

may be placed adjacent to the wall to soften the appearance, but such placement will likely cause little additional noise reduction beyond that produced by the wall itself unless several rows of tall trees in dense planting configurations can be used. Some noise reduction in the form of less reflected noise from the wall back toward the roadway and beyond may be realized with minimal plantings, however.

3. For moderate noise problems, such as those caused by automobile traffic and occasional trucks, two or three rows of dense plantings of tall trees and dense shrubs may provide sufficient protection. When more screening is desired, a low earth berm can be added. This combination is recommended.

Plant materials should be considered as an alternative or supplement to walls or berms in a noise-reduction program. Not only do they provide noise reduction on their own, but they appear to act in such a manner as to complement the reduction caused by the solid-type screen and are more pleasing in appearance.

Any effective noise screen is worthwhile to consider in land use planning. Often only minimal space is required, and the protected area is made available for a wider variety of uses.

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## Noise Abatement and Public Policy Decisions: A Case Study—I-440 in Nashville

ANDREW N. BARRASS AND LOUIS F. COHN

Many state departments of transportation have become increasingly aware that early involvement of the public is essential for an effective highway noise-abatement program. Several states have developed formats for public meetings and other methods that assess citizen opinions prior to initiation of an abatement program. The Tennessee Department of Transportation has developed a thorough public-meeting and public-involvement procedure that is used before final design phases. This procedure was developed as an outgrowth of the I-440 community workshops. The I-440 community or neighborhood meeting is discussed in this paper and the Tennessee approach to noise-abatement information meetings is presented. In addition, other states' experiences are summarized and compared with the I-440 project. Other states' methods of public involvement or information meetings are explored, as well as their position on negative feedback from these various methods.

Since the adoption of federal design noise levels by the Federal Highway Administration (FHWA), many states have become increasingly aware of the necessity of involving the public in the noise-abatement decision-making process (1). Early involvement of citizens in noise-abatement measures by such states as California, Minnesota, and Pennsylvania has led to a consensus that such early involvement is essential for an effective highway noise-abatement program. Data have shown that when new highway construction occurs near otherwise-quiet neighborhoods, citizen apprehension toward both the highway and the potential noise impacts is lessened when public

meetings are undertaken as a part of the project development (2,3).

Many states have developed formats for public meetings or information meetings, slide presentations, or costly multimedia programs for the purpose of presenting information about highway noise generation and potential noise-abatement measures. Minnesota, for example, has developed a thorough and concise slide-and-tape presentation that discusses the history of traffic noise, the development of highway noise problems, and noise-abatement procedures (4). Other city or state agencies and FHWA have produced similar information packages about transportation noise impacts for public meetings or predesign hearings.

The Environmental Planning Division of the Tennessee Department of Transportation (TDOT) has considered numerous possible formats and presentations that deal with the concepts of highway noise and noise abatement. Among these are (a) informal public meetings, (b) discussion-group interaction, (c) slide-tape presentations, and (d) questionnaires.

The method eventually adopted by TDOT is based on community information meetings, which were developed for and conducted as a part of a public-involvement strategy for redesign of a highly controversial Interstate project in metropolitan Nashville. The

project was I-440, an interior bypass or outer loop that passes through predominantly residential areas and connects I-24, I-40, and I-65, which interchange in downtown Nashville.

#### PROJECT BACKGROUND

The public-information meetings now used by TDOT were developed as an outgrowth of a broad-based community-involvement program to reexamine the I-440 project and crosstown transportation needs.

Public hearings were begun as long ago as 1957 for this controversial project. Since that time, many public meetings, information sessions, and evaluation measures have been employed to assess citizen involvement with the various options that could be used to improve city traffic and transportation.

As an integral part of the I-440 redesign and community-involvement effort, highway noise abatement became a prominent discussion issue, and community meetings were held in a format that allowed an informal exchange between TDOT technical staff and the public. During these meetings the issue of noise intrusion was a continuing concern among the citizens.

An evaluative questionnaire was developed and used to gauge public opinion regarding various design schemes, highway location, and noise impacts. The questionnaire was an effective evaluation tool as well as one that provided opportunities for discussion (Figure 1).

Virtually all types of noise-abatement methods were presented in these public meetings; they ranged from the typical noise barriers, or berms, to soundproofing homes or businesses.

The questionnaire and the public-involvement activities that occurred as a part of the I-440 redesign allowed two very significant processes to occur. First, the recognition by TDOT of the need by the public for further information about various aspects of project development and, second, awareness by the public of various environmental problems associated with the project. However, of more significance is the understanding and acceptance of a specific environmental problem--highway traffic noise--and its subsequent abatement.

Therefore an environmental problem is perceived. Through education, its impacts are evaluated and apprehension is (or is not) alleviated, depending on acceptance of recommended abatement methods.

#### PUBLIC-INFORMATION METHODS

Environmental problems associated with highway development are dealt with more meaningfully when greater interaction between the technical staff and the public occurs. This process has become more apparent in recent years because of projects that involve high traffic volumes, new-location projects, and especially Interstate projects.

#### Premeeting Activities

The premeeting information activities include three general processes: (a) right-of-way or predesign public hearings, (b) analysis of primary and secondary impacts from traffic noise and further acquisition of data, and (c) premeeting mailing.

Information concerning potential noise problems is usually discussed or presented as a part of the project environmental-impact section of right-of-way or predesign public hearings. Questions raised by the public are taken from the transcripts or noted during the meeting and then incorporated into

strategies for future plans and further impact analysis.

By designation of primary and secondary impact areas from preliminary plans and by review of the environmental assessment for the project, neighborhoods are located for intensified studies. In some instances enough concern is expressed that additional ambient monitoring surveys are undertaken in specified neighborhoods. An example of this type of monitoring (which occurred in addition to the preliminary environmental assessment) is the more than 100 sites monitored for the I-440 project (4).

After initial review of the preliminary right-of-way and design plans, project noise levels are modeled in high-volume traffic areas. This may occur as part of the development of the noise study report or independently. Analysis of modeling data designates primary and secondary impacted homes or businesses and especially sensitive receptors.

An information mailing is then distributed to property owners and residents who may be affected. The mailing includes the following:

1. Plan type A: project description;
2. Plan type B: project location and termini;
3. Plan type C: general information regarding project phase development;
4. Plan type D: project map, which usually includes the neighborhood designation;
5. Plan type E: brief paragraph concerning design noise levels or the section of the FHWA Federal-Aid Highway Program Manual on abatement procedure (4);
6. Plan type F: statement of probable noise impacts specific to the neighborhood; and
7. Plan type G: invitation to public-transportation meeting concerning noise impacts and possible abatement measures.

The mailing designates a time and place for the meeting. Usually the meeting is on a weekday evening and is located at a place familiar to the residents, e.g., a local school or church.

#### Noise-Information Meeting

The public-information meeting format evolved after the overall I-440 experiences had been reviewed. T.E. Daugherty of FHWA has outlined some of these experiences thoroughly in a recent publication (5). In addition, other aspects of the format were incorporated after discussions with the Pennsylvania Department of Transportation and a review by Neuhaus and Mathews (6).

The approach of the information meeting usually conforms to the conversational-arrangement format (Figure 2) discussed by Neuhaus and Mathews (6). However, this arrangement may vary with site availability or number of citizens since this format is usually limited to about 70 persons. Because the TDOT approach is more of a neighborhood meeting and not a total-community meeting, the number of attendees is usually less than 50.

A typical information meeting will include the following sections. First, there is the introduction and welcome in which the TDOT moderator introduces the advisory staff, honored guests, etc. This introduction also contains a project overview that includes slides or diagrams and a sequential presentation of the project development as well as construction phasing. Second is a section devoted to fundamentals of highway noise, which is an educational segment the purpose of which is to present a brief definition of sound energy, noise measurement, traffic noise generation, monitoring, and modeling.

Figure 1. Individual questionnaire on I-440 project.

1. A) DO YOU LIVE ON PROPERTY NEXT TO THE I-440 RIGHT OF WAY?  
 YES      NO

B) IN WHAT NEIGHBORHOOD DO YOU LIVE (OR NEAREST STREET INTERSECTION)?  
 \_\_\_\_\_

2. WHAT BEST DESCRIBES YOUR PERSONAL FEELINGS ABOUT I-440?  
 FOR COMPLETING I-440  
 AGAINST COMPLETING I-440  
 GENERALLY FOR I-440, BUT CONCERNED ABOUT SOME ASPECTS  
 GENERALLY AGAINST I-440, BUT WOULD LIKE MORE INFORMATION  
 INTERESTED BUT HAVE NOT FORMED AN OPINION  
 INDIFFERENT - DON'T CARE ONE WAY OR THE OTHER  
 OTHER \_\_\_\_\_

3. IF YOU CHECKED THE BLOCK INDICATING "CONCERNED ABOUT SOME ASPECTS", PLEASE LIST THOSE ASPECTS YOU ARE CONCERNED ABOUT.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

4. A) DO YOU THINK THAT NOISE ALONG I-440 WILL BE A SIGNIFICANT PROBLEM?  
 YES      NO

B) IF NOISE IS A PROBLEM, WHAT METHOD OF NOISE ABATEMENT WOULD APPEAL TO YOU?  
 LANDSCAPED EARTH MOUND ALONG THE EDGE OF THE HIGHWAY  
 PLEASANTLY DESIGNED AND LANDSCAPED WALLS  
 BUFFER ZONE-BUY MORE HOMES AND BUSINESSES ALONG THE RIGHT-OF-WAY  
 ELIMINATION OF HEAVY TRUCKS FROM THE HIGHWAY  
 SOUNDPROOFING HOMES AND BUSINESSES  
 DEPRESSING THE HIGHWAY IN SENSITIVE AREAS  
 OTHER \_\_\_\_\_

5. A) IN YOUR OPINION WILL I-440 IMPROVE OR RESTRICT ACCESS IN YOUR TRAVEL:

	IMPROVE	RESTRICT	NO CHANGE
TO WORK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TO SHOPPING PLACES	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TO SCHOOL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TO RELIGIOUS ACTIVITIES	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TO SOCIAL OR RECREATIONAL ACTIVITIES	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
TO MEDICAL SERVICES	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
OTHER- _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

B) IF ANY BLOCKS ARE INDICATED AS "RESTRICT", WRITE THE STREET NAME OR GENERAL AREA: \_\_\_\_\_

6. DO YOU ANTICIPATE THAT CONSTRUCTION ACTIVITIES RELATING TO I-440 WOULD CAUSE YOU PROBLEMS? IF SO, TO WHAT DEGREE.

	SEVERE	MODERATE	NO PROBLEM
DIFFICULTY IN TRAVEL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NOISE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DUST	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
UTILITY INTERRUPTIONS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
HEAVY EQUIPMENT IN THE AREA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
OTHER- _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IF YOU HAVE ANY SUGGESTIONS HOW THESE PROBLEMS COULD BE REDUCED, PLEASE DISCUSS \_\_\_\_\_

7. DO YOU THINK THAT BUILDING OR NOT BUILDING I-440 WOULD RESULT IN UNDESIRABLE CHANGES IN THE PRESENT LAND USE CHARACTERISTICS OF YOUR NEIGHBORHOOD? IF SO, WHERE AND WHAT KIND OF CHANGES?

	IF I-440 IS BUILT	IF I-440 IS NOT BUILT
_____		
_____		
_____		
_____		

8. BASED ON WHAT YOU KNOW ABOUT I-440, DO YOU THINK THAT THE PROPOSED INTERSTATE HIGHWAY FITS INTO ITS SURROUNDING URBAN ENVIRONMENT IN AN ACCEPTABLE MANNER? IF NOT, WHAT CHANGES WOULD YOU LIKE TO SEE MADE?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

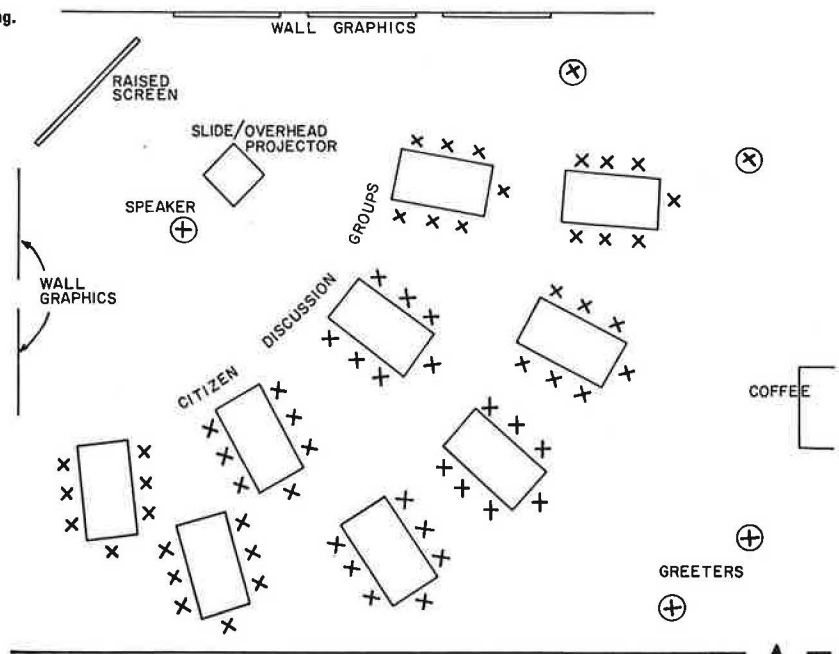
9. A) HOW DID YOU LEARN OF THIS MEETING? \_\_\_\_\_

B) HOW DO YOU THINK THE DEPARTMENT CAN BEST INFORM CITIZENS OF COMMUNITY MEETINGS?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Third is a presentation on highway noise abatement that shows traffic noise-abatement methods from both an academic view and a cost-effective or technically feasible view and includes state-of-the-art technology in noise abatement. The format for the information presentation of the last two sections includes slide-and-tape lecture presentations, diagrams of barriers, charts of roadway design and placement of wall graphics of preliminary plans, and an audio presentation of various sounds at different increments of L10 or Leq values. These sections also include short question-and-answer periods; the entire session lasts less than 30 min.

After these three sections, a general discussion segment allows further question-and-answer activities. However, this period is also one in which small-group activities (at the discretion of the citizens present) occur; these include presentation of area (neighborhood or street) abatement plans, discussion of preliminary plans for specific streets or residential linkages, and further explanation of technical noise information. Additional information regarding noise-abatement alternatives that use the technical staff as group leaders is also presented. The concluding activity of the information meeting is the completion of a questionnaire by the

Figure 2. Arrangement of conversational information meeting.



citizens present. The questionnaire includes requests for information related to the general project, department plans and goals for the area transportation system, technical information, noise-abatement recommendations, and suggestions for noise-abatement methods for the neighborhood.

#### Postmeeting Activities

The questionnaire usually includes the address and telephone number of the division office to enhance postmeeting follow-up opportunities by both telephone and written communications. Other postmeeting activities include additional field monitoring (if a need for it was voiced at the meeting), additional prediction modeling for further barrier analysis, and development of a final noise study report, which in some cases requires an additional information mailing or an information meeting with specific residents from the local streets that are affected.

#### RESULTS AND EXPERIENCES WITH PUBLIC INVOLVEMENT

The public-information meeting described here appears to provide adequate public input and evaluation of needs for further dissemination of information or revision of plans. Another more-important aspect of the public-involvement process is divided into two separate points.

Inclusion as part of the meeting agenda of a technical presentation in which such educational tools as slides, mock diagrams, contour maps that show  $L_{eq}$  or  $L_{10}$  dropoff rates, preliminary plans, preliminary abatement schemes, and one-to-one discussions causes increased credibility for both the complexity of the environmental problem and the expertise of the staff members. Allowing questions and discussion of the citizens' concerns causes a better understanding by the department staff for the lack of project information or technical information. Therefore, a more-meaningful dialogue about specific goals or needs develops, which can be explored further prior to final design of a highway.

In the majority of cases, this evaluation or public-feedback mechanism prevents costly and time-

consuming total reevaluation of plans or redesign of a highway for the purpose of noise abatement.

As a result of the public meetings for I-440, no additional right-of-way was included when it was needed to provide for berm-and-barrier combinations. In addition, the I-440 questionnaire determined the need for barrier landscaping that increased public acceptance of the project.

The aesthetics associated with noise abatement by the creation of open space or a buffer zone and by barrier placement or design was a topic discussed by all at the information meetings. The inclusion of tangential aspects of the project such as pedestrian overpasses or bikeways integrated within the barrier development makes noise abatement more visually pleasing, economical, and acceptable to the public.

When the technical aspects of noise generation are explored during the meeting, questions arise concerning noise levels (ambient, projected, or both) at individual homes. In some instances, projected (modeled) levels may not agree with the individual's perceived noise level. Remonitoring of specific neighborhoods has occurred as a result of questions raised during the information meetings. When the development of a final noise study report is undertaken, an intensified noise-monitoring program is outlined to specifically include concerned citizens' homes or businesses. An example of the type of study that could be used in controversial areas of a project is one similar to the I-440 study, which included a preliminary monitoring program of more than 100 residential sites and 20 selected sensitive-receptor sites. [Maps that show the measured  $L_{10}$  noise levels and the predicted noise isopleths for I-440 are available on request from the authors.] These same sites were also modeled for future prediction levels. Specific areas within a community that were not included in the preliminary environmental assessment may become apparent because of the information meeting. Therefore, additional monitoring and modeling data would be needed to assess impacts or abatement more thoroughly.

During the smaller discussion-group segment of the I-440 community meetings and more recent information meetings, specific goals for abatement

for designated areas were discussed. An example of these goals included the 10-dB(A) noise reduction or attenuation of possible barrier types. However, if abatement is found to be economically infeasible, then the outcome is usually lack of communication with members of that neighborhood. However, in one case--the crossing of TN 1 and TN 137 in Johnson City, Tennessee--it is now planned to construct two expensive barriers because the public had expressed a deep concern for some form of noise abatement although initially barriers appeared unjustified economically.

Two other case studies have shown that this public-information process can prevent the building of expensive barriers. Where I-40 and I-640 cross in Knoxville, Tennessee, preliminary abatement studies indicated a need for noise barriers because noise levels were projected to increase to 80-85 dB(A). At the public meeting the residents affected at this specific area stated that, instead of noise-abatement barriers, they would be willing to relocate for the creation of a buffer zone. Including relocation costs, estimates of the savings by developing the buffer zone [as opposed to building a barrier 9 m (30 ft) high and 700 m (2000 ft) long on steep topography] are approximated to be \$300 000.

On another project--the crossing of TN 93 and TN 137 in Kingsport, Tennessee--preliminary analysis of noise impacts to a neighborhood indicated that a berm would be necessary to protect the residents. At the public meeting, citizens from the Arnolds Chapel area expressed the opinion that the height of the berm would have a visual impact because travelers on the new facility would be unable to see their community church. After analysis of questionnaires specific to the area and after lengthy follow-up communications (which included a petition to the department from the local residents), an exception to the Federal-Aid Highway Manual procedure was requested and the \$450 000 barrier was not constructed.

TDOT public-information meetings have in general resulted in savings by preventing redesign, additional right-of-way, redevelopment of landscaping, and barriers and by expediting preparation of final plans. Although those positive aspects of early public involvement are predominant in the case studies, some costs are involved. The cost in staff time for planning the meetings, travel, and monitoring assessments (including needs for additional equipment and computer time) and the additional taxing of the staff with follow-up activities are great.

The use of the questionnaire--although it is highly informative and an excellent tool for evaluating the concerns of a specific area--has been misconstrued by some public groups to represent a voting mechanism for barrier design or placement. In an area along Ellington Parkway (a federal-aid primary project) in Nashville, citizens were divided in their feelings about a barrier. Those opposed felt that the barrier would block their view of the setting sun against the hillsides and those in favor were ardently against the noise impact. The outcome of the public meeting had two interesting effects. The first was a highly technical problem: At what point should the barrier end if it was still to provide the necessary abatement for protecting those in favor of the abatement? The second was the development of a local program that requested questionnaires be mailed back to the department that voted No to the barrier. However, this issue was resolved simply when one resident expressed a desire for the barrier and his residential location divided the antibarrier troops. TDOT therefore decided to

construct the entire barrier.

Other problems of public meetings are those that are simply inherent. These include proper seating, proper location, best times and dates, and proper notification.

Evaluation of the public-transportation meetings for discussions of noise information and abatement has shown it to be a worthwhile program and one that has improved highway development.

#### COMPARISONS WITH OTHER STATES

As mentioned in the introduction to this paper, Tennessee is not the first state to develop a strategy for citizen involvement in highway noise-abatement decision making. In fact, for those states that have programs to retrofit existing highways with noise barriers, a highly definitive and detailed public-involvement strategy is a necessity.

Connecticut, for example, has encouraged citizens to complain when noise from the existing highway system is a problem. When a complaint is received, whether through a letter, a call to the Department of Transportation (ConnDOT), or a referral from the governor's Information Line, ConnDOT engineers visit the complainant, perform an ambient measurement survey, and conduct a preliminary noise-abatement feasibility study. When a noise-abatement project results from a complaint or from some other means (through application for federal noise-abatement funds), a public meeting is scheduled to explain the project dimensions and to receive public input. Prior to approving a noise-abatement project, ConnDOT in many cases will ask the affected residents to actually vote (by returning a postcard) whether they support the project. If the result of the vote is negative, the project is cancelled; if it is positive, the project proceeds to the design stage (7).

In its fledgling noise-abatement program, the New York State Department of Transportation (NYSDOT) uses a public-meeting format also, but it is supplemented by social surveys. For its only major project undertaken so far--the Youngman Highway Project in Buffalo--NYSDOT conducted two identical hearings on the same day--one in the afternoon and one in the evening--to explain the project. Also, a vote was taken to determine the type of wall desired by the community; concrete was selected rather than wood or metal. It was not necessary at the hearings to seek a determination whether the project was favored because the detailed social surveys conducted prior to that time clearly indicated overwhelming support and approval (8).

The TDOT I-440 project is not, of course, a retrofit situation but instead an expressway on a new location. Because of its semiurban characteristics, noise levels and abatement are of such a controversial nature that the ultimate implementation of the project has been to a large degree dependent on TDOT's success in ameliorating public concern about noise. Other projects around the nation have faced similar problems.

In St. Petersburg, for example, the Florida Department of Transportation (FDOT) received continuing citizen concern about possible noise impacts from I-275, which caused the direct intervention of the Florida Department of Environmental Regulation, the U.S. Environmental Protection Agency, the Florida Wildlife Federation, and the Pinellas Area Coalition on Transportation. Their involvement produced a recommendation for a noise barrier in an area adjacent to a public housing project. Inclusion of the barrier was very important to the removal of opposition to the project.

FDOT conducted social surveys before and after beginning the project. Interestingly, when the residents of the public housing project were interviewed prior to the opening of the highway, they were not greatly concerned about possible noise impacts. Of greater concern to this highly transient population were traffic-related problems such as congestion and accessibility. However, although most of the residents did not consider themselves affected by noise from I-275, 80 percent did feel that the noise barrier was good for the neighborhood.

Another urban Interstate project that had highly controversial noise problems was the completion of I-95 in Philadelphia, Pennsylvania. Opposition to this project was so intense and organized that a court consent decree prohibited opening of the completed highway until all noise problems were resolved. The Pennsylvania Department of Transportation (PennDOT) was required to work closely with representatives of approximately 20 constituent community groups in the 5-km (3-mile) project corridor.

The public-involvement strategy adopted by PennDOT differed significantly from the others discussed (including that of TDOT on I-440). Because of the intensity of opposition to the project by the citizens, PennDOT elected to work with only two or three community leaders in each of four project areas. A total of approximately 30 very informal meetings was held, usually in the homes of the community leaders, at which agreements were eventually reached concerning abatement schemes. Once all the agreements had been reached, joint recommendations were presented at two large public meetings. The community leaders were involved in the actual conduct of these meetings in order to reinforce the solidarity achieved. At the conclusion of the meetings, attendees completed questionnaires that indicated feelings about the abatement proposal. The resulting barrier system was greatly supported by the constituent community groups and included some very innovative treatments. The high community support and the feelings of joint responsibility and even ownership of the barriers were significant achievements of this public-involvement process.

#### CONCLUSION

After a thorough review of this particular case study in Tennessee and a summary of other states' experiences related to involvement of the public in noise-abatement procedures, it becomes overwhelmingly obvious that citizen participation is a necessity for developing positive public opinion related to noise impacts (9). In the case studies presented, the public opinions on noise abatement were the determining factors that led to the decisions regarding the methods employed by technical staff to abate specific project impacts.

The method of public assessment appears to be best when the assessment tools are diverse and broad-based. Evaluation and feedback mechanisms are important in addition to specific educational or

information meetings. One-to-one interaction between technical staff and the public (either by means of an information meeting or various methods of communication) enhances department credibility for project goals. This also increases acceptance of the project, the project impacts, and forms of abating those impacts. The public policy with regard to abatement is therefore most meaningful and less costly when derived by group decisions and not simply by assessment of technical data.

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