Noise-Compatible Development: A Pilot Demonstration Project

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ABSTRACT

Recently FHWA initiated a pilot demonstration project in noise-compatible development. Site visits were made to two locations (Oakdale, Minnesota, and Bradenton/Manatee County, Florida) to offer technical assistance in both estimation of future noise levels and consideration of noise in land use planning and development decisions. Based on local data of traffic, speed limits, and the percentage of truck travel, noise contours were produced for all major highway facilities in both areas. In addition, planning techniques for considering noise were discussed, as were the legal aspects regarding noise and zoning. Based on these pilot projects, it was concluded that the information provided was useful to the local communities, and that technical assistance from the federal and state levels is critical to the effectiveness of noise-compatible development.

For a number of years FHWA has been interested in the subject of noise-compatible development for several reasons. First, while state and local noise barrier programs along major highways have had many successful applications, the percentage of highway right-of-way on which barriers can be placed is fairly small because of topography, the nature of development, cost, aesthetics, or the inability to install a continuous barrier without breaks. Second, it is generally not practical to erect barriers along the thousands of miles of highways where there is currently no development because it is not known when and where development will take place or what type of development it will be. For these reasons FHWA has a policy of not funding barrier construction on undeveloped lands. Third, it is clear that traffic noise will continue to be an issue because of projected long-term increases in automobile and truck travel, and because of anticipated development along major highways.

Until recently, FHWA involvement in noise-compatible development had been in the production and distribution of pamphlets and audio-visual materials alerting local communities to the need for noise-compatible development. Although these were generally well-accepted materials, it also became evident that they were not meeting all of the needs of local communities with little or no experience in analysis or mitigation of traffic noise, or incorporation of noise as a factor into local land use planning activities. As a result, during the past year FHWA initiated a pilot demonstration project in noise-compatible development. Site visits were made to two locations to offer technical assistance in both estimation of future noise levels and consideration of noise in land use planning and development decisions. The purpose of this paper is to report on the results of these site visits.

DESCRIPTION OF PILOT DEMONSTRATION

The three basic aims of the pilot demonstration were as follows.

1. Develop noise contours for major highway facilities in a local area. The FHWA STAMINA 2.0 noise model was used, making several simplifying assumptions appropriate to the community-wide (instead of site-specific) nature of the analysis. These assumptions will be discussed.
2. Provide local personnel with simple techniques that can be used to produce additional noise contours. The techniques provided and discussed were a nomograph method published by the U.S. Department of Housing and Urban Development (HUD) (1) and the FHWA programmable-calculator method (2).
3. Discuss with the local personnel different techniques that they may use to incorporate noise considerations into the land use planning or subdivision approval processes. A packet of information was provided in which zoning techniques for noise, subdivision approval considerations, site design issues, and so forth were discussed. Legal issues regarding noise and the ability to plan for it were discussed, and informational pamphlets that could be provided to local decision makers or interested citizen groups were also included.

Choosing the Sites

Before setting up a more formalized means of technical assistance, it was decided to try this at two pilot sites to make sure that FHWA would have something meaningful to provide to local communities, and that there is a demand for this type of assistance. In choosing the pilot sites, three screening criteria were used; these criteria would apply to any future technical assistance as well:

1. Local officials consider highway traffic noise to be an issue in their community and are motivated to initiate a noise-compatible development program;
2. Local agencies have not yet developed an expertise in noise-compatible land use planning, but are interested in doing so; and
3. There is right-of-way along major facilities not yet developed but which will be developed in the next few years; this recognizes that the ability to plan for noise is much greater where the land has not yet been fully developed.

Through the FHWA field offices, communities in California, Florida, Minnesota, Nevada, and Pennsylvania were submitted as candidate sites.

The communities chosen for the pilot demonstration were Oakdale, Minnesota, and Bradenton/Manatee County, Florida. Before the demonstration, preliminary site visits were made to collect data to develop noise contours and to investigate the structure of local land development activities. The demonstrations that took place at each site are covered in the following sections.

Oakdale

Oakdale is a suburban community of 12,000 people located in the Twin Cities (Minneapolis-St. Paul) area in Minnesota. It is primarily residential in character, with a small amount of light industry and commercial property. Although much of the land is still undeveloped, the Beltway around the Twin Cities (I-694) runs through Oakdale, and its good accessibility has increased pressure for development. In addition to the Interstate facility, there are several major arterials where traffic noise is also a potential issue.

The community was incorporated as a municipality in 1972. The single planner on the city staff is responsible for a number of functions, and relies on the state and consultants for much of the traffic planning and engineering work. The demonstration consisted of several hours of discussion with the city planner, plus a brief presentation on the purpose of the demonstration to the Oakdale City Council.

For input into the FHWA STAMINA model to produce noise contours, 1982 and 2000 traffic estimates were provided by the city's consultants, speed limits were provided by the Oakdale Sheriff's Department, and the percentage of truck travel was supplied by the Minnesota Department of Transportation (MinnDOT). With this information, L_{eq} noise contours were produced for major highway facilities, giving the distance from the centerline of the roadway to levels of 75, 70, 67, 65, and 60 dB(A). In addition, the packet of materials given in Table 1 was presented and discussed, and a slide and tape presentation entitled "Sound Planning" was shown. Meetings were also held at MinnDOT and the League of Minnesota Cities to summarize the demonstration in Oakdale.

At the meeting in Oakdale, the community's interest in traffic noise was discussed, as well as general thoughts on the course of future development. The two primary motivations to addressing noise issues were the desirability of quality development (i.e., a pleasant living environment) and the need to meet Federal Housing Administration/Veterans Administration (FHA/VA) standards on noise so that developments could qualify for mortgage guarantees.

Bradenton/Manatee County

The city of Bradenton (population 121,000) and Manatee County (population 148,000, including Bradenton) are located on Florida's Gulf Coast in a rapidly developing area just north of Sarasota and south of the Tampa/St. Petersburg area. A major Interstate (I-75) goes through the area, and a number of US and state roads also carry heavy traffic. There is considerable truck traffic associated with the citrus industry in certain parts of the county.

There is a city planning staff that covers activities within the Bradenton city limits, and a county staff that covers the remainder of the county. Most of the city is currently developed, so virtually all of the rapidly developing areas are the responsibility of the county staff. Presentations were made to a planner on the city staff and a planner on the county staff.

The year-2000 traffic estimates were available from projections made by the Sarasota/Manatee Area Transportation Study (SMATS). Truck percentages were estimated from counting programs of both the Florida Department of Transportation and Manatee County. Speed limits were assembled by county staff. From this, the L_{eq} contours were produced, and because the state and county use the L_{10} descriptor, a discussion was given on the relationship between L_{eq} and L_{10}. The packet of material in Table 1 was discussed. As in Oakdale, the desire for a pleasant living environment and the desire to meet HUD standards were both reasons to be concerned about noise.

EVALUATION OF PILOT DEMONSTRATIONS

It is difficult to come up with an ultimate measure of success for a program like this because the most likely (and possibly the most desirable) outcome would be for local planning staffs to use the contours and zoning and subdivision information in informal discussions with developers. However, the pilot demonstrations can be evaluated for how well they transmitted useful information to local area planners, and what limitations the information may have had. The technical and policy aspects of the demonstration are discussed in the following sections, and an attempt is made to interpret the information from a local point of view.

Assembling Data

The three major data items needed to be able to

TABLE 1 Noise-Compatible Development Materials Distributed to Localities

Publication	Use
Policy on Land Use and Source Control Aspects of Traffic Noise Attenuation. AASHTO, Washington, D.C., 1980.	Demonstrates AASHTO support for noise-compatible development
Guidelines for Considering Noise in Land Use Planning and Control. Federal Interagency Committee on Urban Noise, June 1980; available from FHWA, U.S. Department of Transportation.	Discusses federal agencies' policies and standards for noise
W. J. Gallaway and T. J. Schultz. Interim Noise Assessment Guidelines. Office of Policy Development and Research, U.S. Department of Housing and Urban Development, Dec. 1980.	Provides nomograph techniques for estimating noise impacts from transportation sources on a development
M. J. Meshenberg. The Administration of Flexible Zoning Techniques. Planning Service Report 318. American Society of Planning Officials, Chicago, June 1976.	Discusses newly developing techniques for zoning to be able to consider a wider range of issues
M. T. Stahr. Reducing Noise Impacts of Motor Vehicles: A Problem With Diffused Solutions. Unpublished; submitted for a course at George Washington University, March 1983.	Discusses where noise-compatible development may be appropriate and how it may be accomplished
The Audible Landscape: A Manual for Highway Noise and Land Use. FHWA, U.S. Department of Transportation, Aug. 1976.	Suggestions for incorporating noise into land use and site design decisions
Highway Noise and Compatible Land Use. FHWA, U.S. Department of Transportation, May 1979.	Five case histories
Highway Traffic Noise and Future Land Development Can be Compatible. FHWA, U.S. Department of Transportation, 1979.	Pamphlet promoting noise-compatible development

produce noise contours are traffic forecasts, speed data, and the percentage of truck travel. In both communities all these data were available, and the contours could be produced by making certain assumptions. For Oakdale, the year-2000 traffic projections were given as a range by the consultant [average daily traffic (ADT) of 46,000 to 55,000], recognizing the uncertainty associated with travel forecasts. The midpoint of this range was used for traffic data. For Bradenton, the SMATS travel forecasts were used. These forecasts were from an unrestrained traffic assignment process, and because Bradenton is a rapidly developing area, the projected volumes in some cases exceeded the roadway capacity. In those cases the capacity of the roadway was chosen rather than the projected volume.

The speeds used in estimating contours were the current speed limits on facilities in both areas. Two potential drawbacks of using current speed limits are that the limits may change in the future, and that as future volumes approach capacity, actual speeds will decrease. The decrease in speed, however, may be offset by the noise associated with acceleration and deceleration in congested traffic. Therefore, the use of current speeds was thought to be a reasonable assumption.

Highway noise-prediction models are sensitive to the percentage of truck travel because heavy trucks are much noisier than passenger cars. In both communities (and probably in most other areas as well) there was no breakdown available for every arterial and freeway on truck travel. Also, most truck counting figures do not divide the percentages into heavy versus medium trucks, and the noise models require both. For both Oakdale and Bradenton, the states had collected truck data for major facilities, and in addition, Manatee County (Bradenton) had estimates for some additional facilities. With this information, the percentage of trucks could also be assigned to other facilities of the same type. The breakdown of medium versus heavy trucks was derived from national average data obtained from an FHWA Technical Advisory (3).

Developing Contours

Once the data were assembled, the development of contours was a straightforward matter. The FHWA STAMINA 2.0 model was used. Receptors were located perpendicular to the roadway at 50-ft intervals, and from the output it was possible to interpolate to develop the contours. A sample of the contours developed is given in Table 2. Assumptions used in the STAMINA runs were as follows.

1. National average data by city size from NCHRP Report 187 (4) were used to develop peak-hour factors from ADT. Peak-hour L_{eq} noise contours were developed.
2. Flat sites with no barriers were assumed.
3. Soft sites were assumed.
4. The nighttime percentage of ADT was assumed at 15 percent, thus making the L_{eq} (FHWA measurement) and L_{dn} (HUD measurement) comparable.
5. Each segment of roadway was modeled separately, assuming an infinite length, and distance from the centerline was measured. Segments were not modeled separately for each direction of travel. Distances were rounded to the nearest 10 ft.
6. Shielding by houses was not accounted for.

Although these assumptions were reasonable in each community and simplified the use of STAMINA compared with a project-specific analysis, there is still a lot of analysis involved. This is because each time the ADT, speed limit, or percentage of truck travel changes on a facility, a separate analysis must be done on that link. On a community-wide basis, a large number of analyses may have to be run.

The contours were easy to explain to local staffs not familiar with noise. It was also easy to explain that these were only approximate distances; the local planners were comfortable with that. It was a little more confusing to describe the different noise descriptors (L_{eq}, L_{dn}, L_{10}) and their application because neither community had significant experience in noise measurement. The relationship between L_{eq} and L_{dn} was particularly important in both areas because HUD uses the L_{dn} description for the noise standard for FHA mortgage guarantees and other HUD programs.

TABLE 2 Sample of Contours Developed During Pilot Demonstration Project

Facility	Contour, L_{eq} [dB(A)]	Distance from Centerline (ft) 2000	1982
I-694, between TH-120 and TH-36	75	100	60
	70	200	140
	67	320	220
	65	420	280
	60	900	600
I-694, between TH-36 and 40th Street north	75	100	60
	70	250	130
	67	375	200
	65	500	270
	60	1,100	550
I-694, between 40th Street north and TH-5 (does not take into account barriers)	75	110	60
	70	240	130
	67	360	200
	65	500	270
	60	1,050	550
I-694, between TH-5 and I-94	75	130	70
	70	270	150
	67	430	230
	65	580	310
	60	1,300	650
TH-120, between I-694 and 50th Street north	75	-	-
	70	-	-
	67	60	45
	65	80	60
	60	200	140
TH-120, between 50th Street north and 40th Street north	75	-	-
	70	50	-
	67	90	60
	65	120	70
	60	250	160
TH-120, between 40th Street north and Stillwater	75	-	-
	70	70	50
	67	110	80
	65	160	110
	60	350	230
TH-120, between Stillwater and 10th Street north	75	-	-
	70	60	-
	67	90	60
	65	120	90
	60	270	190

Planning and Legal Aspects

The packet of materials discussed (Table 1) consisted both of informational brochures outlining the traffic noise problem and suggesting land use solutions, and more detailed booklets on how noise impacts may be successfully incorporated into the land use planning and subdivision approval processes. In zoning, several options were discussed, with the most promising appearing to be definition of a noise overlay zone. The overlay zone, which has typically been used previously in defining flood plains, would put high noise areas into a special zone (based on the contours), which would be in addition to whatever zoning the property would already have, and would thus require mitigation. Conditioning subdivision approvals on proper consideration of noise impacts would have the same purpose, but would place consideration later in the development process. The legal issues relating to both liability for noise and zoning for noise were also covered.

Planners in both communities rated these materials "very useful" or "somewhat useful." The underlying sentiment appeared to be that although these were helpful as guidance documents, neither community intended to extensively revamp their zoning process to incorporate noise because of the sensitive political nature of making any changes in the zoning process. Instead, the materials would be used in discussions with developers on a case-by-case basis.

CONCLUSIONS

In evaluating the success of these pilot demonstrations and considering setting up a continuing program of technical assistance, three basic measures of success need to be examined: whether it is technically feasible to supply noise contours, whether there is an identifiable demand for this type of assistance, and whether local areas have enough information to continue to work in noise-compatible development after the demonstration project.

1. Technical feasibility: The two pilot demonstrations have shown that it is possible to provide contours to a local community with a quick turnaround time. Some of the assumptions made about being able to provide this quick turnaround would not be considered acceptable for a project-specific analysis [for use in an environmental impact statement (EIS), for example], but they were thought to be reasonable for community-wide estimates. The necessary data were obtainable in both communities without a major level of effort. The issue of how defensible the contours are and whether they can be successfully used to determine the use of individual parcels of land remains unresolved. If it is assumed that the contours developed are accurate to within ±3 dB(A), this still leaves considerable latitude as to the true location of the contour. A developer may argue that if the contour is 3 dB(A) too high, he will be unfairly prevented from using a large parcel of his land. Although this is an issue to be concerned about, it need not prevent the use of contours in development decisions. As evidence, a parallel situation has existed for years in many communities: Developers have been required to pay for road improvements (widening, turning bays, and so forth) on the basis of imperfect traffic forecasts. The main concerns from both a legal and equity standpoint should be that noise contours be developed by using a rational process and best available data, and that the standards be applied equally to everyone.

2. Demand: There were several other communities that expressed an interest in being pilot sites besides the two chosen, and wider advertisement should increase interest. The total demand is unknown because noise is still not considered a critical issue in most communities. However, for cities and counties expecting growth, planning for noise ahead of time ought to avoid a lot of homeowner dissatisfaction in later years.

3. Continuation of the process: From a technical standpoint, the HUD nomograph procedure provided to both areas should allow them to easily update contours if circumstances change. It was also apparent from the pilot demonstrations, however, that the support of the state is critical to the continuation of these activities. The involvement of state department of transportation experts in noise in both these demonstrations was a major factor in the overall credibility of the demonstration. Local planners in both communities were more at ease in dealing with noise knowing there was someone in the state they could call on for general guidance, technical assistance, and data. Depending on the knowledge and experience available in the local community, help could be needed from federal and state governments in the following areas: traffic forecasts, truck forecasts, noise contours, fundamental concepts of traffic noise, fundamental concepts of noise description, experiences in other communities, and zoning and legal issues. In terms of policy guidance offered to the communities, the pilot programs showed that the handouts appeared to be appropriate and useful. The documents were seen as somewhat vague in terms of specific solutions, however. A "cookbook" approach would be more desirable, but this is not feasible because each local community will differ in its treatment of zoning, relationship with developers, and so forth.

In general, it can be concluded that (a) there is a need for consideration of noise in the land use planning and subdivision approval process, (b) local areas will have to follow through because they are responsible for land use decisions, (c) it is necessary for federal and state governments to offer assistance to local governments on this subject, and (d) the pilot demonstration projects were a reasonable example of how all this may be accomplished.

REFERENCES

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