PIMA COUNTY
DEPARTMENT OF TRANSPORTATION
201 NORTH STONE AVENUE, THIRD FLOOR
TUCSON, ARIZONA 85701-1207

PRISCILLA S. CORNELIO, P. E.
DIRECTOR

(520) 740-6410
FAX (520) 838-7537

Procedure Number: 03-5, Amended
Effective Date: April 8, 2008

Approved: _____
Priscilla S. Cornelio, PE, Director

SUBJECT: Revision of Traffic Noise Analysis and Mitigation Guidance for Major Road Projects, Amendment to Statement of Purpose, and Cost Effective Criteria

---

I. Statement of Purpose

Pima County's Traffic Noise Analysis and Mitigation Guidance for Major Roadway Projects was implemented in 2003. Within this procedure is a requirement to reexamine the construction costs of noise barrier walls every two years. In keeping with this requirement, Pima County has analyzed these costs and, based on this analysis, is implementing changes to the existing procedure effective immediately. These changes are noted below by ~~strikeout~~ (deleted information) and underlining (new information). Justification for these changes to the procedure is documented later in this memorandum.

It is the intent of Pima County Department of Transportation that this procedure shall apply to all of Pima County's major roadway projects. If any part of this procedure is superseded by Federal or Arizona Department of Transportation (ADOT) requirements, only that portion of the roadway on which the Federal or State rules apply shall be subject to the Federal or State rule. This procedure shall apply to all other portions of the roadway project. For example, if State funding is utilized on one portion of an improvement corridor, but not on another, this policy shall apply to those areas of the project on which the application of State rules are not required.

II. Traffic Noise Abatement Procedure

B. Noise Barrier Criteria

1. Traffic noise barriers will be considered when all of the following criteria are met:

b. The cost of providing noise abatement shall be reasonable. To be considered reasonable, sound mitigation shall not exceed ~~$30,000~~ $35,000 per benefited sensitive receiver. Sensitive receivers that will be considered as benefited are those at which noise mitigation will produce at least a 5 dBA noise reduction. Facilities which contain non-residential receivers such as picnic areas, recreation areas, playgrounds, active sports areas, parks, schools, churches, libraries, hospitals, places of worship, and cemeteries shall be counted as a single benefited sensitive receiver. Commercial properties shall not be considered for noise abatement unless they include a sensitive receiver as defined above. For the purposes of establishing reasonable cost, a barrier construction cost of ~~$21~~ $25 per square foot shall be used. This figure shall not include the cost of aesthetic or architectural features not contributing to noise mitigation. The barrier construction cost shall be reviewed ~~every two years~~ periodically by Pima County to evaluate the impact of inflation and other factors on cost.

f. Noise barriers in excess of 10 feet in height shall not be constructed. Any requested modification to the barrier height that reduces the effectiveness of the mitigation will result in the wall being eliminated from consideration.

III. Justification of Changes to the Procedure

A sample survey of other states was conducted to determine the current cost per benefited receiver. This criterion is used in virtually all states to establish reasonability of wall construction. The results are summarized in the table below.

State	Cost/Benefited Receiver ($1000)	Date of update if known
Arizona	46	2007
Washington	37.38 (sliding scale)	2006
Pennsylvania	50	2006
Missouri	30	1997
California	32	2006
Texas	25	unknown
Oregon	25-35	2004
Ohio	35	unknown
Utah	25	unknown
Average (9 states)	33.4	n/a

Pima County's 2003 cost per benefited receiver criterion of $30,000 is still within the range of the sampled states. These numbers have increased recently by several states, however, and Pima County's value has fallen slightly below the average cost per benefited receiver of the sampled states. Therefore, it is recommended that the cost per benefited receiver criterion for Pima County be increased to $35,000 which would place the value slightly above the average for the sampled states.

More important than the cost per benefited receiver criterion, however, is the actual cost of wall construction. The value of $21 per square foot used to determine the reasonability of walls costs has also remained unchanged since the procedure was implemented in 2003; however, construction costs have increased since that time.

In 2007, the Arizona Department of Transportation (ADOT) updated the costs associated with wall construction in traffic noise analyses to address inflation. ADOT is currently using a cost of $33 per square foot in their calculations. Of the sampled states appearing in the table above, only costs for the state of Washington were available ($53 per square foot). Engineers' estimates and bid tabulations for recent projects in Arizona (I-10/Twin Peaks Traffic Interchange, I-10 (Sarival to SR 101L), Valencia Road (4VMCLT)) have averaged approximately $24 per square foot; therefore, a cost of $25 per square foot appears reasonable for the current and near future and is conservative enough to adequately protect the residents of Pima County.

The requirement to review barrier construction costs every two years is excessive. As noted in the discussion above, costs have not changed dramatically over the five years since the procedure was implemented. Therefore, changing the requirement to a periodic review is appropriate.

PIMA COUNTY
DEPARTMENT OF TRANSPORTATION & FLOOD CONTROL DISTRICT
DEPARTMENT PROCEDURE

Procedure Number: 03-5

Effective Date: DECEMBER 1, 2003

Approved: _____
Kurt Weinrich, Director

SUBJECT: TRAFFIC NOISE ANALYSIS AND MITIGATION GUIDANCE FOR MAJOR ROADWAY PROJECTS

I. Statement of Purpose

Traffic noise abatement is a growing concern of local, state, and federal transportation agencies. For noise mitigation measures to be effective and accepted by the public, the methods by which noise impacts and mitigation measures are determined must be defined. This procedure provides guidance for the development of noise mitigation for Pima County's major roadway projects. For the purposes of this Procedure a "major roadway" will have the same definition as found in the Community Participation and Mitigation Ordinance, Ordinance No. 1992-69.

II. Traffic Noise Abatement Procedure

A. Mitigation Levels

For major roadway projects within Pima County, after applying a 3 dBA benefit for the use of Rubberized Asphalt Concrete (RAC) and rounding to the nearest decibel, traffic noise mitigation shall be considered if either:

1. The predicted exterior noise level for a sensitive receiver is 66 dBA Leq or above; or,
2. The predicted exterior noise levels at a sensitive receiver "substantially" increase over existing (pre-project) levels as a result of the major roadway project – "substantial" is defined as 15 dBA or greater.

B. Noise Barrier Criteria

1. Traffic noise barriers will be considered when all of the following criteria are met:
   a. Constructing a noise barrier shall achieve a meaningful noise reduction. To be meaningful, predicted noise levels at an affected sensitive receiver shall be reduced by at least 5 decibels. Sensitive receivers are individual housing units, multi-family or single-family. Sensitive receiver also include facilities such as picnic areas, recreation areas, playgrounds, active sports areas, parks, schools, churches, libraries, hospitals, places of worship, and cemeteries.
   b. The cost of providing noise abatement shall be reasonable. To be considered reasonable, sound mitigation shall not exceed $30,000 per benefited sensitive

receiver. Sensitive receivers that will be considered as benefited are those at which noise mitigation will produce at least a 5 dBA noise reduction. Facilities which contain non-residential receivers such as picnic areas, recreation areas, playgrounds, active sports areas, parks, schools, churches, libraries, hospitals, places of worship, and cemeteries shall be counted as a single benefited sensitive receiver. Commercial properties shall not be considered for noise abatement unless they include a sensitive receiver as defined above. For the purposes of establishing reasonable cost, a barrier construction cost of $21 per square foot shall be used. This figure shall not include the cost of aesthetic or architectural features not contributing for noise mitigation. The barrier construction cost shall be reviewed every two years by Pima County to evaluate the impact of inflation and other factors on cost.

c. Noise barriers shall not be constructed unless two or more adjacent receivers are benefited.
d. Noise barriers shall not be constructed unless a majority of the property owners of benefited receivers for that barrier approve of the mitigation. Signatures from 50 percent plus one of property owners of benefited receivers indicating a desire for noise barriers will be considered a majority.
e. Noise abatement shall be considered only for the first floor of multi-story residences.
f. Noise barriers in excess of 10 feet in height shall not be constructed. If the roadway is a Pima County designated scenic route, a maximum barrier height of six feet shall apply.
g. Noise mitigation for undeveloped lands shall be considered only if a building permit has been issued prior to the date of approval of the final environmental documentation.

2. Once the Environmental Assessment and Mitigation Report (EAMR) has been approved by the Board of Supervisors (BOS), additional noise analysis and mitigation evaluation will not be considered unless deemed necessary by the County Engineer.

III. Traffic Noise Analysis Methodology

A. Model

The prediction of noise levels shall be made with the traffic noise prediction model currently adopted by FHWA and the Arizona Department of Transportation (ADOT). Modeling protocols shall follow the guidelines adopted in the most current version of the appropriate model documentation and guidance documents.

B. Anaylsis

Traffic noise analysis for major roadway projects within Pima County shall be conducted in accordance to the following guidelines:

1. All monitored and modeled values shall be rounded to the nearest whole decibel.
2. Traffic noise monitoring shall be conducted for a "reality check" (calibration and verification) of the noise prediction model. Traffic noise monitoring protocol shall generally follow the latest edition of the Federal Highway Administration's (FHWA) publication *Highway Traffic Noise Analysis and Abatement Policy and Guidance* and *Highway Noise Barrier Design Handbook*. During calibration of the model, monitored values should be compared with modeled values and these values should be in agreement per federal guidelines. When monitoring for Pima County projects, a sufficient number of monitoring sites should be selected to be representative of sensitive land uses within the

project area and representative of areas of widely differing traffic characteristics (either in traffic volumes or vehicle fleet mix). As a general guide, only about five sites per project mile are necessary.

Classification counts will be preformed during the morning, noon and evening traffic peak periods and one off-peak period on the day the noise measurements are taken.

3. A 3 dBA credit for the use of Rubberized Asphalt Concrete (RAC) shall be applied to the traffic noise prediction model as a shielding factor, if the STAMINA model is utilized, or as an adjustment factor, if Traffic Noise Model (TNM) is utilized.

IV. Traffic Noise Report

A. Traffic Noise Report

The Traffic Noise Report should at a minimum contain the following information:

- Introduction
- Project Description, Location and Setting
- Noise Abatement Criteria
- Study Methodology
  - Input
    - Land Use and Topography
    - Traffic Data
    - Roadway Geometry
    - Receiver Locations
    - Sensitive Receivers
    - Existing Noise Measurements
    - Modeling Assumptions (factors)
  - Noise Analysis
    - Calibration
    - Prediction of Noise Levels (current and future)
    - Impacts
  - Noise Mitigation Analysis and Recommendations
- Construction Noise
- Conclusions

B. Presentation of Noise Readings

The results of the existing and predicted noise readings should be presented in tabular form as well as in the form of a decibel contour map. The contour maps are to be incorporated into the report as well as displays for use in presentation of the noise study at public meetings.

C. Field Data and Input

Copies of the field data and model input and output shall be made available upon request.

V. Appendix

The Appendix that summarizes the data used to prepare this guidance is available for review in the Director's Office.

APPENDIX A

TRAFFIC NOISE PROCEDURE DISCUSSION

Appendix A

Traffic Noise Procedure Discussion

The FHWA noise policy provides guidance for noise analysis and development of noise mitigation. However, many of the parameters are not strictly defined. Tables 1 through 7 identify the primary noise analysis parameters, the number of state DOTs that have defined the parameters, and if they are defined, how they are defined (Newton, 2000). Following each noise abatement parameter is an explanation of the derivation of Pima County's noise abatement criteria.

Noise policies are dynamic tools and some states may have modified policies since the research referenced in the tables. Therefore, in addition to the information presented in the tables, multiple state and local DOT noise policies were reviewed for this analysis. Policies reviewed are included in Appendix B.

Table 1. Noise Abatement Criteria Approach Level

Noise Abatement Criteria "Approach" Level	Number of State DOTs	Definition
3 dBA (64 dBA)	1	Potential negative impact from traffic noise is assessed based on predicted noise levels approaching or exceeding the Federal Highway Administration (FHWA) Noise Abatement Criteria (NAC) of 67 dBA. Approach is defined as the number of dBA before the FHWA NAC.
2 dBA (65 dBA)	5	
1 dBA (66 dBA)	43	
0 dBA (67 dBA)	1	
Not Defined	1	

The noise abatement approach level of 66 dBA was selected for Pima County's noise procedure because it meets FHWA requirements for an approach level, making Pima County's procedure applicable to federally funded projects. Relying on the Federal standard will increase public support and acceptance of the approach criterion. The criterion is higher than ADOT's 64 dBA approach level, thus saving significant transportation dollars, while providing noise mitigation at a level acceptable to FHWA. The majority of State DOTs use a mitigation consideration level of 66 dBA.

Table 2. Substantial Noise Increases

"Substantial Increase" over Existing Noise Level (Noise Increase)	Number of State DOTs	Definition
5 dBA	1	A substantial increase is defined as the future increase in noise levels over the existing noise levels. As previously stated, potential negative impact from traffic noise is assessed based on predicted noise levels approaching or exceeding the FHWA NAC.
6 dBA	1	
10 dBA	20	
11 dBA	1	
12 dBA	1	
15 dBA	22	
16 dBA	1	
10-15 dBA	3	
Not Defined	1	

A 15 dBA increase over existing noise levels was selected as a substantial increase for Pima County's recommended noise procedure. The majority of State DOTs identify a substantial increase as either a 10 dBA or a 15 dBA increase above existing noise levels. ADOT identifies a 15 dBA increase as a substantial increase in noise. Substantial increase was defined as 15 dBA for Pima County's procedure because it was consistent with ADOT and acceptable to FHWA for federally funded projects.

Table 3. Minimum Standard for Noise Abatement

Minimum Abatement To be Provided	Number of State DOTs	Definition
5 dBA	33	Minimum benefit received from noise mitigation efforts. The FHWA requires that abatement must provide at least a 5 dBA reduction in highway traffic noise levels to provide noticeable and effective attenuation.
6 dBA	2	
7 dBA	10	
8 dBA	3	
9 dBA	0	
10 dBA	2	

The minimum noise reduction selected for Pima County's noise procedure is 5 dBA. Noise reductions of 3 dBA are barely noticeable to the human ear. Noise abatement must be effective to warrant its expense and noise reductions of less than 5 dBA are not considered effective by the FHWA. The majority of State DOTs require a 5 dBA reduction as the minimum standard for noise abatement. Openings in walls for driveways will often reduce the effectiveness of the wall to less than a 5 dBA reduction. ADOT requires both a minimum reduction of 5 dBA and a reduction below the ADOT approach level of 64 dBA for noise abatement to be considered reasonable. Achieving both criteria is difficult and commonly not accomplished.

Table 4. Maximum Acceptable Cost of Noise Abatement

Maximum Cost of Abatement Per Benefited Receiver	Number of State DOTs	Definition
$15,000	10	This is the maximum amount that will be spent per benefited receiver to provide noise abatement.
$20,000	9	
$25,000	12	
$30,000	8	
$35,000	3	
$40,000	4	
$45,000	1	
$50,000	3	
Not Defined	1	

A maximum cost of $30,000 for noise abatement per receiver was selected for Pima County's noise procedure. A maximum cost of $35,000 per benefited receiver is used by the ADOT. While the maximum allowable amount established by State DOTs varies, the majority spend between $15,000 and $30,000 per benefited receiver. Many of these State DOTs have the option to use wood for sound barrier construction, and some have assigned a lower cost per benefited receiver in an attempt to limit the construction of walls. A mitigation maximum of $30,000 was selected for Pima County because wooden barriers are normally not acceptable in this area and this amount is relatively consistent with ADOT.

Table 5. Identifying Benefited Receivers

"Benefited" Receiver Used in Cost Analysis (Noise Reduction)	Number of State DOTs	Definition
3 dBA	6	Minimum noise reduction that a receiver must receive to be considered benefited for the purpose of determining the cost effectiveness criterion.
4 dBA	1	
5 dBA	41	
Not Defined	3	

A 5 dBA decrease was selected as the minimum noise reduction a receiver must receive to be considered benefited. The more receivers a particular wall benefits the greater its effectiveness and the lower its relative cost. A 5 dBA reduction was selected as the minimum criterion to be

considered benefited for Pima County's procedure because it is consistent with the 5 dBA decrease required for mitigation to be considered effective. The majority of State DOTs identify 5 dBA as the minimum noise reduction a receiver must obtain to be considered benefited. ADOT also identifies a benefited receiver as one that receives at least a 5 dBA reduction in the predicted noise level as a result of noise abatement measures.

Table 6. Maximum Noise Wall Height

Maximum Noise Wall Height (feet)	Number of State DOTs	Definition
15	1	This is the maximum height at which a state DOT will construct a noise barrier.
16	2	
18	2	
20	6	
22	2	
25	5	
30	1	
Not Defined	32	

Pima County is recognized for its mountain and desert views and informal character; therefore, a maximum height of 10 feet for noise walls was selected for Pima County's noise procedure. A maximum height of 10 feet was selected because this height can reasonably accomplish the goal of noise mitigation, while preserving the character of our existing setting. It was also recognized that additional restrictions were needed along Pima County's designated scenic routes. In these areas, walls of 10 feet in height would impair the visual quality that has resulted in the roadways' designation as scenic; therefore, a maximum wall height of six feet is appropriate. ADOT uses 20 feet as a maximum height for noise walls, which is appropriate for the high-type of roadways they maintain and construct.

Table 7. Noise Mitigation Consideration for Undeveloped Land

"Planned, Designed, and Programmed"	Number of State DOTs	Definition
Zoning Approved	0	The stage at which undeveloped land shall be considered for potential noise mitigation.
Final Site Plan Approved	1	
Final Plat Approved	2	
Final Plat Recorded	5	
Final Development Approved	2	
Building Permit Issued	33	
Foundation Under Construction	2	
Development Under Construction	2	
Not Addressed or Defined	4	

If undeveloped land has been issued a building permit it will be considered for noise mitigation under Pima County's noise procedure. At this stage of development, a sufficient monetary commitment has been made to the site and the intended use has been identified; therefore, the appropriateness of mitigation can be determined. The majority of State DOTs, as well as ADOT, consider issuance of a building permit sufficient for consideration of noise mitigation. Noise analysts will contact Pima County during the noise assessment to determine if suspect vacant parcels have secured a building permit.

References

Arizona Department of Transportation. 2000. Noise Abatement Policy.

Federal Highway Administration. 1996. Measurement of Highway-Related Noise.

Federal Highway Administration. 1995. Highway Traffic Noise Analysis and Abatement Policy and Guidance.

Federal Highway Administration. 1992. Reasonableness and Feasibility of Abatement.

Federal Highway Administration. 1982. STAMINA 2.0/OPTIMA: User's Manual.

Federal Highway Administration. 1998. FHWA Traffic Noise Model: User's Guide. FHWA-PD-96-009.

Federal Register. 1991. 23 CFR Part 772.

Newton, A. 2000. Development of a Model State Highway Agency Noise Policy. University of Louisville. Master's Thesis.

APPENDIX B

TRAFFIC NOISE POLICIES

Please see the following supplementals of Traffic Noise Policies reviewed for this procedure:

Arizona Department of Transportation Noise Policy

Maricopa County Department of Transportation Departmental Policy on Noise Abatement

Missouri Department of Transportation Noise Policy, pages 7-9

New Mexico State Highway and Transportation Department Noise Policy

New York State Department of Transportation Noise Policy

Ohio Department of Transportation Noise Policy

Oregon Department of Transportation Noise Policy

Pennsylvania Department of Transportation Noise Policy

Texas Department of Transportation Noise Policy