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Massachusetts Department of Transportation
Type I and Type II Noise Abatement
Policy and Procedures

Glossary of Terms

Activity Categories – Categories of land use and human activities, established by the Federal Highway Administration, that are sensitive to noise in different ways. Each Activity Category has specific Noise Abatement Criterion. A discussion of the Activity Categories used in a highway traffic noise analysis is included in this policy and procedures document.

Approach the Criteria – For purposes of this document, approaching the criteria will mean noise levels that are 1 dB(A) less than the Noise Abatement Criteria for Activity Categories A to E listed in Table 3.

Benefited Receptor – A noise-sensitive receptor in the study zone that attains at least a 5 dB(A) insertion loss or greater from a noise abatement measure. A benefited receptor does not have to be an impacted receptor.

Cost Effectiveness Index (CEI) – An index that is based on cost, average insertion loss, and the number of benefited receptors and, if applicable, average time per visit. The CEI is one of the criteria used to determine the reasonableness of noise abatement in the study zone.

dB(A) – An A-weighted decibel unit that is used to measure noise. It best corresponds to the frequency response of the human ear.

Design Year – The future year used to estimate the probable traffic volume for which a highway is designed. It is typically 10 to 20 years from the start of construction.

Date of Public Knowledge – The date that the public is officially notified of the adoption of the location of a proposed highway project. The Date of Public Knowledge is defined as the date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD) on a proposed project. The definitions of CE, FONSI, and ROD are in Title 23, Code of Federal Regulations, Part 771 (23 CFR 771), Environmental Impact and Related Procedures.

Existing Noise Levels – The loudest hour noise levels from the combination of natural and mechanical sources and human activity that currently exist in a particular area. Existing noise levels generally should not include infrequent noise sources (e.g., lawn mowers).

Feasibility – The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure. Feasibility generally deals with considering whether it is possible to provide noise abatement given the site constraints and whether the noise abatement provides a minimum reduction in noise levels.
Future Noise Level – The highest hourly traffic noise level predicted using the Federal Highway Administration’s Traffic Noise Model.

Impacted Receptor – Any receptor that experiences a traffic noise impact.

Insertion Loss – Insertion loss is the amount of noise reduction provided by a noise abatement measure. For Type I projects, the insertion loss is the difference between design year build noise levels with the noise abatement measure and design year build noise levels without the noise abatement measure. For Type II noise projects, the insertion loss is the difference between current noise levels with the noise abatement to current noise levels without the noise abatement. Insertion loss is a function of a noise barrier’s height, length, and location and is independent of the magnitude of existing or future noise levels.

Leq – An equivalent steady-state noise level that accounts for the moment-to-moment fluctuations in noise levels from all sources during the time period under consideration. For highway noise analyses, one hour is the typical time period used.

Loudest Traffic Hour (LTH) – The one-hour period when the traffic characteristics regularly yield the highest traffic noise levels.

Noise Abatement – Any measure implemented to reduce highway traffic noise levels.

Noise Abatement Criteria (NAC) – The upper limit of acceptable highway traffic noise for different Activity Categories. The NAC varies according to Activity Category.

Noise Barrier – A physical obstruction constructed between the highway noise source and noise-sensitive receptors to reduce the traffic noise levels at noise-sensitive receptors. Noise barriers may be stand alone noise walls, noise berms (made of earth or other material), or combination berm/wall systems.

Noise Level – The noise level obtained through the use of A-weighting characteristics. The unit of measure is the decibel (dB) commonly referred to as dB(A) when A-weighting is used.

Noise Reduction Design Goal – The desired insertion loss. For residential areas and Activity Category C land uses, the noise reduction design goal is considered to be achieved when at least one first row benefited receptor attains a minimum of 10 dB(A) of insertion loss. The noise reduction design goal is also considered to be achieved when proposed noise abatement provides a minimum of 10 dB(A) of noise reduction for all receptors using Activity Category D facilities.

Noise-Sensitive Receptor – A discrete or representative location of a noise-sensitive area for any of the land uses listed in Table 3 where a lowered noise level would be of benefit. In cases where a representative location is used, the entire noise-sensitive area does not have to experience noise levels that approach or exceed the Noise Abatement Criteria.
Permitted – A definite commitment to develop land with an approved specific design of land use activities as evidenced by the existence of a currently valid building permit.

Reasonableness – The combination of social, economic, and acoustical factors considered in the evaluation of proposed noise abatement measures. Reasonableness implies that good judgment and common sense has been applied in arriving at a decision on the construction or installation of proposed noise abatement measures.

Statement of Likelihood – A statement of MassDOT’s intent to provide noise abatement measures at certain locations. The statement of likelihood is provided in the environmental clearance document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Study Zone – The study limits within which the design year traffic noise impacts from the proposed project occur. A highway traffic noise model is typically used to determine the extent of impacts from a proposed project.

Substantial Noise Increase – An increase in the design year noise level that is greater than 10 dB(A) over the existing noise level. A substantial noise increase is independent of the absolute existing noise level and is a noise impact even if future noise levels do not approach or exceed the NAC.

Traffic Noise Impacts – Impacts that occur when the existing noise levels or the predicted future build Loudest Traffic Hour (LTH) traffic noise levels approach (within 1 dB(A)) or exceed the Noise Abatement Criteria (NAC) listed in Table 3, or when the predicted future build LTH traffic noise levels create a substantial noise increase over existing noise levels.

Type I Noise Abatement Program – The Type I Noise Abatement Program is a Federal-aid highway program for Type I projects.

Type I Project – A Type I project is a project that involves:

(1) The construction of a highway on new location;
(2) The physical alteration of an existing highway where there is either a substantial horizontal alteration or a substantial vertical alteration;
(3) The addition of a through traffic lane(s);
(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane;
(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange;
(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.

A fuller discussion of Type I projects is included in Section 3.0, Type I Projects, in this policy and procedures document.
**Type II Noise Abatement Program** – The Type II Noise Abatement Program is a voluntary Federal-aid highway program for Type II projects (*i.e.*, projects that involve the construction of noise barriers on existing highways). Type II projects are often referred to as retrofit projects. The development and implementation of a Type II Noise Abatement Program is not required by Federal law or regulation and is strictly an optional decision by a State. MassDOT has a Type II Noise Abatement Program that is limited to noise impacts from Interstate Highways under its jurisdiction.

**Type III Project** – A Type III project is a project that does not meet the classification of a Type I or Type II project. Type III projects do not involve added capacity, construction of new through lanes or auxiliary lanes, changes in the horizontal or vertical alignment of the roadway, or exposure of noise sensitive land uses to a new or existing highway noise source. Type III projects do not require a noise analysis or consideration of noise abatement measures.
1.0 Background

The Federal Highway Administration (FHWA) is the Federal agency responsible for administering the Federal-aid highway program. Under this program, Federal funds are allotted by Congress to the individual states. Compliance with FHWA regulations is a prerequisite for the granting of Federal-aid highway funds for construction or reconstruction projects.

Studies have shown that some of the most pervasive sources of noise in our environment are those associated with transportation. Traffic noise can adversely affect human activities. Noise is considered problematic when it interferes with speech communication on the land use associated with the property.

Traffic noise tends to be a major source of noise to residences and businesses adjacent to highways, although it is not usually a serious problem for properties more than 500 feet from heavily traveled freeways. Vehicle noise is primarily a combination of the noises produced by the engine, exhaust, and tires.

In response to the highway traffic noise problem, in 1972, Congress required FHWA to develop a noise standard for new Federal-aid highway projects. This noise standard provided national criteria and requirements for all state transportation agencies and gave flexibility to states on how to approach the problem of highway traffic and construction noise in the planning and design of Federally aided highways. FHWA issued regulations for mitigation of highway traffic noise and construction noise, titled *Procedures for Abatement of Highway Traffic and Construction Noise*. The regulations are found in Part 772 of Title 23 of the Code of Federal Regulations (CFR), known more simply as 23 CFR 772.

FHWA’s noise regulations define two types of highway noise projects, Type I Projects and Type II Projects. Type I projects involve construction of new highways or improvements to existing highways. Type II projects are ‘stand alone’ projects that involve construction of noise barriers to reduce noise levels at residential areas (and other sensitive land uses) adjacent to existing highways. Type II projects are not constructed as mitigation for new or expanded highway construction. The development and implementation of Type II projects are not mandatory requirements of Federal law or regulation. A program to provide noise abatement along existing highways is strictly an optional decision by a State. The Massachusetts Department of Transportation (MassDOT) has established a program for both Type I and Type II projects.

2.0 Applicability

To enact its noise abatement program, MassDOT has developed these Type I and Type II Noise Abatement Policy and Procedures to comply with and to implement the noise regulations in 23 CFR 772, as well as to be in accordance with the FHWA’s Highway Traffic Noise Analysis and Abatement Guidance, dated June 2010 (revised January 2011). This document establishes consistent criteria and procedures for providing noise abatement for all Type I and Type II projects. It describes how highway traffic noise impacts are defined, how noise abatement is evaluated, and how
noise abatement decisions are made on all Type I and Type II projects in Massachusetts. Careful adherence to these procedures is vital to obtaining federal funding for construction or installation of proposed noise abatement and for the fair and equitable administration of the Type I and Type II Noise Abatement Program. FHWA has reviewed and has concurred with this policy and procedures document.

The effective date of this document is July 13, 2011. Beginning on and after that date, the requirements in this Type I and Type II Noise Abatement Policy and Procedures document apply uniformly and consistently to all Type I and Type II highway projects under MassDOT’s jurisdiction. The Type I and Type II Noise Abatement Policy and Procedures also apply to multimodal projects under MassDOT’s jurisdiction that receive Federal-aid highway funds or are otherwise subject to FHWA approval and that begin on or after July 13, 2011. MassDOT will consult with FHWA to determine if any additional analysis and documentation is needed for Type I and Type II highway projects begun before July 13, 2011, but requiring FHWA approvals on or after that date.

The Type I and Type II Noise Abatement Policy and Procedures are subject to change at the discretion of MassDOT and FHWA. MassHighway’s Type I Noise Barrier Guidelines, dated April 1, 1996, are superseded.

Federal-aid funds can only be used to reduce traffic noise impacts and provide highway traffic noise abatement benefits. These funds cannot be used as payment or compensation for a highway traffic noise impact through the purchase of a noise easement from a property owner. In addition, Federal-aid funds cannot be used to purchase homes or developed property to create a noise buffer zone.

MassDOT’s Type II Noise Abatement Program applies only to Interstate Highways with receptor locations that have been included in the Type II Noise Barrier Lists, as described in Section 4.0, Type II Projects.

If an area does not meet the feasibility and reasonableness criteria during the consideration of noise abatement on a Type I project, it will not be eligible for noise abatement under MassDOT’s Type II Noise Abatement Program.

MassDOT has posted this Type I and Type II Noise Abatement Policy and Procedures document on its Environmental Website. If there are any questions about whether a project is subject to the Type I and Type II Noise Abatement Policy and Procedures, please contact the MassDOT Environmental Services Section at 617-973-7484.

3.0 Type I Projects

A Type I project is a project that involves:

(1) The construction of a highway on new location;
(2) The physical alteration of an existing highway where there is either a substantial horizontal alteration or a substantial vertical alteration;
(3) The addition of a through traffic lane(s);
(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane;
(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange;
(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.

If any segment or component of a project (or a project alternative) is determined to be a Type I project under this definition, then the entire project, as defined in the environmental clearance document, is a Type I project and a highway traffic noise analysis is required for the entire project. A noise analysis is required for all Type I projects regardless of whether they occur on a controlled access highway or on an uncontrolled access highway. Furthermore, highway traffic noise analyses are required for all Type I projects, even when there is no change in the surrounding noise environment.

3.1 Highway on New Location

The construction of a highway on new location, as a Type I project, is self-explanatory. There was no highway before the construction, and there will be one afterwards.

The following actions are also highways on new location and are classified as Type I projects:

▷ The addition of new interchanges to an existing highway;
▷ The addition of lanes to existing interchange ramps that are carried to the mainline highway;
▷ The relocation of existing interchange ramps, and
▷ The addition of ramps to an existing partial interchange.

3.2 Physical Alteration of an Existing Highway

3.2.1 Substantial Horizontal or Vertical Alteration

Projects that involve a substantial horizontal alteration of the alignment of a highway are Type I projects. A substantial horizontal alteration is defined as the halving of the distance between the traffic noise source and the closest noise-sensitive receptor when comparing the existing condition to the future build condition.

Projects that involve a substantial vertical alteration of a highway are also Type I projects. A substantial vertical alteration occurs when a project removes the shielding between a noise-sensitive receptor and the highway, thereby exposing the line-of-sight of the previously shielded noise-sensitive receptor to the highway. This can occur by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise
source and the noise-sensitive receptor, such as by cutting back side slopes or other terrain features.

For example, a project that changes an at-grade intersection or an at-grade railroad crossing to a grade separation (i.e., an overpass) is a Type I project, because the project results in either a highway on new alignment or because the grade separation project substantially alters the vertical alignment of the existing highway. In some cases, for example railroad crossings, the grade separation project results in an overall benefit to the noise environment because of reduced requirements to sound train horns at grade-separated crossings.

Bridge replacement projects may be Type I projects if the bridge is realigned or is substantially different from the existing bridge.

3.2.2 Increase in the Number of Through Travel Lanes or Addition of Auxiliary Lanes

The addition of through travel lanes to the mainline of an existing highway requires consideration of the through traveled way (i.e., that portion of the highway constructed for the through movement of vehicles, exclusive of the shoulders and turn lanes). The lane addition must be a full lane width (i.e., 12 feet), and must increase the capacity of the highway. Since new through lanes result in added capacity, more traffic, and usually more traffic noise, the addition of a full lane to the mainline of a highway is a Type I project whether this lane is added in the median or on the outside of the existing highway. The addition of new through lanes requires a noise analysis on both sides of the highway whether the new lanes are all in one direction of travel or in both directions.

The addition of through travel lanes that function as high-occupancy vehicle (HOV) lanes, high-occupancy toll (HOT) lanes, bus lanes, or truck climbing lanes are classified as Type I projects. Frequently, HOV or HOT projects cause little or no change in the existing or future noise environment. However, highway traffic noise impacts may occur since existing noise levels may already approach or exceed the NAC. In these cases, noise abatement will be considered and implemented, if feasible and reasonable.

The addition of an auxiliary lane (i.e., a parking, weaving, or climbing lane) to an existing highway, except when the auxiliary lane is a turn lane, would be a Type I project.

New through lanes may be created through restriping projects. In this case, the pavement width of the existing highway would remain the same, but the project restripes the existing pavement to increase the number of through travel lanes or auxiliary lanes. Creation of through lanes through restriping would be a Type I project.

Allowance of the use of the shoulder (breakdown lane) during peak periods would be a Type I project since the shoulder would function as a through travel lane.

3.2.3 Changes to Highway Ancillary Facilities

The following projects involving highway ancillary facilities are considered Type I projects:
Construction of a new truck weigh station or rest area;
Improvements to an existing truck weigh station or rest area that involve increased capacity for overnight parking or involve relocation of parking facilities closer to noise-sensitive land uses;
Construction or expansion of an existing ride-share lot and access roads to a ride-share lot; and
Construction of a new toll plaza or substantial alteration of an existing toll plaza.

Since these land uses involve a mix of stationary and mobile sources, they require special attention and consideration for determining existing and future noise levels. Noise analysts should develop a methodology, in coordination with MassDOT, to determine existing and future noise levels at these locations.

4.0 Type II Projects

Because there are many residential areas in Massachusetts adjacent to highways that are exposed to high noise levels (i.e., noise levels that exceed FHWA’s NAC described in the Section 5.1, Noise Abatement Criteria), the then-Massachusetts Highway Department (MassHighway) decided to implement a Type II Noise Abatement Program. Because of the high cost of design and construction (approximately $3 million to $5 million per mile in 2010), noise barrier projects could not be constructed along all highways under MassHighway’s jurisdiction. MassHighway, therefore, chose to limit its Type II Noise Abatement Program to noise impacts from Interstate Highways under its jurisdiction at the time. In addition, in Massachusetts, traffic volumes and speeds are highest on the Interstate Highways. To target the locations most affected by noise, only Interstate Highways were considered in the in the Type II Noise Attenuation Study conducted in 1988.

In March 1988, MassHighway completed a statewide noise study to determine the areas most adversely affected by noise from Interstate Highways. In determining and abating traffic noise impacts, MassHighway primarily considered exterior areas where frequent human use occurs. The statewide noise study allowed MassHighway to develop an equitable approach to mitigating highway noise. The study, named the Massachusetts Type II Noise Attenuation Study (the Type II Study), established a Final Priority List to rank the 53 locations along Interstate Highways under MassHighway’s jurisdiction most seriously affected by noise from the highways. Locations along the Massachusetts Turnpike were not included as part of the Type II Study because the Massachusetts Turnpike was under the authority of the Massachusetts Turnpike Authority at the time and not MassHighway. MassHighway’s Type II Priority List is presented in Table 1.

In an effort to improve the quality of life along the Massachusetts Turnpike and in response to the concerns of its neighbors, in 1992, the then-Massachusetts Turnpike Authority established a priority listing of areas where noise barriers were determined to be cost effective. The Massachusetts Turnpike Authority’s Noise Barrier Priority List is presented in Table 2.

The Massachusetts Transportation Reform Act was signed into law in June 2009 and consolidated all Massachusetts’ transportation agencies into one newly-established Massachusetts Department of Transportation (MassDOT). Under the law, the Massachusetts Turnpike Authority and MassHighway
were merged into the Highway Division of MassDOT. Because there is one MassDOT, there is no need to have two separate Type II Noise Barrier Priority Lists. MassDOT will create a new combined Type II Noise Barrier Priority List by merging locations from the two separate Type II noise barrier priority lists that have not yet had Type II noise barriers designed or constructed. Development that occurred between May 14, 1976 and November 28, 1995 at these locations would be considered and the priority points would be recalculated. Moving forward, MassDOT will then systematically examine these locations listed in the combined list, in the order of their ranking, to determine the feasibility and reasonableness of future Type II noise barriers. MassDOT will reanalyze the methodology used to create its Type II Noise Abatement Program at least every five years.
<table>
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<td>Milton/Quincy</td>
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<td>36</td>
<td>Lowell</td>
<td>I-495</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>37</td>
<td>Wilmington</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>38</td>
<td>Wilmington</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>39</td>
<td>Wilmington</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>40</td>
<td>Chelmsford</td>
<td>I-495</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>41</td>
<td>Reading/Wakefield</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>42</td>
<td>Methuen</td>
<td>I-93</td>
<td>Studied Under Type I Program. Feasible and Reasonable.</td>
</tr>
<tr>
<td>43</td>
<td>Chelmsford/Westford</td>
<td>I-495</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>44</td>
<td>Randolph/Quincy</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>45</td>
<td>Chelmsford</td>
<td>I-495</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>46</td>
<td>Chelmsford</td>
<td>I-495</td>
<td>Studied Under Type I Program. Not Reasonable.</td>
</tr>
<tr>
<td>47</td>
<td>Methuen</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>48</td>
<td>Chelmsford</td>
<td>I-495</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>49</td>
<td>Wilmington</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>50</td>
<td>Chelmsford</td>
<td>I-495</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>51</td>
<td>Medford</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>52</td>
<td>Medford</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>53</td>
<td>Braintree</td>
<td>I-93</td>
<td>To Be Studied</td>
</tr>
</tbody>
</table>
Table 2 Massachusetts Turnpike Authority’s Noise Barrier Priority List

<table>
<thead>
<tr>
<th>Rank</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Newton, Barnes Road/Hunnewell Avenue</td>
<td>Constructed</td>
</tr>
<tr>
<td>2</td>
<td>Newton, Bowers Street</td>
<td>Constructed</td>
</tr>
<tr>
<td>3</td>
<td>Newton, Curve/Crescent Street</td>
<td>Constructed</td>
</tr>
<tr>
<td>4</td>
<td>Newton, Charlesbank Road</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>5</td>
<td>Newton, Charles Street</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>6</td>
<td>Newton, Austin Street</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>7</td>
<td>Ludlow, Cady Street</td>
<td>Constructed*</td>
</tr>
<tr>
<td>8</td>
<td>Brighton, Riverview Road</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>9</td>
<td>Allston, Lincoln/Franklin Street</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>10</td>
<td>Natick, Hammond Road</td>
<td>Constructed</td>
</tr>
<tr>
<td>11</td>
<td>Brighton, Lincoln/S. Waverly Street</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>12</td>
<td>Newton, Auburn/Central Street</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>13</td>
<td>Ludlow, West Avenue</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>14</td>
<td>Newton, Washington/Brookside Avenue</td>
<td>To Be Studied</td>
</tr>
<tr>
<td>15</td>
<td>Framingham, Westgate Road</td>
<td>Constructed</td>
</tr>
<tr>
<td>16</td>
<td>Ludlow, Davis/Fuller Street</td>
<td>Constructed</td>
</tr>
<tr>
<td>17</td>
<td>Chicopee, Whitin Street</td>
<td>To Be Studied</td>
</tr>
</tbody>
</table>

*Constructed berm with landscaping per community wishes

5.0 Analysis of Highway Traffic Noise Impacts

Federal regulations require the following actions during the planning and design of a Type I or Type II highway project: (1) identification of highway traffic noise impacts; (2) examination of potential noise abatement measures; (3) incorporation of feasible and reasonable highway traffic noise abatement measures into the highway project; (4) coordination with local officials to provide helpful information on compatible land use planning and control and, in the case of a Type II project, to provide information on eligibility requirements for Federal-aid participation; and (5) identification and incorporation of necessary measures to abate construction noise.

A three-part procedure is used for determining if the construction or installation of Type I or Type II noise abatement is appropriate. These three procedures are as follows:

- Analysis of highway traffic noise impacts;
- Determination of the feasibility of noise abatement; and
- Determination of the reasonableness of noise abatement.

MassDOT will only consider locations on the Type II Noise Barrier Priority Lists for protection under its Type II Noise Abatement Program. If any locations on the Type II Noise Barrier Priority Lists are within the study areas of future Type I projects, MassDOT will consider noise abatement at those locations as part of the Type I projects.
5.1 Noise Abatement Criteria

FHWA has established Noise Abatement Criteria (NAC) to help protect public health, welfare, and livability from excessive vehicle traffic noise. FHWA considered numerous approaches in establishing the NAC. The use of NAC for hearing impairment or for annoyance, sleep, or task interference or disturbance was determined to be impracticable. NAC for interference with speech communication was well researched and was determined to be usefully applied to the problem of highway noise. This was a compromise between noise levels that are desirable and those that are achievable. The NAC are described in Table 3.

Table 3: Noise Abatement Criteria (NAC)

<table>
<thead>
<tr>
<th>Activity Category</th>
<th>One-Hour, A-Weighted Noise Levels in Decibels (dB(A))</th>
<th>Description of Activity Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>57 (Exterior)</td>
<td>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 purposes.</td>
</tr>
<tr>
<td>B**</td>
<td>67 (Exterior)</td>
<td>Residential.</td>
</tr>
<tr>
<td>C**</td>
<td>67 (Exterior)</td>
<td>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.</td>
</tr>
<tr>
<td>D</td>
<td>52 (Interior)</td>
<td>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.</td>
</tr>
<tr>
<td>E**</td>
<td>72 (Exterior)</td>
<td>Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in Categories A-D or F.</td>
</tr>
<tr>
<td>F</td>
<td>--</td>
<td>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.</td>
</tr>
<tr>
<td>G</td>
<td>--</td>
<td>Undeveloped lands that are not permitted.</td>
</tr>
</tbody>
</table>

* Leq (h) is an energy averaged, one-hour, A-weighted noise level in decibels (dB(A)). The Leq(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.

** Includes undeveloped lands permitted for this Activity Category.


Type I and Type II noise analyses must evaluate noise levels in each Activity Category in the study zone (except Activity Category F).

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Massachusetts Department of Transportation
Type I and Type II Noise Abatement Policy and Procedures
Activity Category A includes 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. While it is appropriate for the determination of Activity Category A receptors to occur early in the process and through an interagency consultation process; the final determination for this designation remains with FHWA. Before MassDOT initiates any noise analysis, it will submit justification to FHWA for approval of any designations of land use as Activity Category A, if necessary. Activity Category A land uses are analyzed using the lower Activity Category A NAC even if the land use is within an Activity Category with a higher NAC.

Activity Category B includes the exterior impact criterion for single family (including mobile home parks) and multifamily residences. MassDOT will also treat hotels and motels that serve as long-term residential units as Activity Category B, rather than Activity Category E.

Activity Category C includes the exterior areas of a variety of nonresidential land uses not specifically covered in Activity Category A or B. This category may include public or private facilities. The procedures discussed in the document titled Massachusetts Department of Transportation Methodology for the Determination of Cost Effectiveness of Proposed Noise Abatement for Activity Category C Land Uses and Activity Category D Facilities should be used to determine the number of impacted receptors, the number of benefited receptors, and cost effectiveness of construction of proposed noise barriers for the land uses listed in Activity Category C.

Activity Category D includes the interior impact criterion for the facilities listed in Activity Category C that may have interior uses. For Activity Category D land uses, MassDOT will consider an indoor noise analysis only after it has fully completed an analysis of any outdoor activity areas and has determined that noise barriers are not feasible and reasonable for those exterior areas. In situations where no exterior activities are to be affected by the traffic noise (a typical example would be a public meeting room with no outdoor common grounds activity areas), or where the exterior activities are far from or physically shielded from the roadway in a manner that prevents an impact on exterior activities, MassDOT will use Activity Category D as the basis for determining noise impacts. The procedures discussed in the document titled Massachusetts Department of Transportation Methodology for the Determination of Cost Effectiveness of Proposed Noise Abatement for Activity Category C Land Uses and Activity Category D Facilities should be used to determine the number of impacted receptors, the number of benefited receptors, and cost effectiveness of proposed noise abatement for the facilities listed in Activity Category D.

Activity Category E is the exterior impact criterion for developed lands that are less sensitive to highway traffic noise. Activity Category E includes motels, hotels, offices, and other developed lands not included in Activity Category A through D or in Activity Category F. In the rare case where an Activity Category E land use has one or more exterior areas of frequent human use that are subject to noise impacts (i.e., has noise levels that approach or exceed 72 dB(A), MassDOT would use the approach used for Activity Category C land uses to determine the reasonableness of noise abatement measures.
Activity Category F includes developed lands that are not sensitive to highway traffic noise and/or do not have exterior areas of frequent human use and therefore no activity criteria is appropriate to apply. There is no impact criterion for the land use facilities in this Activity Category and no noise analysis or consideration of noise abatement measures is required for these locations.

Activity Category G includes undeveloped lands. Undeveloped land is not sensitive to highway traffic noise and does not have exterior areas of frequent human use. For undeveloped lands, no NAC is established and consideration of mitigation is not required.

In some cases, lands that are undeveloped at the time of the project may be known to be permitted for development in the future. MassDOT considers the existence of a currently valid building permit issued by the local jurisdiction or by the appropriate governing entity as defining undeveloped lands for which development is permitted. If undeveloped land is determined to be permitted (i.e., a building permit has been issued on or before the Date of Public Knowledge), then the land will be assigned to the appropriate Activity Category and be analyzed 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, MassDOT will determine the distance from the roadway to the exterior NAC for each Activity Category in Table 3 and provide this information to local officials through the project’s environmental clearance documents and noise analysis documents. Federal and State funding of noise abatement measures will not be considered for lands that are not permitted by the Date of Public Knowledge. If the local government allows development to occur on undeveloped lands where highway noise impacts were predicted to occur, then mitigation will be the responsibility of the local government and/or property owner.

5.2 Highway Traffic Noise Impact Determination

For Type I projects, MassDOT recognizes and considers absolute noise levels as well as substantial increases in noise levels when identifying highway traffic noise impacts. MassDOT considers noise impacts to occur in an area when existing or future computed noise levels approach (within 1 dB(A)) or exceed the FHWA NAC for Activity Categories A through E; or when the computed future (design year) build noise levels exceed the loudest existing noise levels by 10 dB(A) or more in Activity Categories A through E.

For Type II projects, MassDOT determines traffic noise impacts based on current year conditions and considers noise impacts to occur in an area when existing computed noise levels approach (within 1 dB(A)) or exceed the FHWA NAC for Activity Categories A through E. Noise abatement measures are to be evaluated at Type II locations to determine if noise abatement measures are reasonable and feasible.

In accordance with FHWA’s noise regulations, all noise analyses must be conducted using the FHWA Traffic Noise Model (TNM) Version 2.5 (or the latest version) or by using any other model FHWA determines to be consistent with the methodology of the FHWA TNM. The use of
TNM Lookup Tables on Type I or Type II projects is no longer acceptable. Furthermore, while noise contour lines are useful for project alternative screening and for providing information to local officials, they shall not be used for determining highway traffic noise impacts.

In determining and abating traffic noise impacts, MassDOT primarily considers exterior areas where frequent human use occurs. A one-hour Leq is used for assessing highway noise impacts on different land uses. Interior noise levels for Activity Category D land uses can be derived by subtracting the building noise reduction factors in Table 4 from the predicted exterior noise levels for the building in question.

### Table 4 Building Noise Reduction Factors

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Window Condition *</th>
<th>Noise Reduction Caused By Exterior of the Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Open</td>
<td>10 dB</td>
</tr>
<tr>
<td>Light Frame</td>
<td>Ordinary Sash (closed)</td>
<td>20 dB</td>
</tr>
<tr>
<td></td>
<td>Storm Windows</td>
<td>25 dB</td>
</tr>
<tr>
<td>Masonry</td>
<td>Single Glazed</td>
<td>25 dB</td>
</tr>
<tr>
<td></td>
<td>Double Glazed</td>
<td>35 dB</td>
</tr>
</tbody>
</table>

*The windows shall be considered open unless there is firm knowledge that the windows are kept closed almost every day of the year.


### 5.3 Data Collection and Determination of Existing Noise Levels

Collection of data in the project area, such as identification of existing activities, developed land, and undeveloped land; traffic data; and noise measurements are needed to determine the existing noise levels used in the noise analysis.

#### 5.3.1 Identification of Existing Activities, Developed Land, and Undeveloped Land

Geographic Information Systems (GIS), zoning maps, coordination with local officials, other data sources, and field verification are typically used in the data collection effort to identify existing activities, developed land, and undeveloped land. In some cases, lands that are undeveloped at the time of the project may be known to be under consideration for development in the future. The FHWA regulations refer to these lands as “undeveloped lands for which development is permitted” and the highway noise impact on these lands should also be assessed. MassDOT considers the existence of a currently valid building permit as defining undeveloped lands for which development is permitted. If the local government allows development to occur on undeveloped lands where highway noise impacts were predicted to occur, then mitigation will be the responsibility of the local government and/or property owner.

Residences may be owner-occupied, rented, or leased. All residences in a multifamily facility that are predicted to experience highway traffic noise impacts are counted as impacted receptors. This may include units above the ground level.
Multifamily residential units often have associated common outdoor areas for recreational or other use (e.g., a pool). These common areas are typically available for use by all residents of the multifamily facility. MassDOT will coordinate with the owner or manager of the multifamily residence to obtain information on the actual use, potential use, and capacity limits of the impacted common areas. This information will then be used to determine the number of receptors to be used in the noise analysis for these impacted common areas.

For Activity Category C land uses, receptors should be placed at the closest location to the highway right-of-way line where frequent human activity normally occurs to determine if the NAC is approached or exceeded. If the NAC is approached or exceeded at the right-of-way line, receptors should also be placed at locations away from the right-of-way line to determine the extent of impact. Parking lots are not to be considered as valid receptor locations. A fuller discussion of determining noise-sensitive receptors in Activity Category C land uses is included in the document titled *Massachusetts Department of Transportation Methodology for the Determination of Cost Effectiveness of Proposed Noise Abatement for Activity Category C Land Uses and Activity Category D Facilities*.

All users of Activity Category D facilities would be considered receptors because they would each experience the same interior noise levels when they use the facility. If the interior noise levels approach or exceed the noise abatement criterion of 52 dB(A), then each user would be an impacted receptor.

MassDOT will determine the number of receptors for outdoor activity areas in Activity Category E land uses in the same manner as the number or receptors determined for common outdoor areas for multifamily residences.

### 5.3.2 Traffic Data

Noise levels from highway traffic are affected by three factors: (1) the number of vehicles; (2) the speed of the traffic; and (3) the vehicle mix in the flow of traffic. For purposes of the highway traffic noise analysis, motor vehicles fall into one of five categories: (1) automobiles (vehicles with two axles and four tires); (2) medium trucks (cargo vehicles with two axles and six tires); (3) heavy trucks (cargo vehicles with three or more axles); (4) buses (vehicles designed to carry more than nine passengers); and (5) motorcycles (vehicles with two or three tires and an open-air driver/passenger compartment). The percentage of automobiles, medium trucks, heavy trucks, buses, and motorcycles and the directional distribution factor should be collected for the existing year and analyzed for the design year.

Traffic data can be used to narrow the time period that could potentially be the Loudest Traffic Hour (LTH). Generally, the loudness of highway traffic noise is increased by heavier traffic volumes, higher vehicle speeds, and greater numbers of heavy trucks. Contrary to popular belief, in heavily congested urban areas, the LTH typically does not occur during the peak traffic hour because, while the peak traffic hour will have the highest traffic volumes, these traffic volumes may not represent the worst noise conditions (i.e., they operate low speeds and heavy truck volumes drop as truckers try to avoid severe congestion). In this case, highway traffic noise levels would be lower. Usually, the LTH along a highway occurs just before or after the peak traffic hour.
hours when the vehicle volume, speeds, and the truck-to-auto ratio are in a combined optimum condition to yield the highest hourly noise level. The noise analysis should use the LTH when modeling potential noise impacts.

5.3.3 Noise Measurements

The purpose of field noise measurements is twofold: (1) to help establish the existing noise levels in the LTH for projects on existing highway alignment as well as for projects on new highway alignment and (2) to validate or calibrate the computer noise model (FHWA’s Traffic Noise Model (TNM)).

Field noise measurements should be conducted along existing or proposed roadway segments or links that are near existing and permitted noise-sensitive receptors that may be affected by the proposed project. All field monitoring should be conducted in accordance with FHWA’s guidance document titled *Measurement of Highway-Related Noise*, dated May 1996. Field noise measurements should not be taken under wet or snowy conditions. ANSI Type I or Type II integrating sound level meters should be used to measure noise in the field. The noise monitor should be calibrated at least at the beginning and end of each measurement session. Additional calibrations are recommended if the measurement session lasts more than three hours, or if there are monitoring site changes with more than one hour of down time in between noise measurements. If the final calibration differs from initial calibration by greater than 1 dB(A), all measurements should be discarded and repeated. All acoustic instrumentation should be calibrated annually by its manufacturer, or other certified laboratory to verify accuracy.

Generally, a one-hour highway noise measurement can be statistically accurate if a minimum of approximately 15 minutes of measurements is conducted. This assumes that motor vehicles are the dominate noise source and hourly sound levels are reasonably constant.

There are a number of factors to be considered in determining the LTH. Time of day is one factor. Both a peak traffic period and non-peak period noise measurement may be required to verify LTH noise levels. An example of a situation where this would be required is on highly congested facilities where trucks avoid peak automobile travel periods. The day of week (weekend versus workday) is another consideration. Finally, the week of year (for example, tourist season versus off-season) may need to be taken into account. Using time periods during different seasons are only appropriate if initial investigations did not identify an existing noise impact.

There are three options that may be used for determining the LTH:

- **Option #1**: Evaluation of the weekday hourly traffic volumes and speeds to identify a time period, such as mid- to late afternoon or mid- to late morning, to conduct hourly noise measurements to identify the LTH. This approach assumes that the traffic data can reasonably eliminate other time periods, such as evening and peak traffic hours.

- **Option #2**: Monitoring of noise for 24-hour weekday period to identify the LTH.
Option #3: Requesting MassDOT’s approval of other methods to establish the LTH. Some projects may have unique impacts on traffic volumes, speeds, and/or truck percentages that require a different approach for establishing the LTH.

Where more than one receptor is clustered together, noise measurements at a single site can be taken as representative of a group of receptors. A representative location is one that has a common noise environment for all the receptors in a group. For proposed highways on new alignments where no highway currently exists, measurements should be taken at representative receptor locations.

The entire project area should be reviewed to determine if there are other highway noise sources in the area (for example, the presence of local cross streets) or any unusual noise sources (such as barking dogs) that may influence the ambient noise readings. When non-highway transportation noise sources affect the noise environment next to a highway, the magnitude of this impact should be assessed. If the highway project is near a rail line, rail noise levels should be calculated using the procedure in the FHWA document titled *Advanced Prediction and Abatement of Highway Traffic Noise*, dated June 1982. Transit noise should be calculated by using the procedures in the Federal Transit Administration’s *Transit Noise and Vibration Impact Assessment Guidance*, dated May 2006.

Measuring noise in exterior areas of frequent human use is the primary consideration for the noise analysis. Exterior areas of frequent human use are normally at ground level. Measurements should usually be taken in an area between the right-of-way line and the building where frequent human activity occurs, such as a patio or the yard of a home.

When analyzing areas with multifamily dwelling units (*e.g.*, apartments, condominiums, etc.), measurements should be taken at an exterior area, such as a patio, playground, or picnic area between the highway and the actual building, if one exists. If there are no ground level exterior areas at multifamily facilities, a balcony/deck location may be chosen for analysis. If there are no exterior areas of frequent human use at all, such as at churches, hospitals, or libraries (*i.e.*, Activity Category D land uses), interior measurements can be made and the analysis should be completed using the interior NAC.

Another purpose of field noise measurement is validation or calibration of the accuracy of the noise model runs used to predict existing or future noise levels for the project. The noise model runs should be validated or calibrated using the data collected in the measurement phase. All existing and future noise level predictions should be made for the LTH of the day. If the noise level measurements and the predicted noise levels from the noise model runs for the existing condition are within reasonable limits (±3 dB(A)), then it can be assumed that the noise model runs have been properly validated and are then reliable for computing the loudest noise levels in the study zone. If the noise model runs are not within ±3 dB(A) for all the measurements at all the sites, then the noise model runs are not considered valid until additional measurements are made or until the reason for the discrepancy is identified and a correction is made within the model.

Calibration of noise model runs, where the user adjusts the noise level at a specific receiver to account for differences between measured and modeled noise levels, is not routinely advisable. Problems with validating most noise model runs usually are due to input errors rather than problems.
with the noise model runs and users are encouraged to exhaust input options before making receiver adjustments. Typically, calibration involves situations where the noise model runs are consistently over-predicting or under-predicting by an amount greater than 3 dB(A). A possible solution is to adjust the noise model runs by the difference between the measured and predicted values. The reasons or causes for the difference between measured and predicted highway traffic noise levels, as well as the actual level of the adjustment, must be determined and documented in the analysis. Generally, differences in measured and predicted noise levels greater than ±3 dB(A) occur because of a site condition not accounted for in the noise model runs, such as ground type, meteorological effects, or contributions from non-transportation-related noise sources.

5.4 Prediction of Future Noise Levels (Type I Projects Only)

After determination of the existing noise levels, the next step in the noise analysis for Type I projects is prediction of future noise levels. If noise abatement is proposed, only FHWA’s TNM may be employed to determine the future noise levels in the study zone and to determine any proposed noise barrier’s dimensions.

Input parameters necessary to run the TNM include:

- Distance from the center of each roadway to each receptor;
- Width of roadway and lanes;
- Height of the receptor;
- Barrier/buffer information, such as trees, berms, and structures;
- Type of propagation path (hard versus soft);
- Variations in terrain between the receptor and the source; and
- Grade, if any.

Noise level predictions are required for all alternatives under detailed study in the environmental clearance document. The following conditions should be included in the noise analysis.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Build</td>
<td>Existing and Design Year</td>
</tr>
<tr>
<td>All Build</td>
<td>Design Year Only</td>
</tr>
</tbody>
</table>

High speed lane(s) with no trucks are typically modeled as a single roadway in the TNM. The remaining lanes would then be grouped and modeled as a single roadway also. In both cases, the shoulder width is included in the model.

Noise-sensitive receptors should generally be modeled individually. For long corridors or for project alternative screening, receptors can be grouped and modeled.
5.5 Noise Abatement Measures

Noise abatement measures may be considered in the following priority when analyses indicate the need for their consideration.

1. Traffic management measures, such as traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, reduced speed limits, and exclusive lane designations.

2. Alteration of horizontal or vertical alignment.

3. Construction of noise barriers including acquisition of property rights, either within or outside the highway right-of-way.

4. Acquisition of predominately unimproved property to serve as a buffer zone to preempt development that would be adversely affected by traffic noise. (Type I projects only).

5. Noise insulation of Activity Category D land use facilities listed in Table 3.

Measures such as traffic management, alteration of alignment, or purchase of land for use as a buffer zone usually do not provide substantial noise reduction, or are found to be not feasible and reasonable because of cost, right-of-way requirements, or project purpose. Noise insulation is less likely to be used also. Thus, the most-used noise abatement measure is the noise barrier. Noise barriers are most effective along limited-access highways. Noise barriers are ineffective in situations where there are numerous intersecting streets or driveway openings because of the gaps that are required.

Planting of vegetation or landscaping is not an effective or acceptable noise abatement measure because only dense stands of evergreen vegetation at least 100 feet deep will reduce noise levels.

6.0 Determination of Feasibility of Constructing or Installing Noise Abatement

MassDOT considers engineering and acoustical factors in evaluating when noise abatement is feasible. Feasibility involves determining whether it is possible to build a noise barrier given the site constraints and determining whether the noise abatement provides a minimum reduction in noise levels.

6.1 Engineering Feasibility

For a noise barrier to be engineerly feasible, it must be able to be constructed given the existing topography and taking into consideration the presence of local cross streets; bridge structures over or along the highway; access requirements for driveways or ramps;
drainage, safety, or maintenance requirements; utilities; environmental impacts; and
other predominating noise sources in the area (e.g., aircraft overflights).

Safety factors that should be considered in determining the feasibility of a proposed noise barrier
include maintaining a clear recovery zone, redirection of crash vehicles, adequate sight distance,
fire access, and emergency vehicle needs. Motorist sight distance requirements are included in the
American Association of State Highway and Transportation Officials’ (AASHTO) fifth edition of
*A Policy on Geometric Design of Highways and Streets*.

In determining the feasibility of a proposed noise barrier, maintenance of the noise barrier must be
considered. The proposed noise barrier should not be in a location that makes maintenance of the
noise barrier difficult. It should also be located so that there is sufficient distance (typically,
10 feet) for snow storage between the roadway and the noise barrier. The proposed noise barrier
should not be made of material that is hard to maintain. Access rights or easements required for
maintenance will normally be by donation, since the construction of the noise barrier is for the
benefit of the property owners.

The impact of proposed noise barriers on utilities and the converse must be assessed.
Large overhead power lines, underground water, sewer, gas, fiber optic, and oil lines can have a
major impact on costs and design options.

Environmental impacts are also important factors in determining whether a noise barrier is
feasible. It is unlikely that MassDOT would find a Type I or Type II noise barrier feasible if the
construction of the barrier, by itself, would result in substantial impacts to environmental
resources. For example, a noise barrier should not require filling an amount of wetlands that
requires a Variance from the Massachusetts Wetlands Protection Act (WPA).

A ground-mounted noise barrier should not have a height that exceeds 25 feet. This is because, in
addition to the visual considerations, a noise barrier with a height exceeding 25 feet would be
subject to excessive wind loads.

### 6.2 Acoustic Feasibility

Acoustic feasibility indicates that the noise abatement can, at a minimum, achieve a
discernible reduction in noise levels. MassDOT considers a noise barrier to be
acoustically feasible when it reduces traffic noise by at least 5 dB(A) at the majority of
impacted receptors in the front row. Majority is defined as more than 50 percent of the
impacted receptors. Blocking the line of sight between the noise source and a receptor usually
provides a 5 dB(A) noise reduction.

MassDOT considers noise insulation for Activity Category D facilities to be acoustically feasible
when it reduces traffic noise by at least 5 dB(A) for all the impacted receptors using the facility.
7.0 Determination of Reasonableness of Constructing or Installing Noise Abatement

If potential noise abatement is found to be feasible, then the reasonableness of the noise abatement is considered. Reasonableness implies that good judgment and common sense has been applied in arriving at a decision on the construction or installation of the proposed noise abatement.

There are three mandatory reasonableness criteria that must be met for MassDOT to consider noise abatement to be reasonable:

- The noise abatement must meet MassDOT’s noise reduction design goal.
- The noise abatement must be cost effective.
- The property owners and residents of the benefited receptors must be in favor of the noise abatement.

If the noise abatement does not meet the three mandatory reasonableness criteria, noise abatement will not be constructed or installed.

To comply with Environmental Justice requirements, third party funding is not allowed (if offered) on a Type I project if the noise abatement would require additional funding from the third party to be considered feasible and/or reasonable. Third party funding is acceptable, however, on a Type I project, to make functional enhancements, such as absorptive treatment, access doors, landscaping, or aesthetic enhancements to noise barrier(s) already determined feasible and reasonable. Third parties are any entity other than the MassDOT.

When noise abatement, such as noise insulation, is provided for an Activity Category D facility, an agreement must be entered into with the property owner which specifies that MassDOT is not responsible for any future costs of operating and/or maintaining the noise abatement measure(s).

7.1 Noise Reduction Design Goal

The noise reduction design goal is the desired amount of noise reduction provided by noise abatement. The noise reduction design goal is not the same as acoustic feasibility, which is the minimum level of effectiveness of a noise abatement measure.

For residential areas and Activity Category C land uses, MassDOT considers the noise reduction design goal to be achieved when at least one first row benefited receptor attains a minimum of 10 dB(A) of noise reduction (i.e., insertion loss). The 10 dB(A) noise reduction design goal is a rational and achievable goal based on the rules-of-thumb that, if a noise barrier breaks the line-of-sight between the noise source and the noise-sensitive receptor, the insertion loss is typically 5 dB(A) and that, for each 3 feet of barrier height beyond the line-of-sight blockage, an increase in insertion loss of 1.5 dB(A) is typical. Noise barriers should be designed to have a height as low as possible and still attain the noise reduction design goal.

MassDOT also considers the noise reduction design goal to be achieved when proposed noise abatement provides a minimum of 10 dB(A) of noise reduction for all receptors using Activity Category D facilities.
7.2 Cost Effectiveness

Because MassDOT must balance its available funds and statewide highway safety responsibilities, a mathematical formula, called the Cost Effectiveness Index (CEI), is used when considering the cost effectiveness of proposed noise abatement measures.

7.2.1 Cost Effectiveness Index (CEI) for Activity Category B (Residences)

The CEI for residential areas is calculated by dividing the noise barrier cost by the average insertion loss (the average of individual insertion losses at each benefited receptor) and by the number of benefited receptors in the study zone. Receptors receiving less than 5 dB(A) of insertion loss are not considered benefited receptors and are, therefore, not counted in the CEI calculation. The individual insertion loss values come from the TNM output files.

The CEI is equal to $$/dBIL/unit, where:

\[
\text{$$} = \text{Total barrier cost, based upon a $50 per square foot cost.} \\
\text{dBIL} = \text{Average insertion loss of benefited receptors, in dB(A)} \\
\text{Unit} = \text{Number of benefited receptors protected in the study zone}
\]

The noise barrier cost is determined by multiplying the square footage of the proposed noise barrier (as modeled by the FHWA TNM) by $50 per square foot. These square foot costs are to be used purely for developing CEI. Actual costs will vary. MassDOT considers a noise barrier to be cost effective if, based on the CEI, it costs $8,400 or less per decibel reduction per benefited receptor. Both the CEI of $8,400 and the barrier costs of $50 per square foot were developed for the same year (2010) and are based on historical construction bid data.

To help provide a better understanding of the process used to determine cost effectiveness of noise barriers in residential areas, two examples of CEI calculations are provided.

Example #1

For this hypothetical example, the TNM determined that, to meet the noise reduction design goal, a proposed noise barrier would have to be 18 feet high and 2,600 feet long. The square footage of this proposed noise barrier would be 46,800 square feet, derived by multiplying the barrier’s height (18 feet) by its length (2,600 feet). The cost for the proposed noise barrier would, therefore, be $2,340,000 (46,800 square feet multiplied by the average cost of $50 per square foot for a noise barrier).

With this proposed noise barrier in place, a neighborhood would have 30 benefited receptors, involving 24 homes with a 10 dB(A) insertion loss and 6 homes with a 7 dB(A) insertion loss. In this example, the average insertion loss is 9.4 dB(A). This is calculated by multiplying 24 (homes) by 10 (insertion loss) which equals 240; plus 6 (homes) times 7 (insertion loss) which equals 42. 240 plus 42 equals 282; divided by the total number of homes (30) equals 9.4.

\[
\text{Barrier Cost} = \$2,340,000 \\
\text{dBIL} = 9.4 \\
\text{Units} = 30
\]
Using the formula to calculate CEI, the result of the CEI calculation is $8,298/dBIL/unit. In this example, the noise barrier proposed for this neighborhood is cost effective because, at $8,298, the CEI is below the $8,400 threshold.

Example #2

In this hypothetical example, we will be using the same noise barrier as proposed in Example #1 (18 feet high and 2,600 feet long) but, in this case, the noise barrier would be less effective acoustically. In this case, with the proposed noise barrier in place, the neighborhood would have 20 benefited receptors, involving 12 homes with a 10 dB(A) insertion loss and 8 homes with a 7 dB(A) insertion loss. In this example, the average insertion loss would be 8.8 dB(A). This is calculated by multiplying 12 (homes) by 10 (insertion loss) which equals 120; plus 8 (homes) by 7 (insertion loss); which equals 56. 120 plus 56 equals 176; divided by the total number of homes (20) equals 8.8.

 barriers cost = $2,340,000
 dBIL = 8.8
 Units = 20

Using the formula to calculate CEI, the result of the CEI calculation is $13,295/dBIL/unit. In this example, the noise barrier proposed for this neighborhood is not cost effective and, therefore, not reasonable because, at $13,295, the CEI is above the $8,400 threshold.

As required by the FHWA noise regulations, MassDOT will reanalyze the CEI every five years. This reevaluation will focus on the effect that construction costs of noise barriers have on the CEI. For example, if construction costs of noise barriers increase by 10 percent between evaluations of the CEI, the CEI threshold should increase by the same amount. In this way, a noise barrier determined cost effective at one time would not fail to meet the CEI later.

7.2.2 Cost Effectiveness Index (CEI) for Activity Category C Land Uses and Activity Category D Facilities

MassDOT will use the methodology in Massachusetts Department of Transportation Methodology for the Determination of Cost Effectiveness of Proposed Noise Abatement for Activity Category C Land Uses and Activity Category D Facilities to determine cost effectiveness of noise abatement for Activity Category C land uses and Activity Category D facilities. The unit measure that the CEI uses for Activity Category C land uses and Activity Category D facilities is Cost per dB(A) insertion loss per person per hour ($$/dBIL/person/hour) where:

$$ = Total noise abatement cost
 dBIL = Average insertion loss of benefited receptors, in dB(A)
 Person = Number of benefited receptors per day
 Hour = Average time per visit

As described in Massachusetts Department of Transportation Methodology for the Determination of Cost Effectiveness of Proposed Noise Abatement for Activity Category C Land Uses and
Activity Category D Facilities, MassDOT uses a statewide CEI of $138 per dB(A) insertion loss per person per hour to determine cost effectiveness of noise abatement for Activity Category C land uses and Activity Category D facilities. MassDOT considers noise abatement to be cost effective for Activity Category C land uses and Activity Category D facilities when it costs $138 or less per decibel reduction per benefited receptor.

Two hypothetical examples help provide an understanding of how the statewide CEI of $138 is used to determine cost effectiveness of noise abatement for an Activity Category C land use and an Activity Category D facility. In Example #3, the Activity Category C land use is a school with a noise barrier as the proposed noise abatement. Example #4 involves an Activity Category D facility, in this case, a light frame public meeting room with no exterior areas of activity.

**Example #3**

The following data are known for the school property:

1. Average time per person using playground = 1 hour
2. Proposed height of noise barrier = 13 feet
3. Proposed length of noise barrier = 1,000 feet
4. Average insertion loss from the proposed noise barrier = 8 dB(A)
5. Number of benefited receptors per week = 300 people

The unit measure that the CEI is expressed in is $$ per dBIL per person per hour. In the case of the school property,

\[
\text{Total noise abatement cost} = 13 \text{ feet} \times 1,000 \text{ feet} \times $50 \text{ per square foot} = $650,000
\]

\[
\text{dBIL} = \text{Average insertion loss of benefited receptors} = 8 \text{ dB(A)}
\]

\[
\text{Person} = \text{Number of benefited receptors per day} = 300 \text{ persons per week divided by 7 days per week} = 40 \text{ persons}
\]

\[
\text{Hour} = 1 \text{ hour}
\]

The site-specific CEI is calculated to be $1,890 (650,000 divided by 8 divided by 40 divided by 1). Since the site-specific CEI of $1,890 is greater than the statewide CEI of $138 for Activity Category C land uses, the proposed noise barrier for the school would not be considered cost effective.

**Example #4**

In this example, the noise analysis indicates that the public meeting room has interior noise levels higher than the NAC of 52 dB(A). The public meeting room would, therefore, experience a noise impact. Noise insulation in the form of new storm windows and central air conditioning is proposed as noise abatement. The insertion loss from the proposed noise insulation was determined to be 20 dB(A). The cost of the noise insulation was determined to be $200,000.

From previous consultation with the municipality, (i.e., the property owners of public meeting room), it was found that the meeting room is used twice a week by approximately 100 attendees each time for 3 hours. The daily number of benefited receptors would therefore be 29. This
number is derived by multiplying the number of attendees (100) by the number of times the facility is used per week (2) and by dividing by the number of days in a week (7).

For the public meeting room,

\[
\begin{align*}
S &= 200,000 \\
\text{dBIL} &= 20 \text{ dB(A)} \\
\text{Person} &= 30 \\
\text{Hour} &= 3
\end{align*}
\]

The site-specific CEI would be $115 ($200,000 divided by 20 divided by 30 divided by 3). Since the site-specific CEI of $115 is less than the statewide CEI of $138, noise insulation of the public meeting room would be considered cost effective.

As required by the FHWA noise regulations, MassDOT will reanalyze the CEI for Activity Category C land uses and Activity Category D facilities every five years.

7.3 Viewpoints of Property Owners and Residents

A major factor in determining the reasonableness of proposed noise barriers in noise-affected residential areas is the viewpoints of the property owners and of the residents of the benefited receptors. MassDOT will provide noise barriers if at least two-thirds (67 percent) of the weighted total number of residential votes are in favor of it. In the case of rental properties, FHWA requires MassDOT to consider both the views of the owners of the benefited receptors and the views of the renters.

A public informational meeting is held in the municipality(s) of the proposed noise barrier to present and discuss the noise impacts from the project and to provide an opportunity for local input in the development of the noise barrier project. This meeting occurs during the project development phase as part of the public involvement or public hearing process. MassDOT will notify the property owners in each Activity Category in Table 3 of the public informational meeting and of its intent to install a noise barrier in the noise-affected area.

After presenting the project information to the noise-affected area, a survey of the desires of the property owners and of the residents of the benefited receptors is conducted by mail. Owners of undeveloped lands for which residential development is permitted are also invited to participate in the voting process. While MassDOT will consider commercial and industrial establishments’ desire to maintain visibility of their property from the highway, the property owners and renters of these types of land uses are not allocated any votes and, therefore, do not participate in the voting process. Table 4 presents the number of votes allocated to each type of residential benefited receptor in the study zone.

At least 67 percent of the weighted total number of votes in the study zone must be in favor of the proposed noise barrier for the noise barrier to be considered for construction; otherwise a noise barrier will not be built. If this requirement is met, continued community coordination will take place during the final design phase of the project. A second public meeting is held, after the
noise barrier design further progresses, to present more specific project information to the affected area.

If noise abatement is proposed for Activity Category C land uses or Activity Category D facilities, then each individual property owner (that is, each owner of the Activity Category C land use or Activity Category D facility) must be in favor of it, otherwise, noise abatement would not be considered as a reasonable noise abatement measure.

**Table 5  Number of Votes Allocated to Benefited Receptors Surveyed**

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Occupancy</th>
<th>Row</th>
<th>Number of Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Residential</td>
<td>Owner</td>
<td>First</td>
<td>5</td>
</tr>
<tr>
<td>Existing Residential</td>
<td>Owner</td>
<td>Second, Third, etc.</td>
<td>3</td>
</tr>
<tr>
<td>Existing Residential Renter</td>
<td>Renter</td>
<td>First, Second, Third, etc.</td>
<td>1</td>
</tr>
<tr>
<td>Existing Activity Category C or D Owner</td>
<td>Owner</td>
<td>Not Applicable</td>
<td>1</td>
</tr>
<tr>
<td>Undeveloped Land Permitted for Development</td>
<td>Owner</td>
<td>First</td>
<td>5</td>
</tr>
<tr>
<td>(Residential)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undeveloped Land Permitted for Development</td>
<td>Owner</td>
<td>Second, Third, etc.</td>
<td>3</td>
</tr>
<tr>
<td>(Residential)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Although not a requirement for construction of a proposed noise barrier, MassDOT will also solicit a written letter from appropriate city/town officials stating their support of the desires of the property owners and of the residents of the benefited receptors for the noise barrier to be constructed.

When the municipality is opposed to noise abatement that is determined to be feasible and reasonable, MassDOT will coordinate with the city/town officials. The purpose of this coordination is to determine if the local government’s reasons for the opposition are justified, such as for safety reasons. Municipalities cannot arbitrarily veto and/or restrict the length or height of the mitigation measure that was determined to be feasible and reasonable based on visual quality concerns or any other unjustified reasons. MassDOT’s primary responsibility is to provide abatement for impacted noise-sensitive land uses so as not to jeopardize federal funding for its projects.

**8.0  Technical Considerations**

The structural design of a noise barrier should be in accordance with the current edition of the *Guide Specifications for Structural Design of Sound Barriers* by AASHTO (published in 1989 and amended in 1992 and 2002), and with MassDOT’s *Standardized Foundations for Sound Barrier Walls (September 2004)*.
Where space and other environmental constraints allow, noise berm (earth or other material) or combination berm/wall systems are preferred. Using the existing topography to begin or end a noise barrier in an earth berm or mound should be considered.

Noise barriers should be constructed to be visually pleasing and to blend in with their surroundings. Generally, it is desirable to provide landscaping near the noise barrier to avoid visual dominance.

9.0 Coordination with Local Government Officials

MassDOT coordinates with local officials whose jurisdictions are affected by noise from proposed projects. The primary purpose of this coordination is to promote noise compatible land use planning and control on undeveloped land adjacent to highways. Local governments may use their authority to regulate land development to prohibit noise-sensitive land uses adjacent to highways, or to require developers to plan, design, and construct projects that minimize highway traffic noise impacts on adjacent developments. Local governments may not use this type of legislation, however, to override construction of noise abatement deemed feasible and reasonable. Only residents and property owners of benefited receptors determine the desirability of whether proposed noise abatement should be implemented. Furthermore, local zoning and design requirements, such as height limits on fencing and walls, are not acceptable limitations on the configuration or design of proposed noise barriers.

Local government officials need to know what highway traffic noise levels to expect from a Type I or Type II project and what techniques they can use to prevent future impacts. The following information is, therefore, furnished to allow the public and local officials to understand where local communities should protect future land development from becoming incompatible with anticipated highway noise levels.

- A link on MassDOT’s Environmental Website to the MassDOT Type I and Type II Noise Programs Guidebook.
- Links on the MassDOT Environmental Website to The Audible Landscape: A Manual for Highway and Land Use, a manual that assists local government officials to deal with the problem of noise-sensitive land uses adjacent to highways and to Entering the Quiet Zone, a brochure that provide information to elected officials, planners, developers, and the general public about the problem of traffic noise and effective responses to it.
- Estimated future noise levels from the highway traffic noise analysis for properties in the immediate vicinity of a proposed project (Type I projects only).
- The distances from the edge of the nearest travel lane of the proposed highway project where the future noise levels on the undeveloped land within the project limits approach the exterior NAC for each Activity Category in Table 3 (Type I projects only).
- Information on how noise abatement for undeveloped land not permitted for development by the Date of Public Knowledge is not eligible for MassDOT’s Type II Noise Abatement Program.
Local officials are encouraged to make this information available for disclosure in real estate transactions.

For Type I projects, MassDOT informs the local officials by means of the environmental documentation process (that is, the Environmental Impact Statement (EIS) or Environmental Assessment (EA)), public hearings, public information meetings, and direct contact. In cases of Type I projects that are Categorical Exclusions (CEs), MassDOT will send a letter to the local officials with a summary of the above information. The CE Checklist and the noise analysis themselves would not be sent.

Because MassDOT has a Type II noise program, FHWA’s noise regulations require it to have a statewide outreach program. For its Type II statewide outreach program, MassDOT will use existing forms of information dissemination to periodically announce to the cities and towns the availability of information about its Type II Noise Abatement Program.

10.0 Highway Traffic-Induced Vibration

Studies to assess the impact of operational traffic-induced vibrations have shown that both measured and predicted vibration levels are less than any known criteria for structural damage to buildings. Normal living activities within a building (for example, closing doors, walking across floors, or operating appliances) have been shown to create greater levels of vibration than highway traffic. Vibration concerns are not addressed in this policy.

11.0 Documentation of Highway Traffic Noise Analyses

A traffic noise analysis should include the following information for each alternative under detailed study:

1. Determination of Activity Categories and applicable NAC for adjacent land uses;
2. Identification of existing receptors;
3. Determination of existing highway traffic noise levels;
4. Prediction of future highway traffic noise levels for study alternatives (Type I projects only);
5. Verification of noise model run validation or calibration;
6. Determination of highway traffic noise impacts for study alternatives;
7. Examination and evaluation of alternative noise abatement measures for reducing or eliminating the noise impacts; and
8. Consideration of construction noise.
The following information related to methodology and assumptions shall be included in the Noise Appendix:

1. Model(s) and methodology used;
2. Alternatives and years considered;
3. Existing and design year vehicle volumes, speeds, and mix data;
4. Receptor locations and descriptions, including Activity Category;
5. Basis for determination of existing and future noise levels; and
6. Noise descriptor used.

A reviewer should be able to replicate the results using the TNM with the input data reported in the Noise Appendix.

Reporting noise levels to the tenth of a decibel may imply a false sense of accuracy and precision. All noise levels (measurements and calculations) should, therefore, be reported to the nearest decibel.

### 12.0 Documentation of Noise Abatement in Environmental Clearance Documents

A noise analysis is typically included as part of an environmental clearance document (CE Checklist, EA, or EIS) for a Type I project. In the CE Checklist, Finding of No Significant Impact, or Record of Decision for a Type I project, MassDOT will identify the locations where noise abatement measures are feasible and reasonable, and are likely to be incorporated into the project; and the locations where there are noise impacts for which no noise abatement measures appears to be feasible and reasonable. Use of a table to compare the predicted future levels with the project, the predicted future levels without the project, the existing levels, and the NAC in 23 CFR 772 is typically included for clarity.

Normally, a Type II project will qualify as a CE, under the National Environmental Policy Act, unless other environmental impacts are identified that require additional investigation. Nonetheless, a Type II project requires the same level of analyses and documentation as required for a Type I project.

For projects at locations on the Type II Noise Barrier Priority Lists that qualify as CEs, MassDOT will include the following information in the CE Checklist:

- The location(s) where noise abatement measures are feasible and reasonable, and are likely to be constructed;
- The location(s) where there are noise impacts for which no noise abatement measures appears to be feasible and reasonable; and
The distances from the edge of the nearest travel lane where the existing noise levels on the undeveloped land within the project limits approach the exterior NAC for each Activity Category in Table 3.

MassDOT will send a letter to the local officials with a summary of the above information from the Type II noise analysis. The CE Checklist and the noise analysis themselves would not be sent.

Feasibility and reasonableness determinations for proposed noise barriers may change because of changes in project design after approval of the environmental clearance document. In addition, while the final environmental clearance document contains the preliminary layout and height information for proposed noise barriers, it is unlikely that the exact layout or material type would be determined. For noise-impacted areas on Type I projects or for locations on the Type II Noise Barrier Priority Lists requiring noise barrier consideration, the final environmental clearance document should, therefore, contain a statement of likelihood similar to the following:

Based on the studies conducted to date, the Massachusetts Department of Transportation (MassDOT) intends to install highway traffic noise abatement measures in the form of noise barrier(s) at the noise-impacted locations identified in (section, table, or figure) provided that the following feasibility and reasonableness conditions remain:

- Safety and engineering aspects relating to the roadway user and adjacent property owners do not preclude construction of the noise barrier.
- Environmental impacts are not of a magnitude to make construction of the noise barrier infeasible.
- The noise abatement is acoustically feasible and meets MassDOT’s noise reduction design goal.
- The noise abatement is cost effective.
- There is community acceptance of the noise abatement by the property owners and residents.

The preliminary heights and lengths of the noise barriers are as follows:

[Insert table of preliminary heights and lengths of the noise barrier(s) and insertion losses at each location]

If it subsequently develops during final design that these conditions have substantially changed, the noise barrier(s) might not be provided. A final decision of the construction of the noise barrier(s) will be made upon completion of the project’s final design and the public involvement processes.

The following paragraph will appear in the CE Checklists for Type III Projects:

The [Project Name] meets the criteria for a Type III project established in 23 CFR 772. Therefore, the project requires no analysis for highway traffic noise impacts. Type III projects do not involve added capacity, construction of new through lanes or auxiliary lanes, changes in the horizontal or vertical alignment of the roadway, or exposure of noise
sensitive land uses to a new or existing highway noise source. MassDOT acknowledges that a noise analysis is required if changes to the proposed project result in reclassification to a Type I project.

13.0 Construction Noise

A discussion of construction noise and construction noise mitigation measures deemed appropriate should be included in an EIS, EA, or CE Checklist whether the NAC are exceeded or not. The impact of construction noise does not appear to be serious in most instances and calculation of construction noise levels is usually not necessary for traffic noise analyses. Potential impacts of highway construction noise should be addressed generally and the temporary nature of the impacts should be noted. An indication of the types of construction activities that can be anticipated and the noise levels typically associated with these activities can be obtained from existing literature and presented in the noise analysis.

Using a common-sense approach, traffic noise analyses should identify measures to mitigate potential highway construction noise impacts. Low-cost, easy-to-implement measures, such as work hour limits, equipment muffler requirements, location of haul roads, elimination of "tailgate banging," ambient-sensitive backup alarms, community rapport, and complaint mechanisms should be incorporated into the special provisions to the project's construction specifications, as appropriate. These options can then be applied during the construction of the project by the contractor. Because of their cost, any unique noise control efforts should be thoroughly discussed and justified and coordinated with MassDOT before inclusion into the EIS, EA, or CE Checklist discussion.

14.0 Noise Abatement Measure Reporting

MassDOT has voluntarily maintained and completed an inventory of all completed Type I and Type II noise abatement measures every three years since the 1990s and has provided information from this inventory to FHWA. The next inventory collection will be for noise abatement measures constructed in 2008, 2009, and 2010. For noise abatement measures constructed in 2011 and thereafter, the inventory will include the following information:

- Type of Noise Abatement;
- Cost (overall cost, unit cost per square foot);
- Average Height;
- Length;
- Area;
- Location (state, county, city, route);
- Year of Construction;
- Average Insertion Loss (as reported in the noise analysis);
- Activity Categories Protected;
- 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, structure mounted); and

Project Type (Type I, Type II, and optional project types, such as State funded, county funded, turnpike funded, and others).

MassDOT will obtain this information from traffic noise analyses; plans, specifications, and estimates; and construction bid documents.
Appendix to the 
Massachusetts Department of Transportation 
Type I and Type II Noise Abatement Policy and Procedures

This Appendix provides links to general highway traffic noise guidance and guidance on noise impact assessment, measurement, and design.

Noise Regulation and Policy

➢ 23 CFR 772 Procedures for Abatement of Highway Traffic and Construction Noise (July 13, 2010). This regulation updates the noise abatement standards to clarify applicability, certain noise analysis requirements, and use of federal funds for noise abatement measures.

➢ Highway Traffic Noise Analysis and Abatement Guidance (June 2010 (revised January 2011)). This guidance document, effective July 13, 2011, supplements the requirements contained in 23 CFR 772.

➢ MassDOT Type I and Type II Noise Programs Guidebook (January 2007).

Noise Measurement

➢ Measurement of Highway-Related Noise (May 1996). This report provides a set of standardized procedures for measuring and assessing highway-related noise.

Noise Impact Assessment

➢ Massachusetts Department of Transportation Methodology for the Determination of Cost Effectiveness of Proposed Noise Abatement for Activity Category C Land Uses and Activity Category D Facilities. This report outlines a procedure that employs a systematic approach to the determination of cost effectiveness of noise abatement for Activity Category C land uses and Activity Category D facilities.

➢ Transit Noise and Vibration Impact Assessment Guidance (May 2006). This report contains procedures that should be used to calculate transit noise.

➢ Advanced Prediction and Abatement of Highway Traffic Noise (June 1982). If a highway project is near a rail line, rail noise levels should be calculated using the procedure in this document.

Noise Mitigation


➢ Standardized Foundations for Sound Barrier Walls (MassDOT, September 2004)
FHWA Highway Noise Barrier Design Handbook (August 2000). This design manual provides guidance on how to design a highway noise barrier which fits its surroundings and performs its intended acoustical and structural functions, with a reasonable cost.

Noise Compatible Planning

- Entering the Quiet Zone: Noise Compatible Land Use Planning (September 26, 2002). This brochure provides information to elected officials, planners, developers, and the general public about the problem of traffic noise and effective responses to it.

- The Audible Landscape: A Manual for Highway Noise and Land Use (October 1995). This manual assists local government officials in dealing with the problem of noise-sensitive land uses adjacent to highways