impacted Receptor Methodology 77

1.0 Purpose

This Manual provides procedures and guidance regarding highway traffic noise impact assessment and analysis for federal or federally-funded Type I highway traffic noise projects during the Environmental Clearance and Final Design Phases in accordance with the National Environmental Policy Act (NEPA) of 1969.

Highway traffic noise impact analysis, abatement procedures, criteria, coordination requirements, and reporting guidance contained herein are based on Title 23 of the Code of Federal Regulations, Part 772, the Federal Highway Administration's (FHWA) Procedures for Abatement of Highway Traffic Noise and Construction Noise, (23 CFR 772), which is included as Appendix C of this document. All transportation improvement projects developed in accordance with the Virginia Department of Transportation's (VDOT) guidelines shall conform to the mandates and guidance of FHWA. FHWA regulations and guidance require that mitigation be considered whenever noise impacts are identified.

Note: Although the guidance in this Manual may cite a specific criterion or measure, requirements herein may be further modified for a specific project through the application of available industry wide practices and procedures. As such, any specific criterion or measure cited in this Manual shall not be viewed as a restriction on VDOT's authority to require further analysis beyond a stated minimum standard.

2.0 Policy Statements

2.1 Federally-Funded Type I Highway Traffic Noise Projects

It is VDOT's policy to assess the highway traffic noise impacts of transportation improvement projects and, when potential noise impacts are identified, to give consideration to the incorporation of appropriate avoidance and/or mitigation measures into the design and construction of federal or federally-funded Type I transportation improvement projects. Before noise abatement measures can be considered, the appropriate level of highway traffic noise analysis must be completed to adequately address whether noise abatement measures are warranted, feasible, and reasonable. This assessment is required to justify recommendations to construct any highway traffic noise mitigation measures. Proposed transportation improvement projects that may be considered Type I highway traffic noise projects include the following:

(1) The construction of a highway on new location; or,

(2) The physical alteration of an existing highway where there is either:

(i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,

(ii) Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the

highway or by altering the topography between the highway traffic noise source and the receptor; or,

(3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,

(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,

(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,

(6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,

(7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

(8) If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project.

Note – The FHWA noise guidance recommends that State highway agencies take a broad approach to defining auxiliary lanes with respect to Type I projects as defined in paragraph (4) of the definition of Type 1 project in 23 CFR Part 772.5. Although the function of an auxiliary lane differs depending on the type of facility, an auxiliary lane should classify the project as Type I if the auxiliary lane is 2,500 feet or longer (see the AASHTO Policy on Highway Design or Green Book and Institute of Transportation Engineers (ITE) Manual "Freeway and Interchange Geometric Design Handbook" for more information).

Note – If a Type I project impacts to only one side of a highway facility, the noise analysis shall address both sides of the facility.

Note – If a project involves a combination of Type I improvements and non-Type I improvements, the entire project is treated as a Type I project.

Note – Federally-funded Type I projects shall be analyzed for highway traffic noise in accordance with the guidelines in this Manual. Where the determination of a Type I project is unclear, consult VDOT Noise Abatement Staff.

Note – For weigh stations, rest stops, ride-share lots, or toll plazas contact VDOT Noise Abatement Staff for analysis methodology. Projects that aim to construct or modify a Park and Ride (P&R) lot are generally considered independent utility projects. As such, Design Year noise levels resulting solely from the proposed P&R, and not inclusive of the local roadway noise, are to be compared to the appropriate NAC.

Note – Project Area, as referenced above in Type I project type (8), is defined for noise study purposes as the area within 500 feet from the proposed edge of pavement of the roadway improvements as defined by the roadway construction limits. Highway traffic noise assessment is required for all receptors within the project area.

2.2 Federally-Funded Type II Highway Traffic Noise Projects

Type II projects are proposed federal-aid projects for highway traffic noise abatement (construction of noise barriers) on an existing highway. To fund Type II projects with federal-aid funds, an FHWA-approved Type II program must be established.

Note – VDOT has not established a federally-funded Type II highway traffic noise program.

2.3 Federally Funded Type III Highway Traffic Noise Projects

A Federal or Federal-aid highway project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

3.0 Qualifications Necessary to Perform Noise Analysis

Only individuals (VDOT or consultant staff) qualified in the field of highway traffic noise impact analysis may conduct highway traffic noise analysis for VDOT transportation improvement projects. In order to be considered qualified, the person performing the analysis must have demonstrated experience in conducting highway traffic noise analyses for transportation improvement projects and must have exhibited a working knowledge of the procedures outlined in Report Number FHWA-DP-96-046, "Measurements of Highway-Related Noise," May 1996; 23 CFR Part 772; and this Manual. The qualified individual must also have successfully completed the following:

- Highway traffic noise analysis training approved by or provided by FHWA or the National Highway Institute (NHI); or
- Training on the most current required FHWA noise analysis computer model(s)
- In addition to one of the above requirements, a minimum of 10 years' experience as a primary author of a noise analysis for an individual is required to submit a noise analysis for review and approval.

Once an analyst has completed this training, a copy of the certificate of training completion must be provided to VDOT Noise Abatement Staff so that the individual's name may be added to the list of persons qualified to perform highway traffic noise analyses in the Commonwealth. Refresher and additional training may be necessary as a result of advanced highway traffic noise modeling technologies and changes in highway traffic noise policy and/or procedure. Although personnel may meet the minimum requirements noted above, the display of competence in the profession of highway traffic noise analyses shall be demonstrated by the submission of previously-completed noise analyses. The Department reserves the right to remove those individuals from the approved list of persons qualified to perform highway traffic noise analyses in the Commonwealth as deemed appropriate.

Note: Contact VDOT Noise Abatement Staff for FHWA-recognized training courses.

Note: Instructors of nationally recognized training courses are exempt from receiving a training certificate; however documentation must be provided indicating that they are instructors.

4.0 Time-Related Factors and Their Effects on Noise Studies

Several factors may influence the conduct of noise studies, the evaluation of noise impacts, and the selection of warranted, feasible, and reasonable noise abatement features. The factors presented below are generally related to changes that may occur over time and/or between various phases of a project's development.

4.1 Effects of Revisions to Noise Guidance

It is the desire and intent of VDOT to update and amend its noise guidance material on an as-needed basis to address policy changes and provide technical enhancements. The most recent example of such a modification is this 2011 update to the State Noise Abatement Policy (SNAP) which amended the 1997 SNAP.

For some projects, noise studies may have been completed in accordance with noise policies and guidance which were subsequently modified. In such instances, it is recommended that the original policies and guidance continue to be applied throughout all phases of the project, if results from the completed studies have been published, presented to the public, or otherwise made available to the public. If results of such completed studies have not been published or made publicly available, new studies should be commenced using the most current policy and guidance.

These guidelines are intended to ensure that "commitments" or "perceived commitments" are not compromised solely based on noise policy changes.

4.2 Using Different Traffic Noise Models and Versions

It is the desire and intent of VDOT to use the most up-to-date federally approved noise model and nationally recognized modeling techniques in order to provide the most accurate and comprehensive noise analyses for projects, provided that:

- These modeling techniques do not result in a reduction in the number of areas considered for noise abatement compared to the areas considered in previously publicly disclosed noise studies; and
- The newer modeling techniques do not result in any reduction of previously approved abatement measures based on the noise modeling performed in the previous noise studies.

Note – This may not apply depending on the project status and/or stage (e.g., date of public knowledge). If clarification is needed, please consult VDOT Noise Abatement Staff.

4.3 Using Different Versions of the FHWA Noise Model

For some projects, noise analyses may have been performed during earlier project phases using a version of the FHWA Traffic Noise Model (TNM) or STAMINA 2.0/OPTIMA noise prediction software that, during later project phases, became outdated. Additional noise analyses for these projects may be required because of a new project phase, the need to reevaluate the project, or for some other reason. In such instances, the FHWA TNM Version 2.5 should be used for additional noise modeling.

Note – The Department is committed to providing noise mitigation for locations that may no longer warrant noise abatement as a result of different noise models.

5.0 Questions Regarding This Manual

VDOT's Noise Abatement Section will issue updates and/or make modifications to this Manual as necessary. Please direct questions, comments, or suggestions about this Manual to the following address:

Virginia Department of Transportation
1401 East Broad Street
Richmond, Virginia 23219
Attn: Noise Abatement Program Manager

6.0 Noise Analysis Procedures

Highway traffic noise impacts are initially addressed during the engineering and environmental scoping activities. This is done to assess the potential for future highway traffic noise impacts of the proposed transportation improvement project on the sensitive receptors in the study area. No receptor or community shall be denied the consideration of highway traffic noise mitigation or denied full and fair participation in the decision making process on the basis of its national origin, color, race, or income.

It is VDOT's policy to assess and identify the highway traffic noise impacts of federal or federally-funded Type I transportation improvement projects (as defined in Section 2.1) and to give consideration to the appropriate avoidance and/or mitigation measures for those projects in accordance with 23 CFR Part 772. The level of documentation may vary as discussed below.

6.1 Scoping

The primary criteria for selecting the method for performing and documenting the highway traffic noise impact analysis shall be based on the magnitude of the project and the complexity of the noise-related issues involved. Coordination with VDOT Noise Abatement Staff during the early stages of project scoping is critical to ensure the proper level of noise analysis is conducted.

The appropriate level of analysis can depend on the presence of noise sensitive land uses (existing or permitted), probable occurrence of highway traffic noise impacts, the potential for noise mitigation measures, and/or noise-related public concerns.

The level of analysis of highway traffic noise impacts may be one of three types:

- Narrative Analysis
- Screening Analysis or
- Detailed Analysis

In determining which level of noise analysis is appropriate, the following issues should be analyzed to determine whether the noise sensitive receptors (if present) adjacent to the project would experience an increase in noise levels. If the project has the potential to adversely affect the acoustical environment based on an evaluation of the following factors, a quantitative highway traffic noise analysis (i.e., screening or detailed analysis) is required. It is impossible to identify and account for every special consideration that may arise on a specific highway project and address it in the corresponding noise analysis therefore the list below is to be used as a guide and not considered all inclusive.

- Change of traffic volumes (e.g., greater than 10%);
- Change of traffic composition (e.g., increased truck volumes);
- Change of traffic speed (e.g., greater than 10 miles per hour);
- Change of the geometric relationships (either horizontal or vertical) between the roadway facility and the receptors;
- Projects on new location;
- Change of the distribution of traffic patterns;
- The identification of any existing activities, developed lands, and undeveloped lands for which development is permitted which may be affected by noise from the proposed project; and/or
- Public concerns based on noise-related issues or perceptions

6.1.1 Narrative Analysis

A narrative analysis should be performed on projects where traffic noise-related impacts are not anticipated based on the scoping determination/field view, or other noise prediction tools such as FHWA's Low Volume Road Noise Calculation Tool[1], and therefore a detailed noise evaluation is not required. A narrative analysis will consist of a discussion of the proposed project and its relationship to receptors (if present) and why further quantitative analysis is not required. If no receptors (including non-permitted undeveloped lands) are present, a brief statement should be included that summarizes the fact that there are no noise-sensitive land uses in the study area.

[1] As of the date of this manual, FHWA's Low Volume Road Noise Calculation Tool is still in draft form, and therefore is not yet suitable for use. The Tool may be used once FHWA releases a final version for use.

When a project satisfies the requirements of a narrative analysis, a statement similar to the following shall be included in the appropriate NEPA document: "This proposed project will not result in overall noise levels approaching or exceeding the applicable NAC level(s) at any noise sensitive receptor nor will it result in a substantial increase in noise as compared to existing levels. There are no anticipated highway traffic noise-related public concerns or substantial construction noise impacts. Therefore, this project is not considered to result in noise impacts that would require consideration of abatement." Noise monitoring may be required to justify the results of the narrative analysis.

6.1.2 Screening Analysis

A screening analysis is generally completed for projects where noise impacts may be anticipated, however noise abatement is clearly not feasible. The screening analysis is a simple procedure used to predict traffic noise levels and make a reasonable determination of noise impacts. There are limitations to the screening procedures, and they are not applicable to all projects; consultation with VDOT Noise Abatement Staff is recommended. If the screening analysis results indicate that noise impacts are likely and the placement of typical abatement devices appears to be feasible, a detailed analysis is required. If impacts are noted and abatement is clearly NOT feasible (i.e., driveway access), the screening procedures should suffice and a detailed analysis is not required. However, impacts and the rationale behind the feasible determination should be documented in the NEPA document through a technical memorandum. A screening analysis should be performed using a simplified FHWA TNM run to assess the worst-case conditions. Noise monitoring may be required to justify the results of the screening analysis.

6.1.3 Detailed Analysis

A detailed analysis should be completed for all other projects where the narrative or screening analysis methods are not applicable. A detailed analysis should occur where traffic noise impacts are anticipated and mitigation appears to be feasible. This type of analysis should consist of a formal noise report that is consistent with the policy and guidance documented in 23 CFR Part 772, and VDOT's Highway Traffic Noise Impact Guidance Manual.

6.2 Consideration of Areas Sensitive to Traffic Noise

During the preliminary roadway design of a project, consideration should be given to potential highway traffic noise impacts for the entire project area. Land uses that are sensitive to transportation noise impacts are identified in ***Table 1***.

6.2.1 Common Noise Environment (CNE) Determination

Field reconnaissance may be necessary for identifying and/or verifying the location of noise-sensitive receptor sites and highway traffic noise sources. A common noise environment (CNE) is defined in 23 CFR Part 772 as a group of receptors within the same Activity Category in ***Table 1*** that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and

topographic features. Generally, CNEs occur between two secondary noise sources, such as interchanges, intersections, or cross-roads. CNE boundaries typically do not cross any major and/or significant highway traffic noise source (i.e., existing or proposed roadways), although they may cross secondary roads and neighborhood streets. Grouping common areas into CNEs also assists in evaluating mitigation, organizing reports, and facilitating discussions. Noise-sensitive receptors within 500 feet of the project area should be considered as part of the evaluation. However, if noise sensitive land use continuity exists, i.e., continuous land uses that extend beyond the construction limits (herein neighborhood continuity), noise mitigation shall be considered that addresses this continuity using accepted engineering practices.

Note – 500 feet decision: TNM version 2.5 is performing very well for open area, acoustically soft ground sites at near distances; open area, acoustically hard ground sites at near distances; and barrier sites. A slight degradation in model performance is observed at larger distances: for open area, acoustically soft ground sites [600 ft (~180 m) and beyond] and acoustically hard ground sites [900 ft (~275 m) and beyond]. At these distances, TNM appears to be under-predicting for soft ground and over-predicting for hard ground regardless of the construction limits. Should impacts be predicted beyond 500 feet further investigations are required to determine the extent or cause of the impact (e.g. modeling errors or secondary noise generator).

Note – Not all impacted noise sensitive receptors within 500 feet of the project area may qualify for noise abatement, as noise abatement is typically evaluated for noise impacts caused primarily by the proposed roadway improvements. For example, if a Type I project is located within 500 feet of an Interstate, and no work is being proposed on the Interstate itself, then noise receptors impacted primarily by Interstate traffic noise may not qualify for noise abatement. This determination is not an avenue to summarily dismiss the evaluation of, or the mitigation for, all noise sensitive receptors that may be impacted by highway traffic noise within 500 feet of the proposed project. Close coordination with VDOT Noise Abatement Staff shall occur on a case-by-case basis.

TABLE 1 TO PART 772—NOISE ABATEMENT CRITERIA [Hourly A–Weighted Sound Level decibels (dB(A))[1]]				
Activity category	**Activity Leq(h)[4]**	**Criteria[2] L10(h)**	**Evaluation location**	**Activity description**
A	57	60	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[3]	67	70	Exterior	Residential.
C[3]	67	70	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 structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.
F			Exterior	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] Either Leq(h) or L10(h) (but not both) may be used on a project.
[2] The Leq(h) and L10(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
[3] Includes undeveloped lands permitted for this activity category.
[4] VDOT uses the Leq(h) designation

6.2.2 Undeveloped and Developing Lands: Permitted

Highway traffic noise analyses will be performed for developed lands as well as undeveloped lands if they are considered "permitted." Undeveloped lands are deemed to be permitted when there is a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of at least one building permit.

Note – Since noise studies can span several years, it may be useful to send a letter to affected localities stating that "VDOT has initiated/will initiate noise studies for the Project on Date A. VDOT will consider noise abatement only for noise-impacted development for which a building permit was issued prior to the Date of Public Knowledge." If the proposed development is to be constructed in phases, the building permit only applies to the individual phase(s) of the proposed development. For example, if a proposed residential development has 8 separate construction phases and a building permit is issued for "one unit" in phase 1 and 2, only those phases that have been permitted will be evaluated. Conversely, since building permits were not issued prior to the Date of Public Knowledge for phases 3 through 8, they will not be considered for noise abatement. Noise barriers found to be feasible and reasonable in the final design process are to be constructed in conjunction with the road project.

Note – During a NEPA reevaluation close coordination with the FHWA and VDOT shall occur to determine if the Date of Public Knowledge will change.

6.3 Determination of Existing Conditions

Existing worst noise hour(s) may be determined by monitoring (measuring) noise levels in the field or by modeling with TNM. For projects on new alignments, determine traffic noise levels by field measurements. For projects on existing alignments, predict existing noise levels and design year traffic noise impacts.

6.3.1 Selecting Receptor Sites for Monitoring and Modeling

Areas to be considered for the placement of receptor sites for monitoring and/or modeling should include individual sites that are in close proximity (within 500 feet of the proposed edge of pavement of the *project area*) and could be impacted by the project. Where possible, the locations of monitored and modeled receptor sites should be consistent throughout the entire project area.

Note – Calibration of Noise Meters: Depending on usage, all highway traffic noise meters and acoustical field calibrators should be calibrated at least once every two years or in accordance with the manufacturer's specifications at a certified testing laboratory. Currently, VDOT performs biennial calibrations for the sound level meters and calibrators. A copy of the certificate of calibration for each piece of equipment used in the study for the period that highway traffic noise monitoring occurred for the proposed transportation improvement project should be included in the appendices of the technical report or in the technical files.

A monitored receptor site should be placed in a location that best represents the CNE. Receptor sites should be placed between the highway right-of-way line and the exterior areas of frequent human use. Modeled receptor sites should be located in all CNEs to establish highway traffic noise impacts and to evaluate the location, length, and height of potential noise barriers during the modeling process, as well as at specific locations due to the nature of the transportation improvement project (e.g., topography, locations of special concern). Professional judgment should be used when placing both monitored and modeled receptor sites. Consideration should also be given to historic and Section 4(f) properties during the monitoring/modeling phase of the noise analysis if serenity and a quiet setting are attributes that contribute to the significance of those resources. Please see Sections 13.1.3 and 13.1.4 for additional information when considering historic and Section 4(f) properties.

Note – Exterior Areas of Frequent Human Use. 23 CFR Part 772.11(b) provides that: In determining traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.

6.3.2 Worst Noise Hour

Highway traffic noise analyses should begin by determining the worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area. VDOT Noise Abatement Staff or consultants should discuss the traffic characteristics during the Preliminary Engineering Phase in order to adequately determine the worst-case highway traffic noise hour(s). To help facilitate this, hourly traffic volume, speed, and vehicle mix data to the extent such data are available shall be prepared using the latest Environmental Traffic Data (ENTRADA) spreadsheet which is available upon request (see notes below). There are several techniques to help determine the worst noise hour, including the following:

1. **Evaluation of Peak and Off-Peak Traffic Data**: In many cases, experience has shown that the peak traffic hour may coincide with the worst noise hour of the day. However, on occasion, conditions such as capacity, effects of traffic on vehicle speed, higher than normal off-peak truck percentages, or unusual hourly traffic distribution may cause the worst noise hour of the day to be different from the peak traffic hour of the day. Evaluation may be based on the review and/or analysis of historical traffic data, predicted hourly traffic data, supplementary traffic counts, or a combination thereof. Due to peak-hour congestion on major commuter routes, the worst noise hour may occur during the off-peak period on such roadways. VDOT has developed a loudest-hour spreadsheet that utilizes the data from the ENTRADA spreadsheet. This tool is frequently updated, so close coordination with VDOT Noise Abatement Staff shall occur prior to the distribution and use of the spreadsheet.

2. **24-Hour Monitoring Sites with Evaluation of Diurnal Traffic Patterns**: If there is some question as to the worst noise hour, it may be necessary to conduct 24-hour monitoring to determine the worst noise hour. In this case, 24-hour monitoring should be done in conjunction with evaluating the existing diurnal traffic patterns to determine the existing worst noise hour. The worst noise hour may be different in future design years since traffic scenarios may vary as a result of the proposed transportation improvement project and/or traffic growth. Future worst noise hour(s) should be identified using the existing 24-hour data, diurnal traffic patterns, and compositions. Major projects and projects with public concern related to highway traffic noise may also necessitate 24-hour monitoring.

3. **Public Comment**: Public comment may also produce some helpful information on the loudest day of the week or the loudest hour of the day, although only sound level data collected using certified noise instrumentation shall be considered valid.

4. **Combination of two or all of the above techniques.**

Note – The ENTRADA spreadsheet is updated frequently. Close coordination with VDOT Noise Abatement Staff shall occur to ensure the correct version is being used.

Note – Peak-hour traffic volumes may be utilized to complete preliminary noise analyses with prior approval from VDOT Noise Abatement Staff. However, ENTRADA (or equivalent hourly traffic data) shall be developed and utilized to complete all Final Design Noise Analyses. Exceptions to this must be approved in writing by VDOT Noise Abatement Staff.

Note – Design year traffic used in the preparation of preliminary and final design noise analyses shall include the anticipated traffic generated from all fiscally-constrained projects in the region's long range transportation plan (if any) that may impact design year traffic projections.

6.3.3 Existing Noise Level Monitoring

Existing noise levels used in noise modeling should represent the loudest noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area. Existing noise levels are monitored for one or more of the following reasons:

1. Validating the FHWA TNM at locations currently influenced by existing highway traffic noise sources;
2. Determining existing noise levels in areas remote from existing noise sources or in other areas where noise model validation cannot be performed;
3. Assisting in determining the existing worst noise hour (as referenced in Section 6.3.2); and/or
4. Supplementing other noise-related data in defining the existing noise environment.

6.3.4 Monitor Similar and Unique Conditions

When a unique condition is proposed and highway traffic noise level predictions (derived by the techniques discussed above) cannot accurately assess the future acoustical environment, it may be necessary to monitor another location with similar characteristics. Such a technique may be useful for projects with parking lots, covered roadways, tunnels, transit facilities, extreme rough surface pavements, open-grated bridge decks, parallel or multiple noise barriers, etc. This technique shall be used in coordination with the VDOT Noise Abatement Staff.

6.3.5 Existing Noise Barriers and Privacy Fences

The presence of an existing fence, noise barrier, or earth berm complicates noise analyses. The existing noise model, in order to reflect the existing noise environment, must include any existing solid barrier of considerable mass (weight) and no air gaps, designed specifically to abate noise. The noise levels that are computed to depict the existing conditions are those that include the existing barrier in the model.

However, light-weight privacy fences, which are generally constructed of wood and not normally constructed to abate noise, should not be modeled as noise barriers, since they do not reliably provide an appreciable amount of noise reduction. These fences often contain many gaps, which

allow the transmission of noise, and are constructed of materials that are usually not dense enough to sufficiently impede noise transmission.

Another challenging issue regarding existing noise barriers is identifying and mitigating potential noise impacts associated with a new Type I project. Noise barriers posts and foundations are uniquely designed for each noise barrier, and as a result, retrofitting a noise barrier to address new noise impacts is not typically possible. Therefore the Department has developed methodology to determine if a new noise barrier would be feasible and reasonable to construct a new noise barrier to mitigate new noise impacts.

When an existing noise barrier is not physically impacted and/or relocated as part of a new Type I project and impacts are identified the noise analyst shall determine if the existing noise barrier is still feasible and reasonable. The noise analyst will determine the design year noise levels with and without the existing noise barrier. If the noise barrier is determined to be feasible and reasonable then the process shall stop. However, if the noise analyst determines that the existing barrier is not feasible and/or not reasonable, a new barrier shall be evaluated. Should the new noise barrier being evaluated be determined to be not feasible and/or not reasonable, the existing noise barrier will be left in place without modification. Should the new noise barrier being evaluated be determined to be feasible and reasonable, it shall be recommended for construction as a replacement of the existing noise barrier.

6.3.6 In-Kind Barrier Replacement

When existing noise barriers are present within a project corridor, in accordance with Title 23 of the United States Code, Section 116 Maintenance: *(a) It shall be the duty of the State transportation department to maintain, or cause to be maintained, any project constructed under the provisions of this chapter or constructed under the provisions of prior Acts. The State's obligation to the United States to maintain any such project shall cease when it no longer constitutes a part of a Federal-aid system*. Therefore, VDOT requires the right-of-way to be maintained in perpetuity should the barriers be physically impacted by the proposed project. Close coordination with VDOT Noise Abatement Staff should occur when existing barriers are present or planned in the project corridor. Two scenarios involving existing noise barriers are typically encountered during projects:

Scenario 1: When an existing noise barrier is physically impacted and/or relocated as part of a Type I project, at a minimum the same level of protection must be provided. A proposed modification to an existing noise barrier shall not be subject to the reasonableness criterion if the site conditions require such modification, for example, if the height of a noise barrier must be increased to maintain the attenuation line (barrier top elevation) when the barrier is moved down a fill slope. Similarly, if a proposed project relocates a barrier upslope, the same height of the barrier above ground must be maintained. However, should additional modifications to the noise barrier be required to protect additional receptors impacted as a result of the Type I improvement, these modifications would be subject to the cost-effectiveness criterion, and only the additional benefitted receptors would be subject to the reasonableness calculation.

Scenario 2: When an existing barrier is not physically impacted by the project but the project creates noise impacts that the existing barrier does not completely address, any modifications to, or the replacement of, the noise barrier to address the impacts associated with the Type I improvement would be subject to the cost-effectiveness criterion. For example, if a 40,000 square foot (SF) noise barrier is required to replace a 30,000 SF noise barrier, then only the additional 10,000 SF would be subject to the reasonableness criterion, and only the additional benefitted receptors would be subject to the reasonableness calculation.

6.4 Noise Modeling (Prediction of Existing and Future Conditions)

6.4.1 FHWA Model

Noise modeling of existing and future roadways is an effective tool for predicting noise levels, noise impacts, and the potential benefits of noise abatement. Noise modeling associated with a roadway transportation improvement project is a dynamic process that evolves to address and answer questions related to noise impacts and the potential benefits of noise abatement. The noise-modeling process includes several steps, which are outlined below. Generally, the modeling process includes noise model validation, modeling of existing worst noise hour, modeling of future "no-build" conditions, and modeling of future "build" conditions associated with a proposed transportation improvement project.

The currently approved FHWA TNM is the applicable tool for the prediction of existing and future noise levels associated with transportation improvement projects. The FHWA TNM should be used only by qualified individuals with a thorough understanding of the model and this Manual (see Section 3.0 regarding qualifications). See Section 4.2 for information related to use of the appropriate prediction model.

6.4.2 Limitations

These traffic noise modeling procedures are not applicable in situations where the existing acoustical environment is not dominated by an existing highway traffic noise source. Highway traffic noise models are not capable of accurately determining existing noise levels where highway traffic noise is not the dominant contributing acoustical characteristic. Generally, the procedures are intended for sites that are currently influenced by highway traffic noise and will be similarly affected by the proposed transportation improvement project. In areas dominated by background (non-roadway) noise sources such as jet or rail, monitored (rather than modeled) noise levels should be used to determine existing worst noise hour levels, thereby accurately representing the existing noise environment. Professional judgment shall be used when selecting sites for determining worst-case noise levels in such areas.

6.4.3 Traffic Speed Determination

23 CFR Part 772.9(d) states, "*In predicting noise levels and assessing noise impacts, traffic characteristics that would yield the worst traffic noise impact for the design year shall be used.*"

The posted speed or operating speed may be used to predict highway traffic noise levels on Type I federally-funded projects. The operating speed must be used if it has been determined to be consistently higher than the posted speed limit, and vice versa. However, it may be difficult to determine the potential operating speed of a future roadway. When operating speeds are not readily available, close coordination with the project traffic engineers shall occur.

In corridors with peak-hour congestion, it may be more appropriate to model off-peak travel hours, representing the balance of high vehicle volume traveling at high speeds. In these situations (i.e., congested corridors), the worst noise hour(s) typically occurs in a period approaching or following the typical peak travel hours, when congestion breaks and vehicles travel at posted speeds or greater. According to FHWA guidance, the "worst hourly traffic noise impact" occurs at a time when truck volumes and vehicle speeds are the greatest, typically when traffic is free flowing and at or near level of service (LOS) C conditions.

Note – ENTRADA interrupted speeds shall be used to represent operating speeds for noise study purposes.

6.4.4 Model Validation Purpose

23 CFR Part 772.11(d)(2) requires validation to verify the accuracy of noise models used to predict existing noise levels. To verify the accuracy of the FHWA TNM created for the proposed project, existing noise levels monitored in the field need to be compared with the FHWA TNM noise level predictions for the traffic conditions observed during the monitoring period. The noise model validation procedure is initiated to assure that reported changes in noise levels between existing and future conditions are due to changes in traffic and/or roadway conditions and do not inappropriately reflect discrepancies between modeling and monitoring results. To ensure model validation is documented accurately, the noise report must contain the monitored and modeled noise level for each noise monitoring location in table format, with reported differences in noise level between the monitored and modeled values.

The monitoring methodology for the determination of existing conditions shall be consistent with the current version of FHWA's Measurement of Highway-Related Noise guidance document[2] and supplemented by professional judgment. Where practical, short-term noise monitoring, for modeling validation purposes, should include measurements taken during the worst noise hour(s) with all noise measurements occurring under generally free-flow traffic conditions.

Note – The noise monitoring plan shall be approved by VDOT Noise Abatement staff prior to field work.

Note – The duration for short term noise monitoring depends on several factors. However, short term noise monitoring shall be performed for a minimum duration of 10 minutes.

[2] Available for download at https://www.fhwa.dot.gov/Environment/noise/measurement/measure.pdf.

6.4.5 Model Validation Procedure

The noise model validation procedure is as follows;

1. Determine the existing acoustical conditions following the most recent version of the FHWA's Measurement of Highway-Related Noise guidance document. Observe and record traffic volumes on all influencing roadways (classifying the appropriate vehicular types) and determine the average vehicular speed. (This should be performed using radar equipment, driving through the project area, using distance/time calculations, etc.)
2. Input the traffic characteristics witnessed during short-term noise monitoring (extrapolated to one hour), site geometry, and any other pertinent existing features into the modeling software and calculate the noise levels.
3. Compare the field-observed values to the predicted values. If the difference between the two values is equal to or less than ±3 dB(A), this is an indication that the model is within the accepted level of accuracy. If observed noise levels differ from modeled noise levels by greater than ±3 dB(A), a careful examination of the observed data and predicted data shall be undertaken to determine the reason(s) for this margin of error. A qualified professional is required to reexamine the input parameters and look for obvious differences such as meteorology, pavement conditions, obstructions, reflections, non-traffic (background) noise sources, etc. Differences can be due to unusual circumstances during the measurement, or to insufficient detail or inaccurate assumptions in the model. In the event a logical explanation for the difference cannot be made, the field measurements at that location(s) should be repeated.
4. If the observed noise levels differ from the modeled noise levels by greater than ±3 dB(A) after thorough examination of the observed and predicted data, it may be practical to establish an "adjustment factor" to be applied to modeling results in certain cases. If adjustment factors are used, they shall be discussed and documented in the NEPA document. Contact VDOT Noise Abatement Staff prior to establishing or implementing adjustment factors.

Note – An alternative monitoring location should be considered before adjustment factors are used.

Note – Reporting Decibels as Whole Numbers: While the FHWA TNM performs and reports official analysis results to tenths of decibels, and most noise monitoring equipment data output is also reported to tenths of decibels, except for the validation process all modeled decibel levels are to be presented rounded to whole decibel values in the main body of reports and at public meetings. Report appendices may contain values reported to tenths when presenting FHWA TNM input and output tables, FHWA TNM barrier analysis input and output tables, noise monitoring field data sheets, noise monitoring output files produced by noise meter software, and noise meter calibration certificates.

Note – Decibel Rounding Convention: In rounding calculated with the FHWA TNM, the required convention is illustrated below.

- A value of 60.4 dB(A) shall be reported as 60 dB(A)
- A value of 60.5 dB(A) shall be reported as 61 dB(A)
- A Category B location value of 65.5 dB(A) is reported as 66 dB(A) and is reported as a noise impact (approaching 67 dB(A))

In FHWA TNM calculations, noise level values are calculated to tenths of decibels. When *reporting* insertion losses (I.L.) or existing, "no-build," or "build" alternative noise levels, they shall be reported as whole numbers. When *calculating* barrier I.L. or comparing existing, "no-build," or "build" alternative noise levels, use the "tenth" values to calculate the I.L. or comparison values and then round the results. Some examples are presented below.

a. Existing level = 56.9 dB(A), shall be reported as 57 dB(A)
b. Future "No-Build" Alternative level = 64.5 dB(A), shall be reported as 65 dB(A)
c. Future "Build" Alternative (no barrier) level = 65.5 dB(A), shall be reported as 66 dB(A)
d. Future "Build" Alternative (with barrier) = 55.9 dB(A), shall be reported as 56 dB(A)
e. "Build" Alternative increase over existing = c – a = 65.5 dB(A) – 56.9 dB(A) = 8.6 dB(A), shall be reported as 9 dB(A)
f. "Build" versus "No-Build" = c – b = 65.5 dB(A) – 64.5 dB(A) = 1.0 dB(A), shall be reported as 1 dB(A)
g. Barrier Insertion loss (I.L.) = c – d = 65.5 dB(A) – 55.9 dB(A) = 9.6 dB(A), shall be reported as 10 dB(A)
h. At times, there may be discrepancies in the *reported* data resulting from rounding to whole numbers: 65.4 rounds to 65, but 60.6 rounds to 61; this would appear to be only a 4 dB reduction, but it is actually 4.8 which rounds to 5. In this case, the insertion loss shall be *reported* as 5 dB(A).

Note: Rounding errors are to be identified by footnote.

This process ensures that all noise levels, insertion losses, and comparisons are calculated using the actual FHWA and/or monitored values prior to rounding. To explain any "perceived inconsistencies" resulting from the rounding process, include a statement as a note to the appropriate report tables indicating that "noise values, comparisons, and insertion losses are calculated to the tenth of a dB(A) and then rounded for presentation purposes."

6.4.6 Determining Existing Worst Noise Hour(s)

Once the model is validated, the noise analyst must develop an existing worst noise hour TNM model to predict existing worst noise hour noise levels within the project area. This is required to comply with FHWA and VDOT policy, which requires existing conditions to serve as a comparable basis for the future conditions. An existing worst noise hour TNM model is developed by replacing the traffic data observed during the monitoring phase with existing worst noise hour traffic data provided by the project traffic engineers, and applying these data to the existing roadway geometry.

This step is important because noise monitoring represents a "snap-shot" in time and may not necessarily represent the existing worst noise hour levels. The computed existing worst noise hour levels then serve as a basis for the VDOT "substantial increase" noise abatement criterion. However, in areas dominated by background noise levels from non-roadway sources, noise levels cannot be computed accurately, and the monitored noise levels must be used to best represent the existing noise environment.

6.4.7 Future "No-Build" Conditions

The noise modeling process continues with the development of the future "no-build" noise model. The "no-build" noise model is a representation of the existing roadway network that accounts for natural traffic growth through the design year of the project. This step considers future "no-build" traffic projections on the existing roadway network with no project-related improvements in place. This step allows for a comparison of "no-build" noise levels to "existing" and "build" noise levels associated with a highway improvement project in accordance with NEPA requirements.

On some projects, the future "no-build" conditions may be somewhat different from the existing conditions. For example, roadway improvements within the project corridor may have been approved prior to the current project under study or noise barriers may have been approved for construction in the corridor in connection with a prior traffic noise study. In these circumstances, the conditions that are expected to be present in the design year, without the current project, shall be included in the noise model.

Note – "No-Build Noise Levels": "No-Build" noise levels are not required for a categorical exclusion (CE) or environmental assessment (EA) unless the project is related to the interstate system or a "constructive use" 4(f) determination has been made. "No-Build" noise levels are required for an environmental impact statement (EIS).

6.4.8 Future "Build" Conditions

The final step of the noise impact modeling process (before abatement modeling) is the development of the future design year "build" conditions noise model which must comply with 23 CFR Part 772.13(g)(3). This assessment can include one or more "build" alternatives, depending on the magnitude of the transportation project and the type of environmental document (i.e., CE, EA, or EIS). Typically, CE assessments present one "build" alternative, EA documents present one or multiple "build" alternatives, and EIS documents present multiple "build" alternatives. When multiple "build" alternatives are presented in an environmental document, noise levels, noise impacts, and potential noise abatement measures for each "build" alternative must be documented to the same level of detail.

In areas that contain noise-sensitive receptors, noise modeling should be detailed enough to thoroughly evaluate whether noise abatement is warranted, feasible and reasonable (see Section 7.0). Future condition noise modeling is an evolving process, and noise model refinements are typically necessary throughout the process to determine the extent of noise impact, the number of impacted receptors, the effectiveness of noise abatement, and the number of benefited receptors.

Additional modeling sites are often added throughout the modeling process to clearly define the extent of noise impact, the number of impacted receptors, and the number of benefited receptors.

The FHWA/VDOT noise abatement criteria are discussed in detail in the following sections of this document.

7.0 Determining Highway Traffic Noise Impacts and Establishing Abatement Requirements

7.1 Criteria for Detailed Highway Traffic Noise Abatement Measures

Objectivity and flexibility are important elements of good highway traffic noise abatement decision-making criteria and procedures. The criteria and procedures should be objective enough to be quantifiable. They should also be flexible enough to allow the decision-makers to make meaningful judgments on a project-by-project basis.

As stated in Section 2.0 of this Manual, it is VDOT's policy to implement noise abatement measures when they are determined to be warranted, feasible, and reasonable. The parameters addressed in this section should be assessed to determine whether noise abatement measures meet these three criteria (warranted, feasible, and reasonable). The decision to recommend or not recommend a highway traffic noise abatement option(s) should be based on the collective consideration of all of the parameters, not any one parameter alone. This allows for the identification of the overall benefits, including the effect of abatement on social, economic, and environmental factors.

Note – Use Total Noise Level Values when Comparing to NAC Values: When comparing predicted existing, future "no-build," and future "build" noise levels to the Noise Abatement Criteria (NAC) values, it is essential that the prediction of noise levels considers not just the noise level values associated with the proposed transportation improvement(s) but also considers and includes, as appropriate, noise from all normally occurring activities within the area. Noise from other roadways, other transportation facilities (railways, airports, etc.), industrial, commercial, recreational activities, etc., should be documented, as appropriate. While the total noise level from the combination of all noise sources in an area may result in the noise level exceeding the NAC (and thus a noise impact exists in the area), non-project-related noise sources (if substantial noise contributors) are generally not considered when determining whether project noise abatement is warranted, feasible, and/or reasonable. Contact VDOT Noise Abatement Staff for additional project-specific guidance.

7.2 Highway Traffic Noise Abatement Measures

The following abatement measures, from 23 CFR Part 772.15(c), should be considered when analyses indicate that the transportation project will have noise impacts on sensitive noise receptors.

1. Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Landscaping is not a viable noise abatement measure.
2. Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
3. Alteration of horizontal and vertical alignments.
4. Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. This measure may be included in Type I projects only.
5. Noise insulation of Activity Category D land use facilities listed in ***Table 1***. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

Note – The acquisition of property rights, within or outside of the right-of-way will be evaluated on a case by case basis. A final determination in regard to the feasibility of the acquisition of property rights will be made during the Final Design Noise Analysis, although the need to acquire right-of-way shall not typically be used as a means to avoid noise mitigation. During the preliminary noise analysis, the technical report shall identify any potential need for right-of-way in regards to proposed noise mitigation features. The design project manager shall be notified upon completion and approval of the analysis.

Note –Noise insulation or acquisition of buffer property shall not be considered without prior coordination with VDOT Noise Abatement Staff and FHWA. This coordination shall occur prior to any communications with the public.

Note – Neighborhood Continuity: Noise impacts beyond 500 feet from the roadway and the project area will not be considered in determining the need for noise abatement. However, if neighborhood continuity is required, noise mitigation shall be designed with logical termini using sound engineering practices.

Section 33.1-223.2:21 (Effective October 1, 2014 Title § 33.2-276) of the *Code of Virginia* requires VDOT to consider other mitigation measures besides noise barriers as part of its project development processes. This mandate is expressed in the State Noise Abatement Policy which states: "*Whenever the Commonwealth Transportation Board or the Department plan for or undertake any highway construction or improvement project and such project includes or may include the requirement for the mitigation of traffic noise impacts, first consideration should be given to the use of noise reducing design and low noise pavement materials and techniques in lieu of construction of noise walls or sound barriers. Vegetative screening, such as the planting of appropriate conifers, in such a design would be utilized to act as a visual screen if visual screening is required.*"

Note: VDOT is not authorized by the FHWA to use "quiet pavement" as a form of noise mitigation at this time.

Note: According to the FHWA vegetation is not allowed to be used as a means of noise abatement for projects subject to the provisions of 23 CFR Part 772. The FHWA takes this approach because studies have shown that vegetation must be a minimum of 100 feet thick, a minimum of 20 feet high and sufficiently dense (100% opacity) to provide a 5dB(A) noise reduction. However, vegetation may serve as a good visual screen for locations where abatement is not feasible or reasonable. States may use Federal-aid funds for vegetation near barriers or for landscaping near roadsides for aesthetic and visual purposes, but landscaping does not provide noise abatement.

7.3 Noise Abatement Determination

Noise Abatement Determination is a three-phased approach.

1. Do the sensitive receptors **warrant** highway traffic noise abatement consideration?
2. Is it **feasible** to provide highway traffic noise abatement from an engineering and acoustical standpoint?
3. Is it **reasonable** from a maximum ft^2/benefited receptor standpoint to provide highway traffic noise abatement?

Note – Three-Phased Approach to Noise Abatement Determination: Noise abatement design is driven by the results of the noise analysis (i.e., establishment of warrants). All warranted receptors must progress to the "feasible" phase. All feasible noise barriers, regardless of the number of receptor units benefited, must then progress to the "reasonable" phase. Following the completion of all three phases, a determination can be made related to the feasibility and reasonableness of noise abatement options.

Note – Non-Barrier Abatement Measures: While noise barriers (walls and/or berms) are by far the most common forms of highway noise abatement, the "non-barrier" abatement measures listed in Section 7.2 should also be evaluated in terms of their feasibility and, if feasible, their reasonableness. In most cases, such evaluations can be documented by a qualitative discussion. If a more detailed evaluation is necessary, contact VDOT Noise Abatement Staff for guidance.

The three-phased approach to considering noise abatement and determining the feasibility and reasonableness of noise barriers is discussed below in detail.

7.3.1 Phase 1 – Warranted Criterion

This first phase of the process is to determine if highway traffic noise abatement consideration is warranted for the affected communities and/or the affected receptors. As described in 23 CFR Part 772.11(e) and (f) respectively: *a highway agency shall establish an approach level to be used when determining a traffic noise impact. The approach level shall be at least 1 dB(A) less than the Noise Abatement Criteria for Activity Categories A to E listed in Table 1* and *shall define substantial noise increase between 5 dB(A) to 15 dB(A) over existing noise levels. The substantial noise increase criterion is independent of the absolute noise level*.

Note – No Highway Traffic Noise Impact: If there are no highway traffic noise impacts (i.e., predicted highway traffic noise impacts do not approach or exceed the levels in Table 1 or show a substantial increase over existing highway traffic noise) at a receptor, consideration of the feasibility and reasonableness of noise abatement is not required for that receptor, even though that receptor may receive some benefit from noise abatement constructed to protect nearby impacted receptor(s).

It is important to note that the FHWA noise abatement criteria (***Table 1***) refer to absolute noise levels for certain areas' activity categories. In order to make a determination that a noise impact exists, one of the following conditions must be met:

1. Predicted highway traffic noise levels (for the design year) approach or exceed the highway traffic noise abatement criteria in ***Table 1***. "Approach" has been defined by VDOT as 1 dB(A) below the noise abatement criteria.

2. A substantial noise increase has been defined by VDOT as a 10 dB(A) increase above existing noise levels for all noise-sensitive exterior activity categories. A 10 dB(A) increase in noise reflects the generally accepted range of a perceived doubling of the loudness. Receptors that satisfy this condition warrant consideration of highway traffic noise abatement.

7.3.2 Land Use Activity Category A

Highway traffic noise abatement shall be considered whenever the exterior design year predicted noise levels approach or exceed 57 dB(A) (Leq). Lands that have been analyzed as Activity Category A receptors include: 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 for the area to continue to serve its intended purpose. Highway agencies shall submit justifications to the FHWA on a case-by-case basis for approval of an Activity Category A designation.

A test for meeting Activity Category A designation is presented below. In order to meet the requirements for Activity Category A designation, evaluate the site and related activity in accordance with, and in compliance with, the questions and answers below and answer all of the following questions in the affirmative:

Serenity and Quiet Question: Is the site currently serene and quiet?

- Yes, if the current Leq noise level does not approach or exceed the Activity Category A Noise Abatement Criterion (NAC) during any period when serving its intended purpose.
- No, if the current Leq approaches or exceeds the Category A NAC during any period when serving its intended purpose.

Public Need Question: Does the site currently serve an important public need?

- Yes, if there is an important benefit of the public visiting or using the site due to its historical, religious, cultural, or natural significance.

- No, if there is no benefit.

Intended Purpose Question: Is the preservation of serenity and quiet essential to serve the site's intended purpose?

- Yes, if the intended use of the site in the future (design year) will continue to have historical, religious, cultural, or natural significance.
- No, if the current intended purpose of the site will change in the future in a manner that will not require serenity and quiet.

Frequent Human Use Question: Is the site frequently used (or frequently available for use) by the public?

- Yes, if the public can access the site during all times when it is available and able to serve its intended purpose. NOTE: The owner of a site may limit the number of visitors at a given time in order to conserve the site's serenity and quiet.
- No, if, with the exception of limits of usage established to maintain a site's serenity and quiet, the public is restricted from using the site during certain periods when the site is still available to serve its intended purpose.

Determination: If the answers to ALL of the above questions are yes, VDOT shall send supporting documentation to the FHWA Division Office and participate in any necessary additional coordination with FHWA staff to finalize the eligibility determination. If the answer(s) to any of the above questions is no, VDOT must include this information in the project's noise documentation in accordance with VDOT's noise policy and send the documentation to the FHWA Division Office as required by the FHWA noise regulation and/or VDOT's noise policy.

7.3.3 Land Use Activity Category B

Highway traffic noise abatement shall be considered for single-family and multifamily residences whenever the exterior design year predicted noise levels approach or exceed 67 dB(A) (Leq).

Note – As noted below in Section 7.3.10.2 the maximum height of a noise barrier is 30 feet. For multi-story multi-family residences the noise analyst shall draw a horizontal line from the top of the noise barrier directly to the multi-story unit and analyze the receptors from the point of intersection and below.

Note – For a single impacted Category B receptor please refer to Appendix H for the evaluation methodology.

7.3.4 Land Use Activity Category C

Highway traffic noise abatement shall be considered for 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 structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings whenever the design year predicted noise levels approach or exceed 67 dB(A) (Leq). The definition of a trail is provided at 23 USC 206 (a) (2) (A-F).

Note – If an impact to an exterior use is identified, use the formula presented in Appendix E to determine reasonableness.

Note – Campgrounds that supply electricity and potable water are considered recreational facilities.

Note – For golf courses, only tee boxes and greens are considered to be exterior areas where frequent human use would occur. As such, only these areas shall be subject to the formula presented in Appendix E to determine reasonableness.

Note – Category C Activities present within a Category E land use would be considered Category E Activities. For example, hotel pools are considered Category E receptors. When a hotel pool is present within a project corridor, use the formula presented in Appendix E to determine reasonableness.

Note – Pools are to be analyzed differently depending on their use and association with Category B Receptors. When a public pool is present within a project corridor, use the formula presented in Appendix E to determine reasonableness. When a pool is associated with multi-family dwelling units the noise analyst shall determine if the residential units have individual outdoor activities. If individual activities are present assign one receptor to the pool to determine reasonableness. If no individual activities are present, use the formula presented in Appendix E to determine reasonableness.

Note – When Shared Use Paths and/or Multi-Use Paths are identified within a project corridor they are to be treated as transportation related land uses. However, if the path is publicly owned and is part of or planned as part of a designated and maintained recreational trail system, use the formula presented in Appendix E to determine reasonableness.

7.3.5 Land Use Activity Category D (Interior)

This activity category includes the interior impact criteria for certain land use facilities listed in Activity Category C that may have interior uses. A highway agency shall conduct an indoor analysis if a determination is made that exterior abatement measures will not be feasible and reasonable. An indoor analysis may only be done after exhausting all outdoor abatement options. In situations where no exterior activities are to be affected by the traffic noise, or where the exterior activities are far from or physically shielded from the roadway in a manner that prevents an impact on exterior activities, the highway agency shall use Activity Category D as the basis of determining noise impacts.

Highway traffic noise abatement shall be considered for auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit

institutional structures, radio studios, recording studios, schools, and television studios whenever the design year predicted noise levels approach or exceed 52 dB(A) (Leq).

Note –Interior noise levels shall be reported for all Activity Category D land use facilities. Exterior noise levels should be identified at the receptor's exterior wall nearest to the roadway, and then subtract the appropriate decibel level as identified in Table 6 of the FHWA Highway Traffic Noise: Analysis and Abatement Guidance[3] *(December 2011). If indoor impacts are identified and exterior mitigation is not feasible or reasonable, then an indoor monitoring analysis shall be initiated. The type and duration of the monitoring shall be determined on a case-by-case basis. Consult VDOT Noise Abatement Staff prior to conducting any indoor monitoring or analysis.*

Note – VDOT will only consider noise abatement for Activity Category D land uses (listed in ***Table 1)*** *that are found to have interior noise impacts.*

Note – Soundproofing for Category D receptor units that would experience exposure to higher absolute highway traffic noise levels as a result of the proposed transportation improvement project will only be considered after all feasible or reasonable measures to abate exterior noise levels have been exhausted. These issues will be dealt with on a case-by-case basis.

7.3.6 Land Use Activity Category E

This activity category includes the exterior impact criteria for developed lands that are less sensitive to highway noise. Highway traffic noise abatement shall be considered for hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in Activity Categories A, D or F whenever the exterior design year predicted noise levels approach or exceed 72 dB(A) (Leq).

Note – For Activity Category E, if exterior areas of frequent human use are identified and noise mitigation is feasible and reasonable, owners of these establishments will be contacted to ascertain their desire to have a noise barrier constructed. Only one receptor per unit will be assigned to determine reasonableness. However, if Category E receptors are part of a CNE the desires of the all receptors will be handled on a case-by-case basis. Consult VDOT Noise Abatement Staff for guidance.

7.3.7 Land Use Activity Category F

This activity category includes developed lands that are not sensitive to highway traffic noise. There are no impact criteria for the land use facilities in this activity category and no analysis of noise impacts is required. Activity Category F includes: 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.

[3] Available for download at https://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/.

7.3.8 Land Use Activity Category G

This activity category includes undeveloped lands that may be sensitive to highway traffic noise. During the noise analysis process it shall be determined if undeveloped land is permitted for development. The date of issuance of a building permit by the local jurisdiction or by the appropriate governing entity is the milestone establishing when undeveloped land is considered permitted.

If undeveloped land is determined to be permitted, then the highway agency shall assign the land to the appropriate Activity Category and analyze it in the same manner as developed lands in that Activity Category.

If undeveloped land is not permitted for development by the "date of public knowledge" as define in Section 10.2, the highway agency shall determine noise levels in accordance with 23 CFR Part 772.17(a) and document the results in the project's environmental clearance documents and noise analysis documents. Federal participation in noise abatement measures will not be considered for lands that are not permitted by the date of public knowledge.

Note – Undeveloped land determination: The noise analyst or document writer shall contact, in writing, each locality in which a particular project is located, for determination of any recent permitted development.

7.3.9 Phase 2 – Feasibility Criteria for Noise Barriers

To determine feasibility of a highway traffic noise barrier, the following two conditions shall be considered:

(1) at least a 5 dB(A) highway traffic noise reduction at impacted receptors. Per 23 CFR Part 772 FHWA requires the highway agency to determine the number of impacted receptors required to achieve at least 5 dB(A) of reduction. VDOT requires that fifty percent (50%) or more of the impacted receptors experience 5 dB(A) or more of insertion loss to be feasible; and;

(2) the determination that it is possible to design and construct the noise abatement measure. The factors related to the design and construction include: safety, barrier height, topography, drainage, utilities, and maintenance of the abatement measure, maintenance access to adjacent properties, and general access to adjacent properties (i.e. arterial widening projects).

Note – Accepted engineering practices shall be exercised when considering the factors associated with the design and construction of a noise abatement measure. All conflict(s) must be analyzed thoroughly and documented before a determination is made.

Note – For multistory units with individual outdoor usage such as balconies and patios; only noise sensitive sites that meet the point of intersection and below shall be considered for the feasibility criterion.

7.3.10 Phase 3 – Reasonableness Criteria for Noise Barriers

A determination of noise barrier reasonableness will include the consideration of the parameters listed in the following subsections. The parameters used during the NEPA process are also used during the Final Design Phase when making a determination of noise barrier reasonableness. When performing a reasonableness analysis for the NEPA document, some parameters (e.g., desires of the impacted community) will not yet be quantifiable. Questions relating to these parameters shall be answered in the Warranted, Feasible, and Reasonable Worksheets in order to determine the proposed noise barrier's reasonableness.

Note – All of the reasonableness factors listed below must collectively be achieved in order for a noise abatement measure to be deemed reasonable.

Note – Noise barriers cannot be combined for the sole purpose of making the barriers cost effective. However, individual noise barriers that are shown to provide feasible noise mitigation interdependently may be combined and evaluated as a "noise barrier system".

7.3.10.1 Viewpoints of the benefited receptors.

The FHWA highway traffic noise regulation requires VDOT to consider the viewpoints of the benefited receptors in determining the reasonableness of noise abatement. A final survey and determination shall occur after the approved final design noise analysis; however, comments will be considered throughout the entire design process.

VDOT shall solicit the viewpoints of all benefited receptors through certified mailings and obtain enough responses to document a decision as to whether or not there is a desire for the proposed noise abatement measure. Fifty percent (50%) or more of the respondents shall be required to favor the noise abatement measure in determining reasonableness.

Note – A weighting system shall be applied to the votes. See Section 12.4 for more details.

Note – A second solicitation may be required depending on the results of the first solicitation. See Section 12.4 for more details.

Note – Proof of mailing, such as digital copies of the certified mailing receipt that clearly shows the address mailed (i.e., green cards), shall be included in an appendix of all final design noise analyses.

7.3.10.2 Cost-effectiveness

Cost of an abatement measure is an important consideration but only one of a number of factors to consider. The FHWA allows VDOT to consider the actual construction cost of noise abatement, cost per square foot of abatement, the maximum square footage of abatement/benefited receptor or either the cost/benefited receptor or cost/benefited receptor/dB(A) reduction.

VDOT's noise barrier cost effectiveness value is based upon a Maximum Square Footage of Abatement per Benefited Receptor (MaxSF/BR) value of 1,600. This MaxSF/BR criterion shall be applied statewide as part of the noise barrier reasonableness determination process for all Type 1 projects. It replaces the previously used "Cost per Benefited Receptor" criteria.

Note – Maximum allowable square footage per benefited receptor unit: The results of the noise analysis will determine if a noise barrier is feasible. If a noise barrier is determined to be feasible, the maximum allowable square footage per benefited receptor unit should be applied. Although 1,600 square feet per benefited receptor unit is the allowable upper limit in the reasonableness determination, an optimized noise barrier may be much less than 1,600 square feet per protected benefited receptor. The 1,600 square feet per benefited receptor figure is not a design goal or an allocation.

Note – The maximum allowable height of a noise barrier shall be 30 feet. The height restriction was established by reviewing Table 12 of the FHWA national noise barrier inventory[4]*. Table 12 indicates a significant increase in cost for barriers greater than 30 feet in height. The cost more than doubles when compared to the average cost to construct noise barriers in Virginia.*

Note – For multistory units with individual outdoor usage such as balconies and patios; only noise sensitive sites that meet the point of intersection and below shall be considered for the reasonableness criterion.

Note – The reasonableness of a berm should be determined on a case-by-case basis. Consult VDOT Noise Abatement Staff for guidance.

Note – The reasonableness calculation for Category C and D receptors can be found in Appendix E.

7.3.10.3 Noise Reduction Design Goals

The design goal is a reasonableness factor indicating a specific reduction in noise levels that VDOT uses to identify that a noise abatement measure effectively reduces noise. It is a comparison of the design year noise level with the abatement measure to the design year noise level without the abatement measure. The design goal establishes a criterion, selected by VDOT, that noise abatement must achieve. The design goal is not the same as acoustic feasibility, which is the minimum level of effectiveness of a noise abatement measure. Acoustic feasibility indicates that the noise abatement measure can, at a minimum, achieve a discernible reduction in noise levels.

As required by FHWA, VDOT shall define the design goal of at least 7 dB(A) but not more than 10 dB(A), and shall define the number of benefited receptors that must achieve this design goal.

VDOT's design goal is 7 dB(A) of insertion loss for at least one impacted receptor.

[4] Available at https://www.fhwa.dot.gov/Environment/noise/noise_barriers/inventory/summary/index.cfm.

Note – Analyzing Common Outdoor Use Activities for Apartment, Condominium, and Single/Multi-Family Units: Because apartment and condominium buildings often share common outdoor use activities, it may be difficult to determine and analyze impacts and benefits. Professional judgment should be used and VDOT Noise Abatement Staff should be consulted when such difficulties arise in the project area. When analyzing an impacted or benefited apartment or condominium building where outdoor activity areas are available, each residential unit on each residential floor within that impacted or benefited building shall be considered a receptor unit and included in the allowable cost analysis of the noise barrier. For example, a benefited apartment building with 6 residential units on each of its 5 floors would have 30 receptor units in the allowable cost analysis for that noise barrier for the common outdoor activity (consider legal capacity). Each single-family dwelling unit should be considered as one receptor unit regardless of the house or lot size. Professional judgment should be used in determining the presence and location of outdoor activity areas for both apartments/condominiums and single-family dwellings. For example, the land use in question is residential and has an elevated deck and a swing set facing the noise source. The analyst is to consider both the yard and the deck and only consider the worst-case noise scenario for that receptor. Then, the analyst is to only report the worst-case noise levels for that receptor.

7.3.10.4 Category C Land Use Activity Areas

Within Activity Category C, there are several activities that require different analysis methods to quantifying the number of receptor units for these land use.

Some Category C land use activity areas may be considered of higher value than others. The value placed on an area is subjective and can include such factors as frequency of use and public opinion. The context and intensity of the land use should be considered. In cases where a high value is placed on such an area, it can be desirable to apply a quantification formula to help determine the reasonableness of providing mitigation for the area. This quantification formula is designed to more equitably assess special land use areas and provide the practitioner with a standard method of evaluation. The methodology and formula for calculating cost effectiveness for abatement of special activity areas is presented in Appendix E.

Note – Public Parks: A highway traffic noise impact on a public park, picnic area, recreation area, or playground may result in a constructive use of a Section 4(f) property determination. Refer to Section 12 – Public, Locality, and Agency Involvement and Section 13 – Reporting Results of Highway Traffic Noise Analyses for further details on the public input process and documentation requirements of public parks, picnic areas, recreation areas, and playgrounds.

8.0 Completing the Warranted, Feasible, and Reasonable Worksheets

After the warranted, feasible, and reasonable analysis is completed, the rationale for the areas where noise mitigation is warranted must be documented in a Warranted, Feasible, and Reasonable Worksheet for that CNE/partial CNE. It may be appropriate and necessary to

prepare a separate worksheet for each noise barrier or each noise barrier system associated with a CNE(s), particularly if more than one noise barrier has been developed for a CNE or a noise barrier is designed to protect multiple CNEs. As stated in Section 2.0 Policy Statements of this Manual, it is VDOT's policy that the final decision on the implementation of highway traffic noise abatement measures is made only after careful and thorough consideration of the warrants, feasibility, and reasonableness of proposed highway traffic noise abatement measures.

A Warranted, Feasible, and Reasonable Worksheet (Appendix F) shall be completed for each noise-impacted area that warrants highway traffic noise abatement consideration in accordance with VDOT and FHWA guidelines. The analyst should begin obtaining information for the worksheets during the Environmental Phase of the preliminary design process. The worksheets must be finalized prior to completion of the Final Design Highway Traffic Noise Report so that final approval can be given by FHWA during its review. A copy of this worksheet is included in Appendix F. These worksheets will become part of the permanent project file and must be considered as important decision-making documents that are preserved.

Note – Documentation of the Warranted, Feasible, and Reasonable Worksheets: The worksheet associated with each CNE proposed noise barrier or noise barrier system must be incorporated into the final design document. These worksheets will document, within the administrative record, the warrants, feasibility, and reasonableness of providing highway traffic noise abatement measures for the proposed transportation improvement project.

9.0 Highway Traffic Noise Barrier Design: Commitments

9.1 Highway Traffic Noise Barrier Goals (Barrier Optimization)

It is important to optimize the noise barrier design to achieve the most effective noise barrier in terms of both noise reduction (insertion losses) and cost. Although at least a 5 dB(A) reduction at 50% or more of the impacted receptors is required to meet the feasibility criteria, the following tiered noise barrier abatement goals should be used to govern barrier design and optimization.

1. Reduction of future highway traffic noise by 7dB(A) at one (1) or more of the impacted receptor sites (required criterion).
2. Reduction of future highway traffic noise levels to the low-60-decibel range when practical (desirable).
3. Reduction of future highway traffic noise levels to existing noise levels when practical (desirable).

Note – Barrier Optimization: Similar to other environmental mitigation features, the goal to noise abatement is to achieve 100% effectiveness, i.e., provide benefits to every impacted noise sensitive receptor. However, it is not always possible to benefit every impacted receptor for various reasons. Therefore, when optimizing the proposed noise barrier, the three-tier set of abatement goals should be evaluated, when practical, in terms of establishing noise reductions for benefited receptors only within their areas of frequent outdoor activity to maximize the

design year acoustical environment. The relationship between noise barrier cost and noise barrier performance is non-linear. This means that noise benefits typically increase with increased barrier height and/or length; however, at some point, further increases in barrier height and/or length result in smaller and smaller increases in benefit until a point of diminishing returns is reached. A point can be identified where a potential noise barrier provides the best balance between cost and benefit. Final design noise barriers should seek to maximize benefits while minimizing cost, given the need to achieve predetermined design goals and maintain noise barrier feasibility and reasonableness.

Note – As defined by 23 CFR Part 772 a benefitted receptor is the recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dB(A), but not to exceed the highway agency's reasonableness design goal.

Note – As part of the barrier optimization process, it is desirable that noise mitigation block the line-of-sight between roadway vehicles and impacted receptors, since blocking the line-of-sight between the source and receptor will typically provide a 5 dB(A) noise reduction.

9.1.1 Highway Traffic Noise Abatement Commitments

Highway traffic noise abatement commitments are made at two points in a project's development: the NEPA process and the Final Design Phase.

1. **Preliminary Design/NEPA Document**: Before adoption of the NEPA document, the noise analysis shall identify highway traffic noise abatement measures for each impacted location where such measures are warranted, feasible, and reasonable. At the time that the NEPA document is being finalized, noise studies will have progressed to the stage where noise-impacted areas have been identified. At this stage, it is unlikely that the exact barrier dimensions, location, right-of-way requirements, etc. can be determined. However, approximate barrier location and height information should be known and provided. A statement of likelihood shall be included in the environmental document since feasibility and reasonableness determinations may change due to changes in project design after approval of the environmental document. The statement of likelihood shall include the preliminary location and physical description of noise abatement measures determined feasible and reasonable in the preliminary analysis. The statement of likelihood shall also indicate that final recommendations on the construction of an abatement measure(s) are determined during the completion of the project's final design and the public involvement processes.

2. **Final Design**: During the Final Design Phase, the exact location, abatement types, aesthetic treatments, right-of-way requirements, etc. should be determined and included in the final recommendation for highway traffic noise abatement. A detailed discussion for each recommended noise barrier should be presented in the Final Design Highway Traffic Noise Report.

9.1.2 Abatement Measure Reporting

23 CFR Part 772.13(2)(f) requires that each highway agency shall maintain an inventory of all constructed noise abatement measures and requires that the inventory shall include the following parameters: type of abatement; cost (overall cost, unit cost/ft^2); average height; length; area; location (State, county, city, route); year of construction; average insertion loss/noise reduction as reported by the model in the noise analysis; NAC category(s) benefited; material(s) used (precast concrete, berm, block, cast in place concrete, brick, metal, wood, fiberglass, combination, plastic (transparent, opaque, other); features (absorptive, reflective, surface texture); foundation (ground mounted, on structure); project type (Type I, Type II, and optional project types such as State funded, county funded, tollway/turnpike funded, other, unknown). The FHWA will collect this information, in accordance with the Office of Management and Budget (OMB's) Information Collection requirements.

In order to collect this information the Department requires the developer of noise analyses to furnish dimensions of all noise barriers that have been approved for construction and have received a favorable number of votes based the noise barrier survey responses. Specifically, the northings, eastings, bottom / top of wall elevations, and the information required for 23 CFR Part 772.13(2)(f), as stated above, shall be provided in either text (.csv or .xls) or shapefile (.shp) format.

10.0 Additional Considerations for Final Design Highway Traffic Noise Barrier Analysis

10.1 Final Design Considerations and Measures

A project may require a final design noise study depending on the extent of noise impacts, the likelihood that abatement will be provided, and the potential for design changes that affect the noise analysis results and findings of the NEPA study. The majority of Type I projects should proceed to a final design noise study to ensure that design changes do not alter the impacts. In addition, land use changes may preclude a barrier’s construction, as when land is converted from residential to commercial, or create the need to consider a barrier that was not evaluated in the NEPA phase, as when a new residential development meets the "Date of Public Knowledge" test (Section 10.2).

The level of effort required for the final design noise study should be commensurate with the potential for design change, land use modifications, and impact severity/abatement potential as outlined in the NEPA documents. For projects that identify noise-impacted sites that clearly will not be eligible for mitigation (e.g., roadway widening where driveway access precludes barrier construction), the final design analysis may consist of a qualitative analysis referencing the preliminary design noise study and documenting that its results remain valid. The majority of final design noise assessments will involve a detailed reanalysis of the project using additional noise measurements (depending on the level of the monitoring effort during the NEPA study),

modeling using refined engineering, and public involvement activities and concurrence from the VDOT Chief Engineer and FHWA.

During the Final Design Phase, highway traffic noise abatement shall be reconsidered in light of more exact designs and refined project alignment, reanalysis of the roadway/noise receptor relationships, and expanded community input.

A highway traffic noise analysis conducted during the Final Design Phase shall primarily be concerned with abatement of noise impacts identified during the Preliminary Design Phase. The goals of a final design noise analysis are to:

- determine if any warranted highway traffic noise abatement measures are feasible and reasonable;
- determine the desires of the benefited receptor unit(s); and
- incorporate appropriate aesthetic treatments.

The first step in the refinement process for final design abatement shall be a review of the highway traffic noise analysis project file. Close attention should be paid to the public coordination and comments received during the Preliminary Design Phase, particularly in areas where abatement is warranted. When final alignment limits are set, the final design study should commence according to the procedures set forth in this Manual. A draft version of the Final Design Highway Traffic Noise Report shall be compiled and submitted to VDOT Noise Abatement Staff for review and comment, who will then submit the final approved report to FHWA for their concurrence. Once FHWA concurrence is received, the final public meetings and/or surveys can proceed where barrier options and recommendations are presented.

If requested by the public, preliminary coordination with the public may be conducted at a public meeting/community information meeting (CIM) after receiving FHWA's concurrence with the draft version of the Final Design Highway Traffic Noise Report. If the benefited receptors accept the highway traffic noise abatement recommended by VDOT, the process proceeds to the conceptual design stage where the type, size, and location of highway traffic noise abatement will be determined through an iterative process involving the community and VDOT. After the benefited receptors accept the final highway traffic noise abatement design, noise abatement proceeds to the Plans, Specifications and Estimates (PS&E) and construction phases.

Note – Final Design Refusal of the Proposed Noise Barrier: During the public input process, the benefited receptors have the option of refusing highway traffic noise abatement, at which time the decision is documented in the Final Design Highway Traffic Noise Report and the process ends. The benefited receptors' decision is considered final and the community will not be eligible for mitigation again until a future Type I project is considered.

If, as a result of refined engineering, the project limits become extended, the noise-sensitive receptors within the extended areas need to be assessed for highway traffic noise impacts. The justification for extending the project limits must be discussed in the Final Design Highway Traffic Noise Report and coordinated with FHWA for purposes of NEPA. If a neighborhood

extends 500 feet beyond the revised construction limits, neighborhood continuity should be considered using accepted engineering practices in determining the final terminus for purposes of assessing noise.

Noise abatement will not be considered for noise-sensitive receptors where there is no traffic noise impact from the project.

10.2 Date of Public Knowledge

To be eligible for abatement consideration during the Final Design Phase, developed and undeveloped lands are required to have been "permitted" by the "Date of Public Knowledge." The evaluation, design, and/or construction of noise abatement, if any, after this date become the responsibility of the localities, communities and private developers until VDOT considers highway noise abatement as part of a subsequent Type I project.

The "Date of Public Knowledge" and a thorough discussion of undeveloped lands that are and are not considered to be "permitted" must be documented within the text of the Highway Traffic Noise Report. This is in addition to the documentation required on the Warranted, Feasible, and Reasonable Worksheets.

If FHWA determines that a project change warrants a re-evaluation of the NEPA document, then the Date of Public Knowledge may coincide with the date of FHWA's new NEPA decision. Consult VDOT Noise Abatement Staff for additional guidance.

10.3 Desires of Those Individuals Impacted by Highway Traffic Noise

During the Final Design Phase, it is extremely important to determine if 50% or more of the owners and residents of benefited receptor units desire the noise barrier. Certified letters should be sent only to the owners and residents of the properties that were determined to be benefited by the proposed barrier. Any receptor unit owner opposed to the proposed noise barrier must submit a signed letter or indicate on the voting survey form his/her opposition to the proposed noise barrier. This will serve as an indication that he/she thoroughly understands that there will be future noise impacts and that, if a noise barrier is declined by the community at this time, a noise barrier will not be built in the area unless another Type I project occurs in the future. The results of this survey and any supporting letter(s) must be documented in the Final Design Highway Traffic Noise Report and in the project file.

Details of community voting procedures on noise barrier preferences are discussed in Section 12.4 – Voting Procedures.

10.4 Applications for Absorptive Noise Barriers

Depending on the specifics of the transportation improvement project, absorptive noise barrier surfaces may be recommended to optimize the benefits of the proposed highway traffic noise abatement. Cases where it may be appropriate to consider noise barrier panels with absorptive

surface(s) include: a parallel noise barrier system; presence of an extremely sensitive receptor(s) on the side opposite the highway from the proposed noise barrier; presence of a retaining wall with a reflective surface on the side opposite the highway from the proposed reflective-surfaced noise barrier; presence of impacted receptors on the side opposite the highway for whom a noise barrier was not determined to be feasible or reasonable; and a bifurcated highway system. The items below outline the process for determining whether an absorptive material will be used in noise barrier construction.

- If parallel noise barriers are greater than 20 times the height in distance, reflective barriers will be used. If parallel noise barriers are less than 20 times but greater than 10 times the height in distance then consideration will be given to using absorptive barriers. If parallel noise barriers are less than 10 times the height in distance absorptive noise barriers shall be used.
- If a single barrier is parallel to residential noise sensitive receptors and the barrier is greater than 20 times the height in distance then reflective barriers shall be used. If a single barrier is parallel to residential noise sensitive receptors and the barrier is less than 20 times the height in distance and 10 times the height in distance then consideration will be given to using absorptive barriers. If a single barrier is parallel to residential noise sensitive receptors and the distance is less than 10 times the height then absorptive barriers shall be used.

Note – Absorptive noise barriers are typically recommended for construction for both ground-mounted and structure-mounted applications throughout the Commonwealth.

Note – Consult VDOT Noise Abatement Staff for further guidance.

10.5 Design-Build Projects

For design–build projects, 23 CFR Part 772 requires that the Preliminary Engineering Noise Report document all considered and proposed noise abatement measures for inclusion in the NEPA document. It also requires that final design of design-build noise abatement measures be based on the preliminary noise abatement designs developed in the technical noise analysis and that noise abatement measures be considered, developed, and constructed in accordance with 23 CFR Part 772 and in conformance with the provisions of 40 CFR Part 1506.5(c) and 23 CFR Part 636.109. These latter two provisions contain direction related to the requirements of design-build projects.

Note – All final design noise analyses must consider noise abatement measures based on the final design plans of the project.

11.0 Construction Noise Consideration

Construction noise provisions are contained in Section 107.16(b)(3) Noise of the 2016 VDOT Road and Bridge Specifications. The specifications have been reproduced below:

- The Contractor's operations shall be performed so that exterior noise levels measured during a noise-sensitive activity shall not exceed 80 decibels. Such noise level measurements shall be taken at a point on the perimeter of the construction limit that is closest to the adjoining property on which a noise-sensitive activity is occurring. A *noise-sensitive activity* is any activity for which lowered noise levels are essential if the activity is to serve its intended purpose and not present an unreasonable public nuisance. Such activities include, but are not limited to, those associated with residences, hospitals, nursing homes, churches, schools, libraries, parks, and recreational areas.
- The Department may monitor construction-related noise. If construction noise levels exceed 80 decibels during noise sensitive activities, the Contractor shall take corrective action before proceeding with operations. The Contractor shall be responsible for costs associated with the abatement of construction noise and the delay of operations attributable to noncompliance with these requirements.
- The Department may prohibit or restrict to certain portions of the project any work that produces objectionable noise between 10 P.M. and 6 A.M. If other hours are established by local ordinance, the local ordinance shall govern.
- Equipment shall in no way be altered so as to result in noise levels that are greater than those produced by the original equipment.
- When feasible, the Contractor shall establish haul routes that direct his vehicles away from developed areas and ensure that noise from hauling operations is kept to a minimum.
- These requirements shall not be applicable if the noise produced by sources other than the Contractor's operation at the point of reception is greater than the noise from the Contractor's operation at the same point.

12.0 Public, Locality, and Agency Involvement

12.1 Degree and Type of Involvement

The degree and type of public, locality, and agency involvement will vary from project to project as outlined in the FHWA-approved VDOT Public Involvement Manual. For projects requiring the consideration of highway traffic noise, public involvement activities should allow for presentations and subsequent discussions of both highway traffic noise and construction noise levels and impacts related to the Type I projects. Opportunities for such involvement should be provided as appropriate during both the environmental document preparation phase and the Final Design Phase. Discussion should relate to issues such as:

- highway traffic noise levels;
- highway traffic noise-related impacts;
- highway traffic noise abatement options, including partial highway traffic noise abatement options; and
- areas where highway traffic noise abatement is not feasible and reasonable.

Note – Final Design Noise Abatement Public Meeting(s): Final design noise abatement public meetings should not be conducted until the draft version of the Final Design Highway Traffic Noise Report is reviewed and approved by FHWA.

Note – Final Design Noise Abatement Public Meeting(s): All materials developed for public meetings shall be reviewed by VDOT Noise Abatement Staff for approval.

12.2 Local Officials

An effort should be made to inform local officials within whose jurisdiction the highway project is located of ways to prevent future highway traffic noise impacts on currently undeveloped lands. 23 CFR Part 772.17 states:

(a) To minimize future traffic noise impacts on currently undeveloped lands of Type I projects, a highway agency shall inform local officials within whose jurisdiction the highway project is located of:
   (1) Noise compatible planning concepts;
   (2) The best estimation of the future design year noise levels at various distances from the edge of the nearest travel lane of the highway improvement where the future noise levels meet the highway agency's definition of "approach" for undeveloped lands or properties within the project limits. At a minimum, identify the distance to the exterior noise abatement criteria in ***Table 1***;
   (3) Non-eligibility for Federal-aid participation for a Type II project as described in 23 CFR Part 772.15(b).

To ensure the local officials are informed, a copy of the Preliminary and Final Design Noise analysis shall be made available to the locality upon FHWA concurrence of the report(s).

12.3 Affected Receptors/Community

When construction of a noise barrier is considered in the Final Design Phase, it will not be approved without documentation that the affected community has had the opportunity to provide input into the development process. A good community relations effort can often prove to be the most effective component of the highway traffic noise mitigation process.

Coordination with all receptor unit owners and residents directly impacted by highway traffic noise is a very important part of the Final Design Phase. At any time during this process, the impacted community or individual receptor unit owner(s) may decide that noise abatement is unwanted. If this is the case, the decision not to accept the proposed noise abatement recommendations shall be documented in the NEPA document (if available at that time) and Final Design Reports.

Public involvement allows the community the opportunity to provide input on the proposed location, type, height, and length of the noise abatement feature. The abatement design may be further refined to address the community's comments and to optimize the abatement feature.

Subsequent community meetings may allow for further refinement of the abatement design, keeping in mind the acoustic, engineering, and safety considerations.

Note – Public Involvement for Category C Land Use Activity Areas: An active public involvement approach with all the users of a special land use activity, despite its location, should be incorporated to determine the types, duration, frequency, and areas of activity usage as well as community importance and significance of the outdoor activities. Public involvement activities should recognize that special land use activity areas may cover an area greater than the defined study area for the project, and appropriate steps should be made to accommodate these special circumstances (e.g., town meetings). Although some users may be further removed (in terms of distance) from the special land use activity areas than others, efforts should be made to obtain their input throughout the highway traffic noise analysis process.

12.4 Voting Procedures

The method of obtaining votes from the owners and residents of benefited receptors (i.e., via certified mailings, public meetings, etc.) shall be determined by the VDOT Noise Abatement Staff on a project-by-project basis. Regardless of method, the vote (whether or not there is a desire for a barrier) of each benefited receptor must be documented in writing.

Note – The preferred method of contacting the owners and/or residents for the first time shall be certified mail. Twenty-one (21) calendar days from the anticipated delivery date is required to provide the recipients ample time to review and respond to the survey.

12.4.1 Voting on the Construction of the Noise Barrier

Only the owners and residents of those receptor units that will be benefited by the proposed mitigation may vote on whether the proposed noise barrier should be constructed. The owner/resident of each benefited receptor unit shall be entitled to one weighted vote, regardless of the number of owners of that receptor unit unless they are the owners of a rental facility or the developer of lands. The weighting system is provided in tabular format below (***Table 2***). Votes will be tallied on a noise barrier by noise barrier basis, so it is recommended that the project team tally the votes and summarize the results on a project map showing votes by location. Final interpretation of the voting results will be made by VDOT Noise Abatement Staff, considering all feedback gained during the public involvement process.

Table 2 Public Opinion Survey Weighting System[6]				
Impact and benefit category	**Activity Category[4]**	**Owner and Resident**	**Non-Resident Owner**	**Renter[5]**
Impacted & Benefited	A	See note below		
Not Impacted & Benefited				
Impacted & Benefited	B[1]	5	3	2
Not Impacted & Benefited	B[1]	3	2	1
Impacted & Benefited	C[2]		5	
Not Impacted & Benefited	C[2]		3	
Impacted & Benefited	D		2	
Not Impacted & Benefited	D		1	
Impacted & Benefited	E		2	
Not Impacted & Benefited	E		1	

[1] For activity Category B Receptors only one vote per single family unit will be counted. However the owner of a multiple-family dwelling unit will be granted one vote per benefited unit. Additionally the developer of permitted lands will be granted one vote per benefited lot of the permitted phase where construction has not occurred.

[2] For activity Category C Receptors only 1 vote per facility will be granted.

[3] For activity Category G Receptors the votes will depend on the future land use. The example provided above assumes a residential development.

[4] For permitted land uses defer to the appropriate land use category.

[5] Renter is defined as non-owner resident.

[6] Consult the VDOT external website to obtain the decision making spreadsheet.

Note – Due to the extremely infrequent nature of Category A receptors, they will be handled on a case by case basis. Consult VDOT Noise Abatement Staff for further guidance.

Note – The voting method outlined in this section covers the vast majority of highway projects. In the rare case when extenuating circumstances arise that require unusual or unique considerations be made that are not explicitly covered by these guidelines, project-level decisions will be made in accordance with guidance outlined in Section 13.2.3 of this Highway Traffic Noise Manual.

Of the votes tallied, 50% or more must be in favor of a proposed noise barrier in order for that noise barrier to be considered further. The Noise Abatement Staff will assess the number and location of any opposing votes on a noise barrier by noise barrier basis. This may result in partial highway traffic noise abatement or construction of noise barriers despite opposing votes. The receptor unit owner opposing a proposed noise barrier must submit a signed survey form expressing his/her opposition to the proposed noise barrier, and this must be documented.

Note: To ensure the public has ample opportunity to voice their opinion a second mailing is required when the outstanding votes can change the results of the initial survey. Fourteen (14) days from the anticipated delivery date is required for the second mailing to provide the recipients ample time to review and respond to the survey. Consult VDOT Noise Abatement Staff for further guidance.

Note – Partial Highway Traffic Noise Abatement: VDOT is dedicated to providing feasible and reasonable noise abatement. If the opposing votes are located in areas where partial highway traffic noise abatement is feasible and reasonable without compromising or jeopardizing the noise barrier's abatement ability for the remaining impacted and benefiting receptors, every reasonable effort shall be made to accommodate the needs and wants of every impacted and benefited receptor, despite their approval of or opposition to the proposed noise barrier.

Note – Homeowners Associations: If the benefited receptors units are a part of a homeowner's association, only those receptor units benefited by the proposed noise barrier will have a vote.

Note – Change of property ownership: If a benefited property changes ownership after the public survey and before construction of the noise barrier, only the original owner's vote is considered.

Note –If a project is undergoing a written NEPA re-evaluation because it has been inactive for at least 3 years, then the citizens benefited by a previously identified and publicly approved noise barrier should be re-surveyed. However, if a project has been active and steps have been taken to advance the project since the last citizen survey and a re-evaluation is not being conducted because of the passage of time, then the original survey is considered up-to-date.

12.4.2 Aesthetics

VDOT will decide the color, façade, and texture (absorptive or reflective) of the proposed noise barrier unless there is third-party funding specifically for aesthetics. Since the design of the project and the configuration of the receptor units vary from project to project, professional judgment will be required in making this determination.

12.4.3 Third-Party Funding Options

Third-party funding is limited to aesthetic enhancements above and beyond those for which VDOT is responsible for a noise abatement measure that has previously been deemed warranted, feasible and reasonable. Third-party funding is limited to aesthetic enhancements such as wall graphics, plantings, etc., and cannot be used to offset the cost of the noise barrier if the reasonableness cost criterion is not met. Any additional costs associated with the desires of a locality to have special graphical designs (i.e., imprinted or painted graphical designs rather than standard color/texture) on either the residential side or the highway side of the proposed noise barrier must be paid for by the locality.

Regardless of contribution sharing, no barrier shall be funded by VDOT which does not meet the warrants, feasibility, and reasonableness requirements. The Noise Abatement Staff must work with those providing the funding to determine the details of the arrangement. Once the noise barrier components (posts, panels, caps, etc.) are ordered, the third party is committed to providing the funds associated with the agreement, and no changes will be made to the order unless the third party is willing to absorb the additional cost associated with the order change. All third-party funding agreements must be addressed in a non-discriminatory manner and documented.

13.0 Reporting Results of Highway Traffic Noise Analyses

13.1 Environmental Clearance Reporting

It is the responsibility of the Noise Abatement Staff and the qualified professionals performing the highway traffic noise analyses to ensure that the results of the highway traffic noise analyses are accurately documented for each Type I transportation improvement project. The scope and magnitude of a noise analysis is determined by the factors identified elsewhere in this Manual and not by the type of NEPA documentation required.

The NEPA document shall include a preliminary noise analysis that addresses the highway traffic noise monitoring sites as they relate to impacted communities, proposed highway traffic noise impact prediction techniques, and software requirements as well as any unusual circumstances. It should also include the avoidance techniques offered to reduce or eliminate the potential highway traffic noise impacts.

The preliminary noise analysis shall also identify locations where noise impacts are predicted to occur, where noise abatement is feasible and reasonable, and locations with impacts that have no feasible or reasonable noise abatement alternative. When completing an environmental clearance document, this analysis shall be as extensive as possible given the available design information on the alternative(s) under study at the time. A statement of likelihood shall be included in the environmental document since feasibility and reasonableness determinations may change due to changes in project design after approval of the environmental document. The statement of likelihood shall include the preliminary location and physical description of noise abatement measures determined feasible and reasonable in the preliminary analysis. The statement of likelihood shall also indicate that final recommendations on the construction of an abatement measure(s) will be determined during the completion of the project's final design and the public involvement processes.

Note – General Statement for All NEPA Documents: All NEPA documents must have the following general statement or a variation thereof in the summary relating to proposed noise mitigation: "Preliminary decisions regarding both recommended and non-recommended noise barriers may change between the environmental document and final design as a result of changes in the transportation improvement project design, design year traffic, or the level of detail of the design contained at the time of the preliminary report."

Note – Tiered EIS: VDOT should coordinate with the FHWA Division Office for projects developed under a Tiered EIS with regard to application of a Type I designation. In most cases, it is appropriate to make the Type I project designation under the Tier 2 environmental document. However, a qualitative analysis is recommended for Tier 1 environmental documents.

13.1.1 NEPA Reevaluations

A NEPA reevaluation may be necessary if the project has not advanced and more than three years has passed without a major federal approval (e.g. NEPA approval, authorization to

purchase right of way), if new information becomes available that has a bearing on the existing NEPA document, or the project design has been significantly modified.

If a Final Design noise analysis has not or will not be conducted, the NEPA reevaluation should include a revised noise study to document consistency with the environmental document. For projects that will have a Final Design noise analysis component as a part of the contract, the noise discussion in the NEPA reevaluation should briefly indicate that "impacts/mitigation will be revisited during final design" which is in addition to the information required by 23 CFR Part 772 as discussed above in Section 13.1.

Note: Not all reevaluation scenarios are listed in this document. Consult VDOT Noise Abatement Staff for further guidance.

13.1.2 Highway Traffic Noise Analysis Project File

A highway traffic noise analysis project file shall be prepared using the data obtained from the preliminary noise analysis. The highway traffic noise analysis project file shall serve as a guide in the analysis of highway traffic noise impacts during the Final Design Phase of the transportation improvement project when final alignments have been established and engineering data are available for final detailed analysis of predicted highway traffic noise levels, impacts, and abatement features. The highway traffic noise analysis project file shall contain a discussion of the methodology and computer program(s) used and all relevant data used to arrive at the conclusions in the environmental document.

The highway traffic noise analysis project file shall contain all data collected and analyzed to perform the preliminary noise analysis, such as:

- highway traffic noise monitoring field data sheets;
- mapping used to identify highway traffic noise monitoring sites;
- all input for highway traffic noise computer analyses;
- all final output of computer analysis including noise barrier optimization analyses;
- maps used to lay out the highway traffic noise analysis input parameters, including receptors and highway segments plotted and their coordinates;
- proposed noise barrier type, size, and location data; and
- public comments, coordination, and responses related to noise issues.

The highway traffic noise analysis project file shall be compiled following the completion of the Environmental Clearance Phase and one copy shall be sent to the project manager for inclusion in CEDAR and the Construction District's project file. Since several of the required items could generate large documents, electronic storage is recommended.

13.1.3 Section 106

Highway traffic noise may have a bearing on the assessment of effects under Section 106 of the National Historic Preservation Act on properties listed on or eligible for listing on the National Register of Historic Places. Under a programmatic agreement executed by FHWA, VDOT, and other parties in August 2016, VDOT Cultural Resource staff is authorized to make Section 106 effects determinations on behalf of FHWA. VDOT Cultural Resources staff will consider the contributing characteristics and use of a historic property in determining whether the historic integrity of the property is sensitive to noise. In some instances, the erection of a noise barrier may constitute a Section 106 effect on a historic property. Any discussion of noise effects in the context of Section 106 must be closely coordinated with VDOT Cultural Resource and Noise Abatement staff.

13.1.4 Section 4(f)

Section 4(f) refers to a provision of the Department of Transportation Act (DOT Act) of 1966 that prohibits FHWA and other DOT agencies from approving the ***use*** of National Register properties, and publicly owned parks, recreation areas, wildlife and waterfowl refuges for highway projects unless "there is no prudent and feasible alternative" and actions are taken to minimize harm to those properties; or FHWA makes a finding that the project has a de minimis impact on the property. ***Use*** can include noise impacts. This includes "constructive use" noise impacts where noise levels predicted at a 4(f) resource are considerable enough that the protected activities, features, and attributes would be substantially impaired, even if it does not involve physical use of the property. Noise can be a Section 4(f) constructive use issue if predicted noise levels attributable to the project in proximity to a Section 4(f) resource interfere with the use and enjoyment of a noise-sensitive facility or exterior activity associated with that resource. When Section 4(f) facilities and activities are present adjacent to a project, it is important that they be modeled so that FHWA can determine whether or not a Section 4(f) constructive use is going to occur because of noise increases on the project.

Highway traffic noise analysis for a noise-sensitive Section 4(f) resource shall be identified as a part of the overall transportation improvement project. The highway traffic noise analysis will focus on the noise levels associated with the noise-sensitive facility or activity so that FHWA can then make a determination as to whether there is likely to be a constructive use of the Section 4(f) resource. If a constructive use is identified, the noise analysis will become part of the Section 4(f) analysis and documentation and may form the basis for legally binding mitigation commitments. FHWA will make the determination as to whether the increased highway traffic noise levels interfere substantially with the use and enjoyment of a noise-sensitive receptor protected by Section 4(f). The Section 4(f) evaluation and mitigation commitments for noise-sensitive Section 4(f) resources must be referenced in the Final Design Highway Traffic Noise Report.

Noise-sensitive Section 4(f) resources are evaluated under the appropriate Noise Abatement Criteria activity category in 23 CFR Part 772 (usually activity category C). In order for FHWA to begin considering whether or not a highway traffic noise increase may constitute a constructive use under Section 4(f), there must be:

a. a future highway traffic noise level that approaches or exceeds 67 dB(A); or

b. existing noise levels which approach or exceed 67 dB(A) and a predicted increase with the future "build" alternative greater than 3 dB(A) above the predicted "no-build" alternative noise level.

Once it is established that either one of these criteria has been met for a noise-sensitive Section 4(f) resource, FHWA must then make a determination as to whether the predicted noise level will interfere with the use and enjoyment of a noise-sensitive facility or activity associated with that Section 4(f) resource. Any discussion of noise impacts in the context of a Section 4(f) property must be closely coordinated with VDOT Noise Abatement Staff.

13.1.5 Title VI and Environmental Justice

When assessing highway traffic noise, decisions must consider and adhere to Title VI of the Civil Rights Act of 1964 and Environmental Justice requirements. No one, on the basis of national origin, color, race, minority status, or low income, will be denied the benefits of highway traffic noise abatement when warranted and determined to be feasible and reasonable. Equal access to the decision-making process will be provided during the public involvement process. Additional information regarding Title VI and Environmental Justice can be obtained from the FHWA website. For further assistance on this issue, contact VDOT Central Office Environmental Location Studies Section.

13.2 Highway Traffic Noise Report: Format, Content, and Processing

13.2.1 Highway Traffic Noise Report Format and Content

The Preliminary and/or Final Design Highway Traffic Noise Report should include, minimally, the information presented in the following outline. Although the intent is to provide statewide uniformity for all Final Design Highway Traffic Noise Reports, it is understood that, in many cases, additional information and variations to the outline may be necessary due to project circumstances. The Final Design Noise Report may be modified depending on the results of the Preliminary Design Report. For example, a Technical Memorandum or Barrier Design Report may suffice. A more detailed example outline presented below is available on VDOT's external website. The document includes standardized language, tables, and graphics. The guidance document also provides a checklist that aids the analyst in the completion and delivery of Preliminary and Final Design Noise Analyses to the Department.

Executive Summary

- A synopsis of the project and proposed noise abatement commitments

Introduction

- History, background, design year, and specific details of the project, including the preferred alternative and side road improvements
- Regional location map

- Project location map
- NEPA documentation for consistency (in some cases, it may be necessary to attach the noise section of the NEPA document as an appendix)

Methodology

- FHWA and State noise policy
- Monitoring and modeling methodology used
- Analysis procedure/model/version
- Years considered

Existing Highway Traffic Noise Environment (Monitored and Modeled Data)

- Existing land uses
- Identification and description of each CNE
- Monitored highway traffic noise results (short- and/or long-term)
- Noise meter calibration
- Existing traffic volume, speed, and composition data (recorded and historic data)
- Receptors monitored
- Receptor monitoring data (i.e., time of day monitored, noise level, traffic counts, and composition)
- Basis for determination of existing and background noise levels
- Basis for determination of worst-case existing noise hour and associated noise levels
- Noise model validation information

Future Highway Traffic Noise Environment (Modeled Data)

- Modeled highway traffic noise input and results
- Future highway traffic noise consequences as a result of "no-build" and proposed transportation improvement project

Highway Traffic Noise Consideration and Abatement Alternatives

- Comparison of existing and future total noise levels for all identified receptors
- Determination of noise impacts
- Abatement considerations and options for each impacted community/receptor group
- Highway traffic noise abatement commitments and recommendations (attach the Warranted, Feasible, and Reasonable Worksheets as an appendix)
- Noise barrier matrix indicating the height of the noise barriers at each location where the height changes (i.e., barrier profile) and whether the barrier is ground-mounted or on structure

Construction Noise Consideration and Abatement Opportunities

- Identification and discussion of construction noise impacts and possible abatement opportunities and recommendations

Public Involvement Process

- Discussion of public involvement efforts (including community meetings, individual meetings, and special coordination)
- Voting results related to desire for a barrier
- Abatement commitments: acoustic profiles and aesthetics
- Noise Compatible Planning Concepts/Coordination with local officials
    - Noise Contours

Appendices

- List of preparers and reviewers
- Site sketches of monitored locations, noise meter printouts, noise meter and calibrator calibration reports that cover the monitoring period, FHWA TNM input and output information, traffic data used in the analysis, pertinent correspondence
- Copy of the highway traffic noise portion of the NEPA document (when determined to be necessary)
- Warranted, Feasible, and Reasonable Worksheets for the Final Design Highway Traffic Noise Report
- TNM Certification for Noise Project Manager

Note – Report Graphics: Detailed, public-friendly graphics should be incorporated throughout Preliminary and Final Design Noise Analysis Reports, especially to illustrate CNE boundaries, monitored/modeled highway traffic noise locations, noise levels, and evaluated/proposed noise barrier locations. Each graphic shall adequately identify and label names of highways/roadways, locations of structures (bridges, culverts, etc.), community names, special interest areas, residential/commercial/industrial sites, municipal/county/state boundaries, monitored/modeled sites, right-of-way acquisitions, and areas where vehicle access to an existing roadway is to be removed as well as any other information discussed in the text that can be graphically depicted. Additional labeling may be necessary depending on the specifics of the transportation improvement project. Graphics are only as good as the text associated with them; therefore, an adequate description of the project area and explanation of the activities being proposed shall also be included.

Note – Printouts of Model Runs: A copy of the printed modeling information shall be supplied upon request. Electronic copies of all model runs shall be retained in the technical files and transmitted to the VDOT Noise Abatement Staff. *A word file (.DOC) describing the model runs should be also attached.*

13.2.2 Highway Traffic Noise Report Processing

VDOT Noise Abatement Staff shall review the draft Highway Traffic Noise Analysis Report upon its completion and prior to any public meeting(s). Once reviewed, revised if necessary, and approved, the draft report will be provided to FHWA for their review and concurrence. It is VDOT's practice to provide error-free documents (i.e., technically accurate and with no grammatical or typographical errors) to FHWA. FHWA shall review all draft Highway Traffic Noise Analysis Reports and submit comments to VDOT Noise Abatement Staff.

Note – FHWA Review Requirements: Noise barriers being constructed with federal funding must be reviewed by FHWA.

Once it has been determined that the Final Design Highway Traffic Noise Report is acceptable, VDOT shall make it available for public and agency review and conduct any necessary public meeting(s). VDOT Noise Abatement staff shall analyze the public and agency comments and determine if:

- Additional noise impact assessment is required to address comments; and
- Noise abatement measure commitments need to be revised.

Once these have been considered, the final version of the Highway Traffic Noise Report shall be submitted to VDOT Noise Abatement staff. The final version of the Highway Traffic Noise Report must have the Warranted, Feasible, and Reasonable Worksheets, signed by the Noise Abatement Program Manager and the qualified professional performing the highway traffic noise analysis, as well as the results of the final design noise mitigation public meeting(s). The final version of the Highway Traffic Noise Report shall be processed in the same manner as the draft version of the document.

13.2.3 Extenuating Circumstances

It is impossible to identify and account for every special consideration that may arise on a specific highway project and address it in the corresponding noise analysis. When extenuating circumstances arise that require unusual or unique considerations be made that are not explicitly covered by these guidelines, project-level decisions will be made in accordance with the spirit of the FHWA regulations and these VDOT guidelines. It is imperative that decisions be made collaboratively with VDOT, the environmental consultant responsible for the noise analysis, and FHWA Virginia Division office staff. Unusual and unique circumstances will be considered on an individual project basis and the decision-making process must be fully documented in the noise technical report.

Appendix A Definitions and Guidance on Terms

Absorptive Noise Panel – A noise barrier panel that absorbs a significant portion of incident sound rather than reflecting all incident sound. To be approved for use in Virginia, this type of panel shall have a noise reduction coefficient of 0.70 or greater. See Section 519 of the 2007 Road and Bridge Specifications for further details.

Approach – Defined by VDOT as one dB(A) below the set FHWA noise abatement criteria (e.g., highway traffic noise abatement consideration is warranted at 66 dB(A) for Land Use Activity Category B receptors). See ***Table 1*** for NAC levels. Note that values of 65.5 to 65.9 are rounded to 66 dB(A).

Automobile or Light Truck – A vehicle with two axles and four wheels designed primarily for transportation of nine or fewer passengers (automobile) or transportation of cargo (light truck). Generally, the gross vehicle weight is less than 4,500 kilograms (10,000 pounds).

Auxiliary Lane – The portion of the roadway adjoining the traveled way for parking, speed change, turning, storage for turning, weaving, truck climbing, and other purposes supplementary to through-traffic movement. The width of an auxiliary lane typically is equal to that of a through-traffic lane.

Avoidance – An act or keeping away from, escaping, evading, and preventing something.

Benefited Receptor – The recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dB(A), but not to exceed the highway agency's reasonableness design goal.

Bus/Recreational Vehicle – Any single-unit bus, articulated bus, school bus, motor home, or motor home pulling a trailer or boat.

Common Noise Environment – A group of receptors within the same Activity Category in ***Table 1*** that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. Generally, common noise environments occur between two secondary noise sources, such as interchanges, intersections, or cross-roads.

Construction Noise Level Descriptor – The hourly equivalent sound level, Leq(h) or Lmax depending on the situation. The specific construction noise level descriptor shall be determined by coordinating with VDOT Noise Abatement Staff.

Constructive Use – Constructive use occurs when the transportation improvement project does not incorporate land from a Section 4(f) resource but the project's proximity impacts are so severe that the protected activities, features, or attributes that qualify a resource for protection under Section 4(f) are substantially impaired. Substantial impairment occurs only when the protected activities, features, or attributes of the resource are substantially diminished. FHWA is

not required to determine that there is no constructive use. However, such a determination could be made at the discretion of FHWA.

Date of Public Knowledge – The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD), as defined in 23 CFR part 771.

dB(A) – The sound pressure levels in decibels measured with a frequency-weighting network corresponding to the A-scale on a standard sound level meter as specified by ANSI S1.4-1983 (1997). The A-scale tends to suppress lower frequencies (i.e., below 1,000 Hz) and best approximates the sound as heard by the normal human ear.

Design Speed – The maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern.

Design Year – The future year used to estimate the probable traffic volume for which a highway is designed. For VDOT, the functional classification of the road determines the design year. According to the VDOT Road Design Manual, the *Design Year is Advertisement Date (AD) + 11 years* for restoration in kind and minor improvements of Rural Minor Collectors and Urban Collectors and for all projects on Rural Local and all Urban Local functional classifications. *Design Year is AD + 22 years* for new construction of major improvements or facility expansion of Rural Minor Collectors and Urban Collectors and for all roads in the National Highway System (NHS), all Freeways, all Rural and Urban Arterial, and all Rural Major Collector functional classifications.

Environmental Documents – Documents required by NEPA and related legislation that detail specific impacts and the severity of those impacts on the environment. These include the CE, EA, EIS, technical files, Section 4(f) Evaluation, and Section 106 Report.

Existing Noise Level – The worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.

Feasibility – The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.

Heavy Truck – Any vehicle having three or more axles and designed for the transportation of cargo (typically a single-unit truck, truck tractor-semi trailer combination, and truck or truck tractor with a semi-trailer in combination with a full trailer). Generally, the gross weight of a heavy truck is greater than 12,000 kilograms (26,000 pounds).

Impacted Receptor – The recipient that has a traffic noise impact.

Insertion Loss (IL) – The actual acoustical benefit derived from the presence of a noise barrier.

L10 – The sound level that is exceeded 10 percent of the time (the 90th percentile) for the period under consideration, with L10(h) being the hourly value of L10.

Leq – The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with Leq(h) being the hourly value of Leq.

Line-of-Site (LOS) – An unobscured straight line between the observer location and a specific noise source.

Lmax – The highest sound pressure level, in dB(A), for a specific time period.

Medium Truck – A vehicle having two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight of a medium truck is greater than 4,500 kilograms (10,000 pounds) but less than 12,000 kilograms (26,000 pounds).

Multifamily Dwelling – A residential structure containing more than one residence. Each residence in a multifamily dwelling shall be counted as one receptor when determining impacted and benefited receptors.

National Environmental Policy Act (NEPA) – Federal legislation that establishes environmental policy for the nation. It provides an interdisciplinary framework to ensure that decision-makers adequately take environmental factors into account. The level of documentation for federally-aided projects is influenced by the impact the project may have on the surrounding natural, cultural, and social environment.

Noise Abatement Criteria (NAC) – Noise levels for various activities or land uses that represent the upper limit of acceptable highway traffic noise levels. These levels are used to identify highway traffic noise impacts.

Noise Barrier – A physical obstruction that is constructed between the highway noise source and the noise sensitive receptor(s) that lowers the noise level. Noise barriers include stand-alone noise walls, noise berms (earth or other material), and combination berm/wall systems.

Noise Level Descriptor –The hourly equivalent sound level, Leq(h). Leq(h) is the steady-state, A-weighted sound level which contains the same amount of acoustic energy as the actual time-varying, A-weighted sound level over a one-hour period.

Noise Reduction Coefficient (NRC) – A single number rating of the sound-absorptive properties of a material. VDOT has adopted an NRC criterion of 0.70 or greater when an absorptive treatment is required.

Noise Reduction Design Goal – The optimum desired dB(A) noise reduction determined from calculating the difference between future build noise levels with abatement, to future build noise levels without abatement. The noise reduction design goal shall be at least 7 dB(A), but not more than 10 dB(A). VDOT's design goal is 7 dB(A) of insertion loss for at least one impacted receptor.

Noise Study Area (NSA) – A group or grouping of noise-sensitive receptors into common areas of similar noise influences throughout the entire project limits.

Operating Speed – The highest overall average speed at which drivers travel on a given highway under favorable weather conditions and under prevailing traffic conditions without at any time exceeding the safe speed as determined by the design speed on a section-by-section basis.

Permitted – A term used to describe a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of a building permit.

Posted Speed – The maximum allowable speed limit for a specified section of highway that is posted and enforced by the appropriate law enforcement agency.

Project Area – For noise study purposes, is the area within 500 feet from the proposed edge of pavement of the roadway improvements as defined by the roadway construction limits. Highway traffic noise assessment is required for all receptors within the project area.

Property Owner – An individual or group of individuals that holds a title, deed, or other legal documentation of ownership of a property or a residence.

Reasonableness – The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.

Receptor – A discrete or representative location of a noise sensitive area(s), for any of the land uses listed in ***Table 1***.

Reflective Noise Panel – A noise barrier panel that reflects incident sound rather than absorbing a significant portion of the incident sound.

Residence – A dwelling unit. The term can mean either a single family residence or each dwelling unit in a multifamily dwelling.

Section 4(f) – a provision of the Department of Transportation Act (DOT Act) of 1966 that prohibited FHWA and other DOT agencies from approving the use of certain environmental resources, historical sites, and publicly-owned for highway projects unless "there is no prudent and feasible alternative" and actions are taken to minimize harm to those properties.

Sound Transmission Class (STC) – A single number rating used to compare sound insulation properties of barriers. VDOT has adopted an STC criterion of 23 or greater.

Statement of Likelihood – A statement provided in the environmental clearance document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Substantial Construction – The granting of a building permit, prior to right-of-way acquisition or construction approval for the highway.

Substantial Noise Increase – One of two types of highway traffic noise impacts. For a Type I project, an increase in noise levels of 5 to 15 dB(A) in the design year over the existing noise level. A substantial noise increase has been defined by VDOT as a 10 dB(A) increase above existing noise levels for all noise-sensitive exterior activity categories.

Traffic Noise Impact – Design year "build" condition noise levels that approach or exceed the NAC listed in ***Table 1*** for the future "build" condition; or design year "build" condition noise levels that create a substantial noise increase over existing noise levels.

Through-Traffic Lane – A continuous main lane, including high-occupancy vehicle (HOV) lane or frontage road. Through-traffic lanes exclude lanes for parking, speed change, turning, storage for turning, weaving, and other purposes supplementary to through-traffic movement.

Type I Project –

(1) The construction of a highway on new location; or,

(2) The physical alteration of an existing highway where there is either:

(i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,

(ii) Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or,

(3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,

(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,

(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,

(6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,

(7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

(8) If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project.

Type II Project – A Federal or Federal-aid highway project for noise abatement on an existing highway. For a Type II project to be eligible for Federal-aid funding, the highway agency must develop and implement a Type II program in accordance with 23 CFR Part 772.7(e).

Type III Project – A Federal or Federal-aid highway project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

Worst Noise Hour – A period of 60 consecutive minutes throughout a 24-hour day that reflects the peak noise hour. This period is often, but not always, associated with the peak traffic hour.

Appendix B Frequently Asked Questions

Listed below are several of the most popular frequently asked questions (FAQs). Additional FAQs can be found at the FHWA website.

Q. What is a Type I project?

A. A Type I project is defined by FHWA and VDOT as: (1) The construction of a highway on new location; or, (2) The physical alteration of an existing highway where there is either: (i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or, (ii) Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or, (3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or, (4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or, (5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or, (6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or, (7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

Q. What is a Type II project?

A. A Type II project is defined by FHWA and VDOT as a proposed federal or federal-aid highway project for noise abatement on an existing highway. VDOT does not participate in Type II projects.

Q. Does VDOT allow participation of third party funding?

A. Third-party funding is limited to aesthetic and functional enhancements above and beyond that for which VDOT is responsible.

Q. What is a substantial alteration to the vertical/horizontal alignment?

A. A Substantial Horizontal Alteration is when a project halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition and a Substantial Vertical Alteration is when a project removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor.

Q. What defines an increase in through-traffic lanes?

A. The increase in through-traffic lanes requires consideration of the through-traveled way – the portion of the highway constructed for the movement of vehicles, exclusive of the shoulders and auxiliary lanes. An increase in through traffic lanes involves those projects that include continuous full lane additions including HOV, HOT, bus land and truck climbing lanes.

Q. What is considered an auxiliary lane?

A. Auxiliary lanes are those lanes adjoined to the traveled way intended for speed change, storage, weaving, climbing, and other purposes supplementary to through-traffic movement. Auxiliary lanes are intended to reduce interference with through-traffic and are not usually intended to increase capacity. Turning lanes at intersections, center-turning lanes, weaving lanes between interchanges, etc. are considered auxiliary lanes.

Q. Is an auxiliary lane considered a Type I Project?

A. Yes. Except for when the auxiliary lane is a turn lane.

Q. Is addition of a turn lane a Type I Project?

A. *No, the addition of turn lanes is not considered a Type I Project.*

Q. If a project does not fall under the Type I project description, is it exempt from a noise analysis?

A. It depends. While not common, a project may sometimes affect the acoustical environment without adding lanes or significantly altering the horizontal/vertical alignment. Situations when the project itself causes potential noise concerns can arise during minor improvements.

Q. Is a detailed noise analysis required for a bridge replacement?

A. It depends. If the project consists of a significant alteration to the horizontal and/or vertical alignment or if there is an increase in through-traffic lanes then yes a detailed noise study would be required. However, bridge replacements and rehabilitations within the existing footprint generally are exempt from noise analyses.

Q. Is a noise analysis required if mitigation is clearly not feasible?

A. Yes. The noise analysis procedure is a three-step process: warranted, feasible, and reasonable. The first step is to determine whether noise-sensitive receptors are impacted by noise (to determine if abatement consideration is warranted). The next step is to determine if the abatement is feasible; absent a noise analysis and a determination of whether abatement is warranted, it would be difficult to make a determination that

abatement is not feasible. The NEPA document needs to address impacts, regardless of whether abatement is likely.

Q. Is a mitigation analysis required in Preliminary Design?

A. Yes. Highway traffic noise abatement commitments are made at two times during a project's development: at the conclusion of the NEPA process and during Final Design. While drafting the environmental document during preliminary design, approximate barrier locations and heights need to be determined and a preliminary feasible and reasonable assessment made. Please note: identification of mitigation during the NEPA process does not guarantee mitigation will be constructed. This mitigation is subject to additional consideration during the Final Design phase once more detailed information is available, and this information needs to be clearly documented in the NEPA document.

Q. Is a noise analysis required for undeveloped lands?

A. Yes. A noise analysis is required for undeveloped lands.

Q. What is considered to be permitted?

A. Undeveloped lands are deemed to be permitted if a noise-sensitive receptor(s) has received approval from the local agency (i.e., a building permit has been issued) prior to the date of public knowledge.

Q. What is considered the date of public knowledge?

A. State Highway Administrations must identify when the public is officially notified of the adoption of the location of a proposed highway project. This date establishes the "date of public knowledge" and determines the date when the federal/state governments are no longer responsible for providing noise abatement for new development that occurs adjacent to the proposed highway project. While Virginia has used a "date of public knowledge" consistent with state law (date of location approval by the Commonwealth Transportation Board), FHWA has determined that the "date of public knowledge" cannot precede the date of approval of CEs, FONSIs, or RODs.

Q. What level of noise analysis is needed for a transit only project requiring limited FHWA participation?

A. The determination of whether to use FHWA or FTA's noise analysis and procedures depends upon the specific circumstances of a project. The FHWA noise regulation under 23 CFR Part 772 applies to multimodal projects, even though the term "multimodal" is not defined in the regulation. A proposed transit project that would share an existing highway right-of-way (ROW) is not necessarily a multimodal project under 23 CFR Part 772.7(a). A transit-only project that meets all three of the following criteria is not considered a multimodal project for purposes of 23 CFR Part 772:

1. *Lead Agency: The Federal Transit Administration (FTA) is the lead agency in the National Environmental Policy Act (NEPA) process. The FHWA's limited participation is as a cooperating agency.*
2. *Project Purpose: The main transportation purpose of the project, as stated in the purpose and need statement of the NEPA document, is transit-related and not highway-related.*
3. *Funding: No Federal-aid highway funds are being used to fund the project.*

Transit-only projects that meet all three criteria should use the FTA's Transit Noise and Vibration Impact Assessment Guidance Manual procedures to consider noise associated with the transit projects and any highway elements directly affected by the transit projects.

Appendix C Title 23 Code of Federal Regulations, Part 772

SUBCHAPTER H - RIGHT-OF-WAY AND ENVIRONMENT

PART 772 - PROCEDURES FOR ABATEMENT OF HIGHWAY TRAFFIC NOISE AND CONSTRUCTION NOISE

Sec.
772.1 Purpose.
772.3 Noise standards.
772.5 Definitions.
772.7 Applicability.
772.9 Traffic noise prediction.
772.11 Analysis of traffic noise impacts.
772.13 Analysis of noise abatement.
772.15 Federal participation.
772.17 Information for local officials.
772.19 Construction noise.
Table 1 to Part 772--Noise Abatement Criteria

Authority: 23 U.S.C. 109(h) and (i); 42 U.S.C. 4331, 4332; sec. 339(b), Pub. L. 104-59, 109 Stat. 568, 605; 49 CFR 1.48(b).

Sec. 772.1 Purpose.

To provide procedures for noise studies and noise abatement measures to help protect the public's health, welfare and livability, to supply noise abatement criteria, and to establish requirements for information to be given to local officials for use in the planning and design of highways approved pursuant to title 23 U.S.C.

Sec. 772.3 Noise standards.

The highway traffic noise prediction requirements, noise analyses, noise abatement criteria, and requirements for informing local officials in this regulation constitute the noise standards mandated by 23 U.S.C. 109(1). All highway projects which are developed in conformance with this regulation shall be deemed to be in accordance with the FHWA noise standards.

Sec. 772.5 Definitions.

Benefited Receptor. The recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dB(A), but not to exceed the highway agency's reasonableness design goal.

Common Noise Environment. A group of receptors within the same Activity Category in Table 1 that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and

topographic features. Generally, common noise environments occur between two secondary noise sources, such as interchanges, intersections, cross-roads.

Date of Public Knowledge. The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD), as defined in 23 CFR part 771.

Design Year. The future year used to estimate the probable traffic volume for which a highway is designed.

Existing Noise Levels. The worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.

Feasibility. The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.

Impacted Receptor. The recipient that has a traffic noise impact.

L10. The sound level that is exceeded 10 percent of the time (the 90th percentile) for the period under consideration, with L10(h) being the hourly value of L10.

Leq. The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with Leq(h) being the hourly value of Leq.

Multifamily Dwelling. A residential structure containing more than one residence. Each residence in a multifamily dwelling shall be counted as one receptor when determining impacted and benefited receptors.

Noise Barrier. A physical obstruction that is constructed between the highway noise source and the noise sensitive receptor(s) that lowers the noise level, including stand-alone noise walls, noise berms (earth or other material), and combination berm/wall systems.

Noise Reduction Design Goal. The optimum desired dB(A) noise reduction determined from calculating the difference between future build noise levels with abatement, to future build noise levels without abatement. The noise reduction design goal shall be at least 7 dB(A), but not more than 10 dB(A).

Permitted. A definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of a building permit.

Property Owner. An individual or group of individuals that holds a title, deed, or other legal documentation of ownership of a property or a residence.

Reasonableness. The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.

Receptor. A discrete or representative location of a noise sensitive area(s), for any of the land uses listed in Table 1.

Residence. A dwelling unit. Either a single family residence or each dwelling unit in a multifamily dwelling.

Statement of Likelihood. A statement provided in the environmental clearance document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Substantial Construction. The granting of a building permit, prior to right-of-way acquisition or construction approval for the highway.

Substantial noise increase. One of two types of highway traffic noise impacts. For a Type I project, an increase in noise levels of 5 to 15 dB(A) in the design year over the existing noise level.

Traffic Noise Impacts. Design year build condition noise levels that approach or exceed the NAC listed in Table 1 for the future build condition; or design year build condition noise levels that create a substantial noise increase over existing noise levels.

Type I Project:

(1) The construction of a highway on new location; or,

(2) The physical alteration of an existing highway where there is either:

(i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,

(ii) Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or,

(3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,

(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,

(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,

(6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,

(7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

(8) If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project.

Type II Project. A Federal or Federal-aid highway project for noise abatement on an existing highway. For a Type II project to be eligible for Federal-aid funding, the highway agency must develop and implement a Type II program in accordance with section 772.7(e).

Type III Project. A Federal or Federal-aid highway project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

Sec. 772.7 Applicability.

(a) This regulation applies to all Federal or Federal-aid Highway Projects authorized under title 23, United States Code. Therefore, this regulation applies to any highway project or multimodal project that:

(1) Requires FHWA approval regardless of funding sources, or

(2) Is funded with Federal-aid highway funds.

(b) In order to obtain FHWA approval, the highway agency shall develop noise policies in conformance with this regulation and shall apply these policies uniformly and consistently statewide.

(c) This regulation applies to all Type I projects unless the regulation specifically indicates that a section only applies to Type II or Type III projects.

(d) The development and implementation of Type II projects are not mandatory requirements of section 109(i) of title 23, United States Code.

(e) If a highway agency chooses to participate in a Type II program, the highway agency shall develop a priority system, based on a variety of factors, to rank the projects in the program. This priority system shall be submitted to and approved by FHWA before the highway agency is allowed to use Federal-aid funds for a project in the program. The highway agency shall re-analyze the priority system on a regular interval, not to exceed 5 years.

(f) For a Type III project, a highway agency is not required to complete a noise analysis or consider abatement measures.

Sec. 772.9 Traffic noise prediction.

(a) Any analysis required by this subpart must use the FHWA Traffic Noise Model (TNM), which is described in ``FHWA Traffic Noise Model" Report No. FHWA-PD-96-010, including Revision No. 1, dated April 14, 2004, or any other model determined by the FHWA to be consistent with the methodology of the FHWA TNM. These publications are incorporated by

reference in accordance with section 552(a) of title 5, U.S.C. and part 51 of title 1, CFR, and are on file at the National Archives and Record Administration (NARA). For information on the availability of this material at NARA, call (202) 741-6030 or go to http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. These documents are available for copying and inspection at the Federal Highway Administration, 1200 New Jersey Avenue, SE., Washington, DC 20590, as provided in part 7 of title 49, CFR. These documents are also available on the FHWA's Traffic Noise Model Web site at the following URL: http://www.fhwa.dot.gov/environment/noise/index.htm.

(b) Average pavement type shall be used in the FHWA TNM for future noise level prediction unless a highway agency substantiates the use of a different pavement type for approval by the FHWA.

(c) Noise contour lines may be used for project alternative screening or for land use planning to comply with Sec. 772.17 of this part, but shall not be used for determining highway traffic noise impacts.

(d) In predicting noise levels and assessing noise impacts, traffic characteristics that would yield the worst traffic noise impact for the design year shall be used.

Sec. 772.11 Analysis of traffic noise impacts.

(a) The highway agency shall determine and analyze expected traffic noise impacts.

(1) For projects on new alignments, determine traffic noise impacts by field measurements.

(2) For projects on existing alignments, predict existing and design year traffic noise impacts.

(b) In determining traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.

(c) A traffic noise analysis shall be completed for:

(1) Each alternative under detailed study;

(2) Each Activity Category of the NAC listed in Table 1 that is present in the study area;

(i) Activity Category A. This activity category includes the exterior impact criteria for 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 for the area to continue to serve its intended purpose. Highway agencies shall submit justifications to the FHWA on a case-by-case basis for approval of an Activity Category A designation.

(ii) Activity Category B. This activity category includes the exterior impact criteria for single-family and multifamily residences.

(iii) Activity Category C. This activity category includes the exterior impact criteria for a variety of land use facilities. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.

(iv) Activity Category D. This activity category includes the interior impact criteria for certain land use facilities listed in Activity Category C that may have interior uses. A highway agency shall conduct an indoor analysis after a determination is made that exterior abatement measures will not be feasible and reasonable. An indoor analysis shall only be done after exhausting all outdoor analysis options. In situations where no exterior activities are to be affected by the traffic noise, or where the exterior activities are far from or physically shielded from the roadway in a manner that prevents an impact on exterior activities, the highway agency shall use Activity Category D as the basis of determining noise impacts. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.

(v) Activity Category E. This activity category includes the exterior impact criteria for developed lands that are less sensitive to highway noise. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.

(vi) Activity Category F. This activity category includes developed lands that are not sensitive to highway traffic noise. There is no impact criteria for the land use facilities in this activity category and no analysis of noise impacts is required.

(vii) Activity Category G. This activity includes undeveloped lands.

(A) A highway agency shall determine if undeveloped land is permitted for development. The milestone and its associated date for acknowledging when undeveloped land is considered permitted shall be the date of issuance of a building permit by the local jurisdiction or by the appropriate governing entity.

(B) If undeveloped land is determined to be permitted, then the highway agency shall assign the land to the appropriate Activity Category and analyze it in the same manner as developed lands in that Activity Category.

(C) If undeveloped land is not permitted for development by the date of public knowledge, the highway agency shall determine noise levels in accordance with 772.17(a) and document the results in the project's environmental clearance documents and noise analysis documents. Federal participation in noise abatement measures will not be considered for lands that are not permitted by the date of public knowledge.

(d) The analysis of traffic noise impacts shall include:

(1) Identification of existing activities, developed lands, and undeveloped lands, which may be affected by noise from the highway;

(2) For projects on new or existing alignments, validate predicted noise level through comparison between measured and predicted levels;

(3) Measurement of noise levels. Use an ANSI Type I or Type II integrating sound level meter;

(4) Identification of project limits to determine all traffic noise impacts for the design year for the build alternative. For Type II projects, traffic noise impacts shall be determined from current year conditions;

(e) Highway agencies shall establish an approach level to be used when determining a traffic noise impact. The approach level shall be at least 1 dB(A) less than the Noise Abatement Criteria for Activity Categories A to E listed in Table 1 to part 772;

(f) Highway agencies shall define substantial noise increase between 5 dB(A) to 15 dB(A) over existing noise levels. The substantial noise increase criterion is independent of the absolute noise level.

(g) A highway agency proposing to use Federal-aid highway funds for a Type II project shall perform a noise analysis in accordance with Sec. 772.11 of this part in order to provide information needed to make the determination required by Sec. 772.13(a) of this part.

Sec. 772.13 Analysis of noise abatement.

(a) When traffic noise impacts are identified, noise abatement shall be considered and evaluated for feasibility and reasonableness. The highway agency shall determine and analyze alternative noise abatement measures to abate identified impacts by giving weight to the benefits and costs of abatement and the overall social, economic, and environmental effects by using feasible and reasonable noise abatement measures for decision-making.

(b) In abating traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.

(c) If a noise impact is identified, a highway agency shall consider abatement measures. The abatement measures listed in Sec. 772.15(c) of this part are eligible for Federal funding.

(1) At a minimum, the highway agency shall consider noise abatement in the form of a noise barrier.

(2) If a highway agency chooses to use absorptive treatments as a functional enhancement, the highway agency shall adopt a standard practice for using absorptive treatment that is consistent and uniformly applied statewide.

(d) Examination and evaluation of feasible and reasonable noise abatement measures for reducing the traffic noise impacts. Each highway agency, with FHWA approval, shall develop feasibility and reasonableness factors.

(1) Feasibility:

(i) Achievement of at least a 5 dB(A) highway traffic noise reduction at impacted receptors. The highway agency shall define, and receive FHWA approval for, the number of receptors that must achieve this reduction for the noise abatement measure to be acoustically feasible and explain the basis for this determination; and

(ii) Determination that it is possible to design and construct the noise abatement measure. Factors to consider are safety, barrier height, topography, drainage, utilities, and maintenance of the abatement measure, maintenance access to adjacent properties, and access to adjacent properties (i.e. arterial widening projects).

(2) Reasonableness:

(i) Consideration of the viewpoints of the property owners and residents of the benefited receptors. The highway agency shall solicit the viewpoints of all of the benefited receptors and obtain enough responses to document a decision on either desiring or not desiring the noise abatement measure. The highway agency shall define, and receive FHWA approval for, the number of receptors that are needed to constitute a decision and explain the basis for this determination.

(ii) Cost effectiveness of the highway traffic noise abatement measures. Each highway agency shall determine, and receive FHWA approval for, the allowable cost of abatement by determining a baseline cost reasonableness value. This determination may include the actual construction cost of noise abatement, cost per square foot of abatement, the maximum square footage of abatement/benefited receptor and either the cost/benefited receptor or cost/benefited receptor/dB(A) reduction. The highway agency shall re-analyze the allowable cost for abatement on a regular interval, not to exceed 5 years. A highway agency has the option of justifying, for FHWA approval, different cost allowances for a particular geographic area(s) within the State, however, the highway agency must use the same cost reasonableness/construction cost ratio statewide.

(iii) Noise reduction design goals for highway traffic noise abatement measures. When noise abatement measure(s) are being considered, a highway agency shall achieve a noise reduction design goal. The highway agency shall define, and receive FHWA approval for, the design goal of at least 7 dB(A) but not more than 10 dB(A), and shall define the number of benefited receptors that must achieve this design goal and explain the basis for this determination.

(iv) The reasonableness factors listed in Sec. 772.13(d)(5)(i), (ii) and (iii), must collectively be achieved in order for a noise abatement measure to be deemed reasonable. Failure to achieve Sec. 772.13(d)(5)(i), (ii) or (iii), will result in the noise abatement measure being deemed not reasonable.

(v) In addition to the required reasonableness factors listed in Sec. 772.13(d)(5)(i), (ii), and (iii), a highway agency has the option to also include the following reasonableness factors: Date of development, length of time receptors have been exposed to highway traffic noise impacts, exposure to higher absolute highway traffic noise levels, changes between existing and future build conditions, percentage of mixed zoning development, and use of noise compatible planning concepts by the local government. No single optional reasonableness factor can be used to determine reasonableness.

(e) Assessment of Benefited Receptors. Each highway agency shall define the threshold for the noise reduction which determines a benefited receptor as at or above the 5 dB(A), but not to exceed the highway agency's reasonableness design goal.

(f) Abatement Measure Reporting: Each highway agency shall maintain an inventory of all constructed noise abatement measures. The inventory shall include the following parameters: type of abatement; cost (overall cost, unit cost per/sq. ft.); average height; length; area; location (State, county, city, route); year of construction; average insertion loss/noise reduction as

reported by the model in the noise analysis; NAC category(s) benefited; material(s) used (precast concrete, berm, block, cast in place concrete, brick, metal, wood, fiberglass, combination, plastic (transparent, opaque, other); features (absorptive, reflective, surface texture); foundation (ground mounted, on structure); project type (Type I, Type II, and optional project types such as State funded, county funded, tollway/turnpike funded, other, unknown). The FHWA will collect this information, in accordance with OMB's Information Collection requirements.

(g) Before adoption of a CE, FONSI, or ROD, the highway agency shall identify:

(1) Noise abatement measures which are feasible and reasonable, and which are likely to be incorporated in the project; and

(2) Noise impacts for which no noise abatement measures are feasible and reasonable.

(3) Documentation of highway traffic noise abatement: The environmental document shall identify locations where noise impacts are predicted to occur, where noise abatement is feasible and reasonable, and locations with impacts that have no feasible or reasonable noise abatement alternative. For environmental clearance, this analysis shall be completed to the extent that design information on the alterative(s) under study in the environmental document is available at the time the environmental clearance document is completed. A statement of likelihood shall be included in the environmental document since feasibility and reasonableness determinations may change due to changes in project design after approval of the environmental document. The statement of likelihood shall include the preliminary location and physical description of noise abatement measures determined feasible and reasonable in the preliminary analysis. The statement of likelihood shall also indicate that final recommendations on the construction of an abatement measure(s) is determined during the completion of the project's final design and the public involvement processes.

(h) The FHWA will not approve project plans and specifications unless feasible and reasonable noise abatement measures are incorporated into the plans and specifications to reduce the noise impact on existing activities, developed lands, or undeveloped lands for which development is permitted.

(i) For design-build projects, the preliminary technical noise study shall document all considered and proposed noise abatement measures for inclusion in the NEPA document. Final design of design-build noise abatement measures shall be based on the preliminary noise abatement design developed in the technical noise analysis. Noise abatement measures shall be considered, developed, and constructed in accordance with this standard and in conformance with the provisions of 40 CFR 1506.5(c) and 23 CFR 636.109.

(j) Third party funding is not allowed on a Federal or Federal-aid Type I or Type II project if the noise abatement measure would require the additional funding from the third party to be considered feasible and/or reasonable. Third party funding is acceptable on a Federal or Federal-aid highway Type I or Type II project to make functional enhancements, such as absorptive treatment and access doors or aesthetic enhancements, to a noise abatement measure already determined feasible and reasonable.

(k) On a Type I or Type II projects, a highway agency has the option to cost average noise abatement among benefited receptors within common noise environments if no single common noise environment exceeds two times the highway agency's cost reasonableness criteria and collectively all common noise environments being averaged do not exceed the highway agency's cost reasonableness criteria.

Sec. 772.15 Federal participation.

(a) Type I and Type II projects. Federal funds may be used for noise abatement measures when:

(1) Traffic noise impacts have been identified; and

(2) Abatement measures have been determined to be feasible and reasonable pursuant to Sec. 772.13(d) of this chapter.

(b) For Type II projects.

(1) No funds made available out of the Highway Trust Fund may be used to construct Type II noise barriers, as defined by this regulation, if such noise barriers were not part of a project approved by the FHWA before the November 28, 1995.

(2) Federal funds are available for Type II noise barriers along lands that were developed or were under substantial construction before approval of the acquisition of the rights-of-ways for, or construction of, the existing highway.

(3) FHWA will not approve noise abatement measures for locations where such measures were previously determined not to be feasible and reasonable for a Type I project.

(c) Noise Abatement Measures. The following noise abatement measures may be considered for incorporation into a Type I or Type II project to reduce traffic noise impacts. The costs of such measures may be included in Federal-aid participating project costs with the Federal share being the same as that for the system on which the project is located.

(1) Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Landscaping is not a viable noise abatement measure.

(2) Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.

(3) Alteration of horizontal and vertical alignments.

(4) Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. This measure may be included in Type I projects only.

(5) Noise insulation of Activity Category D land use facilities listed in Table 1. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

Sec. 772.17 Information for local officials.

(a) To minimize future traffic noise impacts on currently undeveloped lands of Type I projects, a highway agency shall inform local officials within whose jurisdiction the highway project is located of:

(1) Noise compatible planning concepts;
(2) The best estimation of the future design year noise levels at various distances from the edge of the nearest travel lane of the highway improvement where the future noise levels meet the highway agency's definition of ``approach'' for undeveloped lands or properties within the project limits. At a minimum, identify the distance to the exterior noise abatement criteria in Table 1;
(3) Non-eligibility for Federal-aid participation for a Type II project as described in Sec. 772.15(b).

(b) If a highway agency chooses to participate in a Type II noise program or to use the date of development as one of the factors in determining the reasonableness of a Type I noise abatement measure, the highway agency shall have a statewide outreach program to inform local officials and the public of the items in Sec. 772.17(a)(1) through (3).

Sec. 772.19 Construction noise.

For all Type I and II projects, a highway agency shall:
(a) Identify land uses or activities that may be affected by noise from construction of the project. The identification is to be performed during the project development studies.

(b) Determine the measures that are needed in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community. This determination shall include a weighing of the benefits achieved and the overall adverse social, economic, and environmental effects and costs of the abatement measures.

(c) Incorporate the needed abatement measures in the plans and specifications.

TABLE 1 TO PART 772—NOISE ABATEMENT CRITERIA [Hourly A–Weighted Sound Level decibels (dB(A))[1]]				
Activity category	**Activity Leq(h)**	**Criteria[2] L10(h)**	**Evaluation location**	**Activity description**
A	57	60	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[3]	67	70	Exterior	Residential.
C[3]	67	70	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 structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.
F			Exterior	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] Either Leq(h) or L10(h) (but not both) may be used on a project.
[2] The Leq(h) and L10(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
[3] Includes undeveloped lands permitted for this activity category.

Appendix D State Noise Abatement Policy

I. Policy.

The Federal Highway Administration (FHWA) regulates highway traffic noise impact analysis, abatement procedures, criteria, coordination requirements, and reporting guidance in Title 23 Code of Federal Regulations, Part 772 (23 CFR 772) and published guidance. All transportation improvement projects developed in conformance with the Virginia Department of Transportation's guidelines shall be in conformance with those federal highway traffic noise impact analysis and abatement procedures and guidance mandated by FHWA.

Whenever the Commonwealth Transportation Board or the Department plan for or undertake any highway construction or improvement project and such project includes or may include the requirement for the mitigation of traffic noise impacts, first consideration should be given to the use of noise reducing design and low noise pavement materials and techniques in lieu of construction of noise walls or sound barriers. Vegetative screening, such as the planting of appropriate conifers, in such a design would be utilized to act as a visual screen if visual screening is required.

II. Administration of State Noise Abatement Policy.

The Commonwealth Transportation Commissioner or his designee, on behalf of the Commonwealth Transportation Board, is authorized to issue administrative procedures and additional guidance as may be necessary to implement this policy.

The Chief Engineer, on behalf of the Commonwealth Transportation Board, is authorized to make the final determination on all noise abatement related issues and will consult with the FHWA when those determinations involve federal regulation, policy and guidance.

The Chief Engineer will brief the Commonwealth Transportation Board members on all proposed changes to the Highway Traffic Noise Impact Analysis Guidance Manual.

Appendix E Activity Category C and D Calculation

Activity Category C Calculation Example

Suggested Treatment for Determining Noise Barrier Reasonableness for Activity Category C Areas

Federal Highway Administration (FHWA) noise abatement criteria include 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 structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings. within Activity Category C. The activity category is for exterior noise levels.

FHWA has required that states and agencies using Federal-aid highway funds develop feasibility and reasonableness criteria for noise barriers. The emphasis of such criteria focused primarily on residential sites since they represent the vast majority of noise-sensitive sites benefited by noise barriers. While barriers have been built in Virginia to protect parks and other recreational facilities, their construction was justified on a case-by-case basis by taking into consideration the type of activity, the duration of activity, and other issues not considered in determining the reasonableness of noise barriers for residential receptors. No formal or standard quantitative procedures for evaluating such land uses that would minimize the judgment needed to make those barrier decisions have been developed for Virginia or the majority of states.

Upon review of statewide barrier construction in Virginia, the following information was obtained:

Total Barrier Length = 134.8 miles (711,744 feet)
Average height = 16.6 feet
Total Barrier Area = 11,835,929 square feet
Average square feet per mile = 87,804

For a barrier to be determined to be cost effective (one of the reasonableness criteria), VDOT requires that the maximum square footage per benefited receptor not exceed 1,600 square feet. For a one mile long, average height barrier, protecting a single row of residences, this limiting value would be obtained with residential dwellings spaced at approximately 96 feet as calculated below:

87,804 s.f. per mile/1,600 s.f. per residence = 55 residences per mile
5,280 feet per mile/55 residences per mile = 96 feet per residence; round to 100 feet.

Assuming that park lands and other outdoor activities within Activity Category C will be treated in a similar manner as Activity Category B residential areas, the following procedure is presented for consideration:

1. Locate closest active area of park at each border of park closest to highway. Mark these points.
2. Draw a line connecting the above points and continue the line to the park boundaries.
3. Treat this line as the first row of receptors and space points at every 100 feet along this line beginning at the left side park boundary.
4. Using the above line and point as a base, establish a perpendicular grid with points spaced at 100 foot intervals in both directions. Mark only those points with areas that are publicly used.
5. Model all marked points and determine which ones are impacted (Leq noise levels greater than or equal to 66 dB(A) or substantial increase over existing noise levels). Only consider these points for barrier optimization. However, non-impacted sites shall count towards the barrier reasonableness calculation. Treat each site as one residence for all areas of public use.
6. Determine parameters (height, length, cost, benefited receptors, etc.) of the barrier system required to protect the park. If part of the barrier also protects adjacent residential areas, treat the entire barrier by adding benefited homes with qualifying park receptor points.
7. Calculate square feet per benefited receptor values.

Other factors which may be considered in the above evaluation include:

1. Adding value to sites (by treating as more than one residence each) based on park usage.
2. Adjusting value to sites based on existing noise level; quiet parks may warrant use of higher site values than parks with high existing levels.

This process is to be used for exterior uses at facilities as listed in Category C. However, it is not intended to be used for calculating the cost effectiveness of a noise barrier for the facilities listed in that category, such as radio studios and recording studios. These facilities are to be counted as a single receptor only. Contact the VDOT Noise Abatement Staff for further guidance.

Activity Category D Calculation Example

To address interior noise mitigation, a one to one conversion of the maximum square feet per benefited receptor to cost per benefited receptor is recommended using current engineering costs for noise barriers. A sample calculation is provided below, which assumes a cost of $42 per square feet for noise barrier materials and installation.

Example: if one receptor is predicted to experience interior noise level impacts, multiply the 1,600 maximum square feet by $42 per square feet for a total of $67,200 per benefited resident. Contact the VDOT Noise Abatement staff to obtain current engineering estimates.

Appendix F Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date: _____
Project No. and UPC: _____
County: _____
Facility: _____
Barrier System ID: _____
Noise Abatement Category(s) _____
Community Name and/or CNE# _____

Design phase: ☐ Preliminary Design ☐ Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). _____
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): _____
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." ☐ Yes ☐ No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? ☐ Yes ☐ No
   b. Project causes a substantial noise increase of 10 dB(A) or more? ☐ Yes ☐ No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: _____
   b. Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL): _____
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL _____
   d. Is the percentage 50 or greater? ☐ Yes ☐ No

2 Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues? ☐ Yes ☐ No

3 Will placement of the noise barrier restrict access to vehicular or pedestrian travel? ☐ Yes ☐ No

4 Will placement of the noise barrier conflict with existing utility locations? ☐ Yes ☐ No

Reasonableness

1. Cost-Benefit Factors
   a. Surface Area (Total square foot) of the proposed noise barrier. (ft^2) _____
   b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more. _____
   c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more. _____
   d. Total number of benefited receptors. _____
   e. Surface Area per benefited receptor unit. (ft^2/BR) _____
   f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600? _____
   g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year? _____

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details
   a. Length of the proposed noise barrier _____
   b Height range of the proposed noise barrier _____
   c. Average height of the proposed noise barrier _____
   d Cost per square foot. ($/$ft^2$) _____
   e. Total Barrier Cost ($) _____
   f. Additional comments (if applicable) _____
   g. Barrier material ☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED? ☐ Yes ☐ No
Is the Noise Barrier(s) FEASIBLE? ☐ Yes ☐ No
Is the Noise Barrier(s) REASONABLE? ☐ Yes ☐ No

Additional Reasons for Decision: _____

Appendix G Chief Engineer Concurrence Memorandum

Significant changes to the VDOT Highway Traffic Noise Impact Analysis Guidance Manual, Version 8, are highlighted in gray.

The signed concurrence memorandum is provided on the following page.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219 2000

Stephen Brich
Commissioner

February 20, 2018

MEMORANDUM

TO: Garrett W. Moore, P. E.

FROM: Angel N. Deem

SUBJECT: Highway Traffic Noise Impact Analysis Guidance Manual Update

The Department is adding new language to the guidance manual referenced above. The proposed language has been reviewed and approved by your office. Additionally, the proposed language has been approved by the Federal Highway Administration's (FHWA) Division and Headquarters offices on November 1, 2017.

The State Noise Abatement Policy states: *The Chief Engineer, on behalf of the Commonwealth Transportation Board, is authorized to make the final determination on all noise abatement related issues and will consult with the FHWA when those determinations involve federal regulation, policy and guidance.* The policy also states: *The Chief Engineer will brief the Commonwealth Transportation Board members on all proposed changes to the Highway Traffic Noise Impact Analysis Guidance Manual.*

As required by the State Noise Abatement Policy; concurrence from the Chief Engineer is requested. Should you have any questions, please contact James Ponticello at (804) 371-6769.

Angel N. Deem
Environmental Division Director

Approved _____
Garrett W. Moore, P.E.
Chief Engineer

Date Feb. 20, 2018

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Appendix H Single Impacted Receptor Methodology

In order to properly attenuate noise at a single impacted receptor, several noise sensitive sites must be evaluated to ensure the extent of the outdoor use area is benefited. Barriers for a single impacted receptor that are found to be feasible and reasonable should use the following methodology:

1. Place a boundary around the extent of the outdoor use area (associated with the single impacted receptor).

2. Additional noise sensitive sites are then placed at the opposite ends of both boundaries.

3. Extend the boundary limits of the of the outdoor use area to the proposed roadway, perpendicular to the roadway. The distance in-between the two extended limits creates a rough barrier length which should provide some attenuation to the impacted receptor however may not consider flanking noise. In order to address the flanking noise considerations in a similar manner to recommendations stated in the FHWA report, FHWA-EP-00-005, "FHWA Highway Noise Barrier Design Handbook," the evaluated barrier was extended in each direction by the same distance the noise sensitive site is located from the roadway. This method is based on FHWA's 4:1 ratio for the minimum distance between the noise sensitive site and the end of the barrier, though this method is closer to a 2:1 ratio.

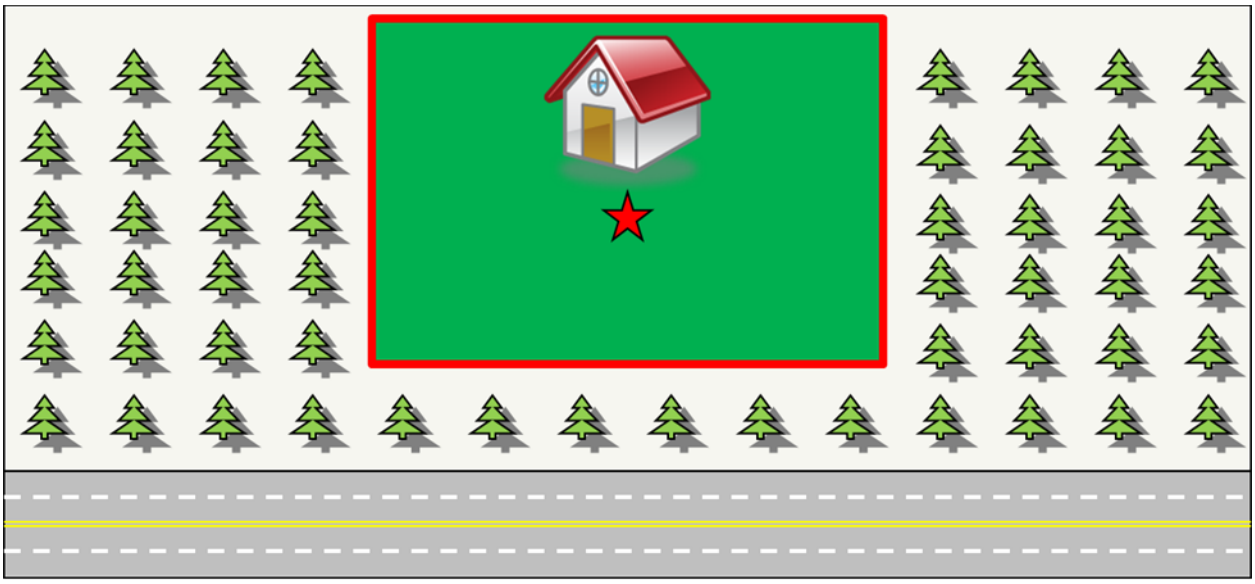
4. A final noise sensitive site is placed at the boundary extent in the middle of the barrier (assuming that the barrier was extended equally in both directions). These noise sensitive sites will predict the attenuation of the barrier at the future design year single receptor impact. This method ensures that the evaluated barrier is long enough to adequately address the impacted area.

Noise attenuation of a single receptor barrier is subject to both the feasible and reasonable criteria and the design goal of 7 dB(A). At a minimum, at least one evaluated noise sensitive site behind the evaluated barrier must meet the design goal of 7 dB(A), and the extents of the outdoor use area must receive at least a 5 dB(A) benefit. The barrier is considered to be feasible if it meets the noise attenuation conditions and counts as a single benefit towards the reasonableness criterion.

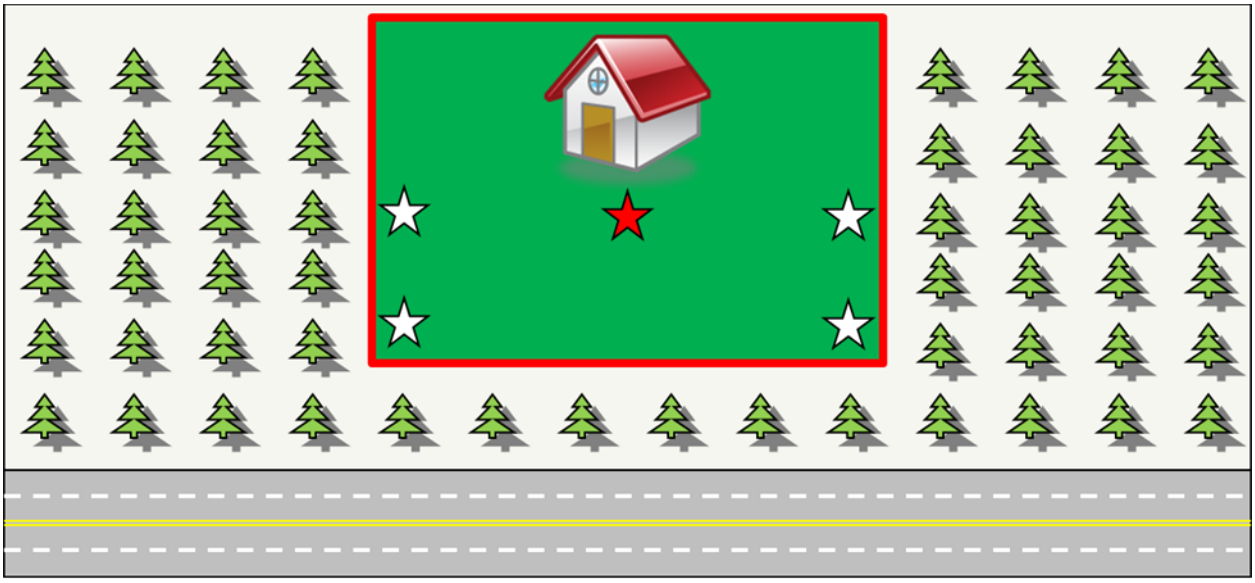
For example: A residence (Category B) on a parcel that has an outdoor use area that is 200 feet wide. By extending the limits of the outdoor use area to the roadways, the evaluated barrier is 200 feet. Since the residence associated with the outdoor use area is located 50 feet from the roadway, the evaluated barrier will be extended an additional 50 feet in both directions. The total **minimum** length of the evaluated barrier for this single receptor impact is 300 feet.

A sample graphics are provided below.

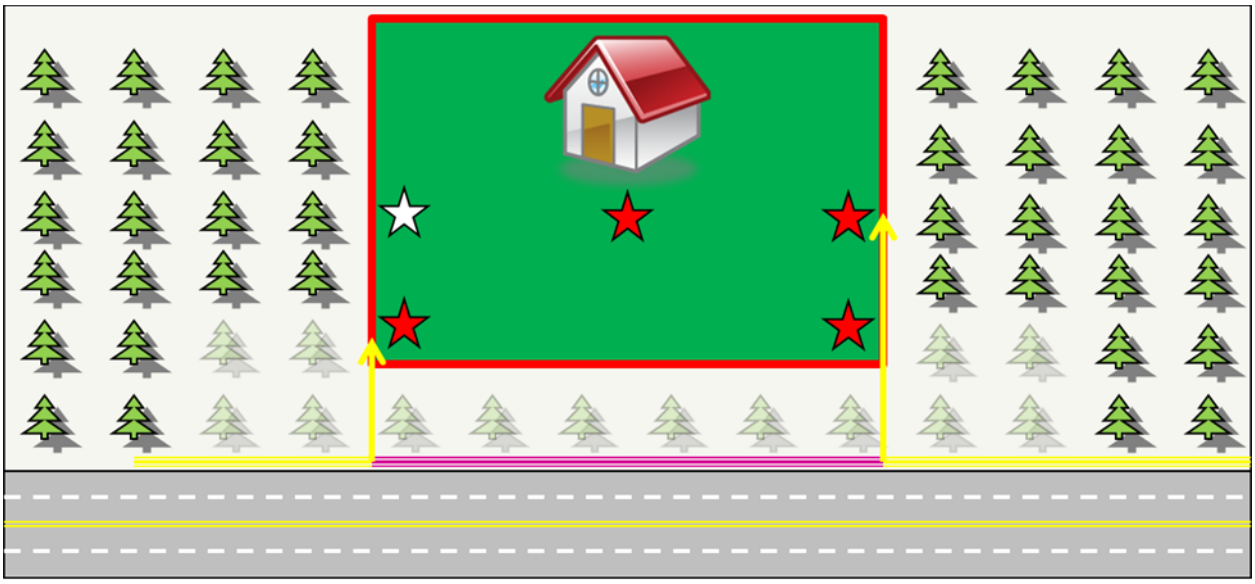
1) Place a boundary around the extent of the outdoor use area (associated with the single impacted receptor)



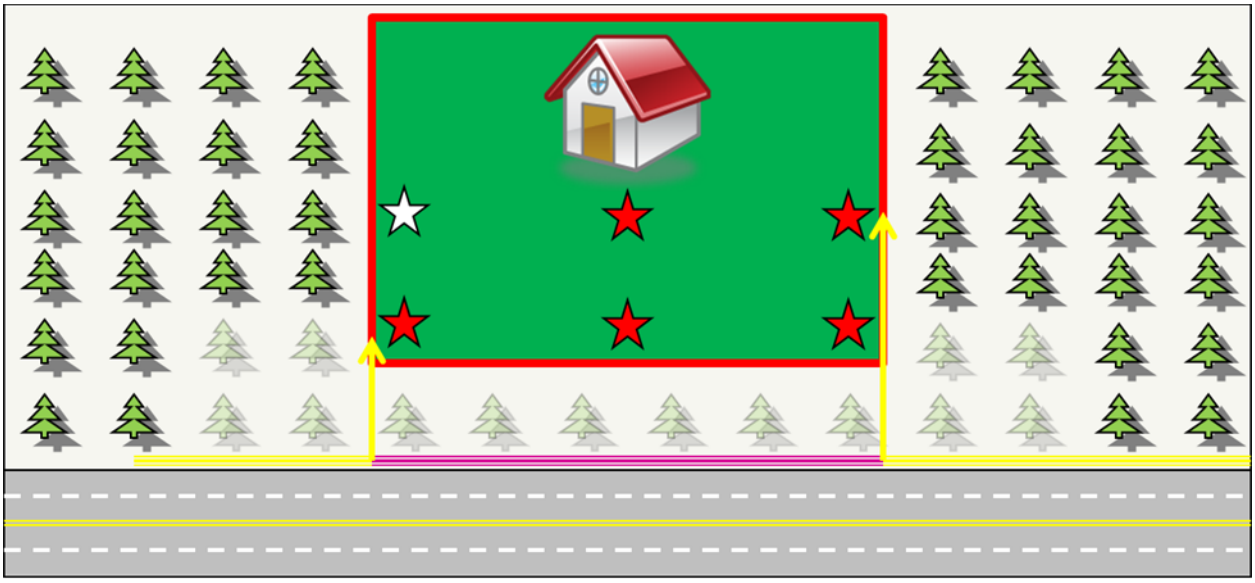
2) Additional noise sensitive sites are then placed at the opposite ends of both boundaries



3) Extend the boundary limits of the of the outdoor use area to the proposed roadway, perpendicular to the roadway. Also, extend the barrier in both directions



4) A final noise sensitive site is placed at the boundary extent in the middle of the barrier



The barrier may be shortened as long as the additional receptors are benefited as described in the methodology above.