COMMUNITY PERCEPTION OF NOISE BARRIERS

Volume I

by

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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ABSTRACT

The report presents the findings of a study of timber, concrete, and metal barriers installed along certain of the Commonwealth's interstate and primary roads. A total of 297 home interviews were conducted in five communities to determine citizens' perception of the effectiveness of these barriers. The interviews were conducted over a 13-week period during the summer of 1978.

More than two-thirds of the respondents had lived in their current dwellings before the noise barrier was built; 11% of them before the highway facility was built. About 92% of the respondents were homeowners, 60% were between the ages of 31 and 50 and the average age of the homes surveyed was 12 years.

For all five sites, 78% of the respondents were satisfied with the barriers and about half felt the barriers were reducing the noise significantly. In general satisfaction they ranked the concrete barrier first and a barrier with offset metal panels next. Aesthetically, a wood panel type barrier was rated the most desirable. In urban locations the wooden barriers appeared to be slightly more desirable than the metal one. Barriers along non-limited access roads were not seen to be as effective as those located along limited access roads.

In addition to attenuating noise, barriers were said to provide security from would be-intruders, uniformity in the appearance of the neighborhood, privacy, safety and a reduction in road tar and air pollution. About a third of the respondents said that the barriers had a positive effect on the value of their property. A significant number of respondents indicated that vegetation was a viable alternative to noise barriers.

SUMMARY AND CONCLUSIONS

As a result of mandates issued in the Federal-Aid Highway Act of 1970, the Department has found it necessary to reduce the intrusion of traffic noise into communities lying adjacent to newly constructed or improved highways. To accomplish this, roadside barriers of timber, concrete, metal and earth have been installed. Such barriers have been effective in reducing noise from highways by as much as 5 to 15 dB(A). To ascertain which materials are the best noise attenuators and to suggest any needed modifications in barrier designs, the study reported here was undertaken. The approach was to conduct home interviews in five communities: two adjacent to wooden barriers, two adjacent to metal barriers, and one adjacent to a concrete barrier. A total of 297 interviews representing 87% of the 340 households lying within the 70 dB(A) noise contours were administered at the five sites.

For the five sites surveyed, 78% of the respondents were satisfied with the barriers, and about half felt the barriers were reducing the noise significantly. In general satisfaction, they ranked the concrete barrier first and a barrier with offset metal panels next. From the standpoint of noise reduction, these two barriers were similarly rated. Both of these barriers were along interstate roads. The fact that the barriers (two wooden and one metal plank type) along non-limited access urban roads were not seen to be as highly effective indicates either that these barriers were not as effective in reducing noise levels or that barriers in urban neighborhoods are not as desirable as those shielding interstate highways. Studies utilizing all types of barrier materials in an interstate setting would certainly provide information as to which is the case.

In many instances, the appearance of the barrier was seen to be just as important as its ability to attenuate noise. Aesthetically, the wood panel type barrier was rated the most desirable and the wood plank type the least desirable. The metal panel barrier was also seen as aesthetically pleasing, while the metal plank and concrete barriers were not. In the urban locations, the wooden barriers appeared to be slightly more desirable than the metal one. Citizens bemoaned the noise generated by objects thrown against metal barriers or scraped across their irregular surfaces. Also, these surfaces were said to produce a glare from headlights, especially during wet weather. In all five communities, landscaping and general maintenance were said to be in need of improvement. Citizens also felt that vegetation would greatly enhance the barrier sites and it is believed that such enhancement would help to reduce some of the negative attitudes about noise barriers. It was even suggested that the barriers be covered with ivy or some other type of climbing vine, the purposes being to beautify the site, increase the attenuation of noise, and eliminate graffiti. This feature was of much interest to a substantial number of the people interviewed.

In addition to attenuating noise, the barriers were seen as providing security from would-be intruders (especially in the limited access setting), uniformity in the appearance of the neighborhood, privacy, safety (i.e., separation of pedestrians and pets from traffic), and as reducing road tar and air pollution. About a third of the citizens felt that the barriers had had a positive effect on the value of their property. Those living adjacent to the interstate highways tended to feel slightly more positive about this effect than did those living in the other communities. Moreover, roughly two-thirds of the respondents felt that barriers had had a positive effect on their communities.

Only 15% of the respondents indicated that they would have preferred a cash settlement in lieu of a noise barrier. However, about 25% did feel that such a settlement would be appropriate under certain conditions. More of the people living adjacent to urban arterial roads than of those living adjacent to limited access highways were of this opinion. A significant number of respondents also indicated that vegetation was a viable alternative to noise barriers. Respondents indicated that their experience with vegetation supported this contention. Apparently, the use of hedgerows or lines of trees could do much to reduce negative attitudes towards barriers, even though their ability to reduce traffic noise is, at best, minimal.

RECOMMENDATIONS

The findings from the study led to the following recommendations.

1. Noise barriers should be installed prior to the beginning of construction of the highway when possible. This scheduling of activities aids greatly in keeping construction dust and debris from getting into the adjacent community and in abating construction noise.

2. Where possible, existing vegetation at barrier sites should be left in place, and where this cannot be done, plantings should be made. In either case, the vegetation should be regularly maintained. For this purpose, perhaps a long-term maintenance agreement should be negotiated with the local jurisdiction at the time the barrier is constructed.

3. When feasible, tree belts, thickets, and hedgerows should be used as noise attenuators. Citizens perceive such vegetative shields as being more desirable than man-made barriers.

4. Tops of barriers should be designed so as to prevent them from being used as play areas by children.

5. All barriers should be surfaced with material that will not reflect glare from headlights.

6. Where it is anticipated that sound might be reflected from the barriers, efforts should be made to use absorptive materials. Methods for reducing such reflection should be studied by the Department.

7. In urban areas, citizens attending preliminary public meetings on projects that are to include barriers should be shown an artist's renderings of the barriers with and without vine coverings.

8. Efforts at involving citizens in the planning and design of noise barriers should continue.

9. The feasibility of providing cash compensation in lieu of noise barriers to adjacent homeowners should be studied.

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10. Additional barrier designs should be evaluated for use in urban settings. These might include barriers made of masonry and brick, vine-covered structures, and serpentine shaped structures of various materials.

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BACKGROUND

The decade of the seventies has seen the citizens of industrial nations become increasingly concerned over the adverse effects of highway noise. This concern was reflected in the Federal-Aid Highway Act of 1970 directing the Secretary of Transportation to develop and promulgate standards to ensure that highways are developed in such a manner as to minimize the effects of noise. These standards are set forth in Part 772 of Title 23 of the code of Federal Regulations. Among other things they require that, to the extent feasible, measures be taken to abate highway traffic noise impacts where the overall benefits of the abatement exceed adverse social, environmental or economic effects. These standards and the increasing national concern for the environment have resulted in efforts to reduce the intrusion of traffic noise into the daily lives of people. Such intrusion can be reduced in three ways: by reducing noise at the source, by controlling land use, and by keeping objectionable noise levels from traveling from the source to the receiver. Highway agencies generally have the authority to implement the last method, and must rely largely on that method to comply with federal law.

Roadside barriers have been constructed in several states in the hope of reducing excessive traffic noise. Four types of barriers — timber, metal, earthberms, and concrete — have been installed to abate noise on highways adjacent to communities. Analytical and field studies have demonstrated that barriers of these types can reduce wayside noise from highways by as much as 5 to 15 dB(A).

The inclusion of noise barriers in highway design adds substantially to the cost of building highways. This added cost, coupled with the fact that the state of the art of noise barrier design is still in its infancy, pointed to the need for an evaluation to ascertain which materials are the best noise attenuators and to suggest modifications in the design of barriers if any were found to be needed. Because of the potential for a long-range investment in various types of abatement material, documentation of the performance characteristics of barriers was considered to be timely. Such

documentation can be achieved in two ways: first, by measuring the attenuation features of barriers with listening devices; and second, by obtaining opinions about barriers from citizens residing adjacent to them. The research reported here employed the latter method. This report contains the results of the surveys for each of the five barrier types as well as a section discussing alternatives to barriers which were suggested by respondents in those surveys.

PURPOSE AND SCOPE

The purpose of this study was to investigate the effectiveness of noise barriers from the citizens' point of view. Specifically, the objective was to document the perceived effectiveness of metal, wooden, and concrete noise barriers.

The study was designed in two phases. Phase I, which is reported here in Volume I of a two-volume report to be prepared, comprised surveys of communities located adjacent to five noise barriers. Phase II will include further surveys of communities located adjacent to noise barriers constructed prior to this year as well as before and after studies of noise barriers scheduled for construction sometime during this year and the next. It is anticipated that six to eight noise barrier sites will be studied during Phase II. Furthermore, Phase II will include an economic analysis of specific noise abatement strategies whose purpose is to interrupt the path of noise between the source and the recipient. Included in this analysis will be a report on the impact, if any, which noise barriers have on the values of adjacent property. A Volume II report will be published which will include these analyses.

METHODOLOGY

Since late 1975 the Virginia Department of Highways and Transportation has erected noise barriers at several highway locations. For this research, five communities adjacent to such barriers were surveyed. The surveys sought citizens' opinions on two wooden barriers, two metal barriers, and one concrete barrier. The concrete and one of the metal barriers were adjacent to interstate highways. The remaining three were alongside 4-lane, heavily travelled urban streets. The locations of the barriers will be given in later sections of this report.

Once the five barrier sites to be surveyed had been selected, an aerial photo of each with the noise barrier superimposed upon it was obtained. All homes lying within the 70 dB(A) noise contour* of the barrier were to be included in the survey. Each site was visited by an interview team that gathered addresses of the residences to be included in the survey. Then, all prospective interviewees were mailed notices stating the purpose of the survey and informing them that interviewers would be in touch with them during a specified period. Interviews were then conducted at each site, with each site survey being completed before another was begun. The interviews were conducted by three representatives from the Virginia Highway and Transportation Research Council, including the author, with spot assistance from three members of the Department's Environmental Quality Division.

The 297 household interviews administered represented 87% of the 340 households lying within the 70 dB(A) noise contours of the five sites. The interviews were conducted on weekdays between 10:00 a.m. and 12:00 noon, 1:00 p.m. and 4:00 p.m., and 7:00 p.m. and 9:00 p.m. The majority of the interviews (78%) were conducted by female members of the interview teams over a 13-week period during the summer of 1978. The interviews were short, averaging approximately 12 minutes each, and were structured ones employing a detailed set of both closed- and open-ended questions pertaining to the various features of the barriers. While care was taken to see that all questions were asked in each interview, the interviewers, when possible, participated in a discussion with the interviewees rather than merely inundating them with questions. It is believed that informal interviews of this type elicit more candid responses than do tightly structured ones.

CHARACTERISTICS OF THE SAMPLE

All of the respondents at the five sites surveyed lived in single-family dwellings. About 70% of them had lived in their current dwellings before the noise barrier was built, 11% of them before the highway facility was built. About 92% of the respondents owned their homes, and about 56% were female. More than 60% were between the ages of 31 and 50, with the average age falling in the late thirties. Less than 1% were over 70. As Table 1 shows, 55% were employed and only 1% were unemployed. Both spouses were employed in 61% of the households. About half of the households

*The 70 dB(A) noise contour is defined as that area along the roadway which will experience greater than a 70 dB(A) noise level if some type of noise attenuator is not erected.

included children, and each family averaged owning two vehicles. The average age of the homes surveyed was approximately 12 years, with the range being from 2 to 25 years. Three ethnic groups were represented in the sample: Caucasian, Asian, and black. Caucasians made up about 95% of the total, blacks 3%, and Asians 2%.

Table 1

Characteristics of Respondents
(N = 297)

Category	Percentage of Respondents
Age	
21-30	18
31-40	30
41-50	31
51-60	14
61-70	7
over 70	< 1
Sex	
Male	44
Female	56
Employment Status	
Employed	55
Unemployed	1
Retired	13
Housewife	31
Number of Automobiles in Family	
1	23
2	55
3	17
4	5
5	< 1
Tenure	
Owner	92
Renter	8
Total for All Categories	100

RESULTS OF INTERVIEWS

Concrete Barrier

Barrier and Community Characteristics

The concrete barrier included in the survey is combined with an earth berm and is located along an 8-lane interstate highway in Northern Virginia. The average daily traffic in the vicinity of the barrier is 113,790 vehicles, 21% of which are trucks or buses. The speed limit is 55 mph (88 km/h).

The barrier was constructed in the winter and spring of 1976 as a result of the widening of the highway from 6 to 8 lanes. It is 1,900 ft (580 m) long and, in combination with the berm, is 12 to 20 ft (3.7 to 6 m) high. It was made of precast concrete at a cost of approximately $166 per lin ft($503 per lin m). The total cost of the barrier was $317,000 installed.

The barrier (referred to by the majority of respondents as a wall) was erected to protect approximately 72 homes from the noise generated by traffic on the highway. Interviews were held with residents of 62 of the homes representing 86% of the total in the sample. Eighty-one percent of the persons responding had lived in their current dwellings before the barrier was built and 40% had lived in these before the highway was built. About 89% owned their homes, and about half were females. One-third were housewives, one-fourth were retired, and the remainder were white-collar workers. Most respondents were between 41 and 50 years of age and most of the homes in the community were 20-25 years old. Sixty-three percent of the respondents were aware that the barrier was to be built before construction on it began.

General Attitudes

Respondents were first queried regarding their general attitudes toward the concrete wall. Among the questions on the questionnaire were the following: (1) On the whole, how dissatisfied or satisfied are you with the noise wall? and (2) What effect do you think the wall is having on noise? Only three of the respondents (5%) were dissatisfied with the noise wall. More than 73% said the wall greatly attenuated the noise while only 5% felt it was totally ineffective. While it appeared that, in general, the community was pleased with the Department's effort to attenuate noise at this site, questions probing into attitudes towards specific aspects of the wall revealed negative reactions that are discussed along with positive reactions in the following sections.

Noise Attenuation

Respondents were very impressed with the ability of the wall to attenuate noise. About 75% cited noise reduction as being the most salutary effect of the wall on the community. Eighty percent said that they could tell that the noise level experienced indoors was lower since the wall had been built. In fact, about half of them said that the wall had made sleeping easier. Similarly, 80% said that when outside they could tell a difference in the noise level. In addition, 58% said the wall improved the utility of their yard.

Cross tabulations between attitudes about noise levels, the location of the dwelling, the age of the respondent, and involvement in the earlier public meetings concerning the wall revealed several statistically significant relationships. As Table 2 shows, dwelling location seemed to affect attitudes about the ability of the wall to attenuate the noise as judged by the noise level indoors. The further the house was from the wall, the less effective the wall was perceived to be.

Table 2

Effect of Dwelling Location on Perceptions of Noise Attentuation

Location of Dwelling	Effectiveness of Wall			
	Very Effective	Fairly Effective	Not Effective	Total
More than 1 row from wall	17	6	7	30
Facing wall	16	0	3	19
TOTAL	33	6	10	49

Cross tabulations also showed a significant relationship between the location of the dwelling and the respondents' attitudes about the effect of the wall on property values. At the 95% confidence level, individuals living more than 100 ft (30.3 m) away from the wall were more likely than those living facing the wall to feel that the wall had enhanced the value of their property. In fact, 75% of those individuals residing facing the wall felt

their property had been negatively affected, perhaps because they see it on a daily basis and thus view it as an eyesore. Those living out of eyeshot of the wall, on the other hand, see it as an enhancement to the community as a whole, and, consequently, as an enhancement to their property.

Cross tabulations of data on age, occupation, sex, and tenure with responses to several questions on noise perception revealed certain statistically significant relationships. At the 95% level of confidence, persons 41-50 years of age were more likely to sleep easier as a result of the wall than were those from other age groups. The same group was more positive about the noise reduction attributable to the wall. Also at the 95% level of confidence, housewives were more likely to feel that their yard was more usable as a result of the wall than were those of other occupations. There were no significant relationships between sex or tenure and any responses concerning noise perception.

Aesthetics and Other Attributes

While about half the respondents found the wall neither objectionable nor unobjectionable aesthetically, 32% did find it unattractive as viewed from the road. Moreover, 43% felt that, as viewed from their home, the wall was unattractive, and 27% had no opinion. Discussion with respondents revealed that it was not the wall that was objectionable, but the berm. In their opinion, an artist's renditions of the wall area presented at early public meetings did not resemble the appearance of the area subsequent to construction. While many residents have taken it upon themselves to manicure the berm (Figure 1), the vegetative cover on certain portions of it has been allowed to grow as high as 2 ft (6.6 m) and no additional vegetation has been planted (Figure 2). Rectification of this situation would likely help reduce many of the negative feelings about the wall. Several respondents suggested that to further enhance the wall, it should be covered with ivy or a similar planting. This, they said, would both eliminate the potential for graffiti and enhance the rather stark appearance of the wall.

In addition to its ability to attenuate noise, several other positive features of the concrete wall were commented upon during the course of the interviews. Respondents felt the wall added a measure of security to the community by providing a barrier to motorists stopping along the interstate highway and wishing to enter the community to seek the use of a telephone or perhaps to perpetrate wrongful acts. In fact, aside from noise attenuation, respondents saw this feature as the most important attribute of the wall. The reduction in air pollutants and road tar was also mentioned by several respondents.

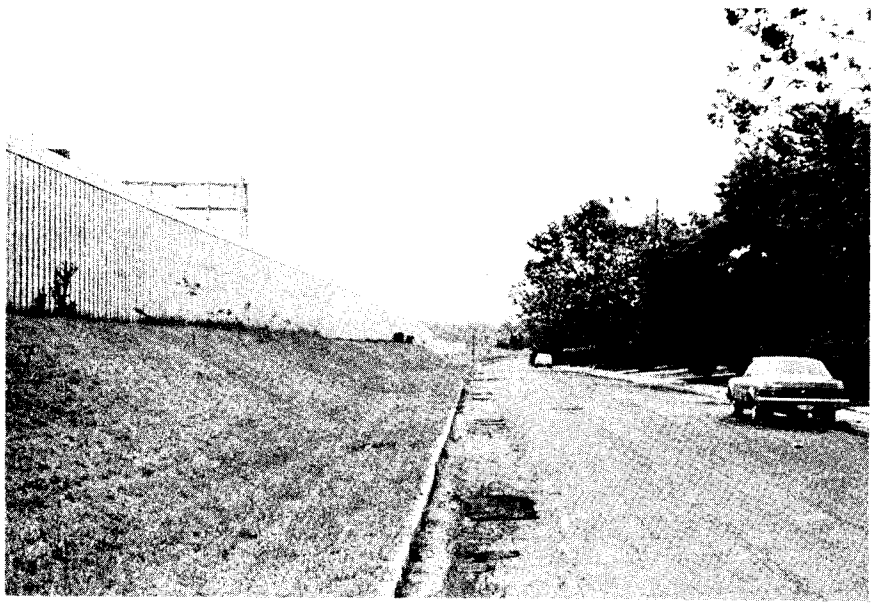

Figure 1. Manicured portion of berm along concrete barrier.

Figure 2. Unmanicured portion of berm.

On the negative side, the wall was said to often provide an undesirable play area for children of the community. Children were often seen walking along the top of the wall, a hazardous activity. A solution to this problem would be to crown the top of the wall.

Respondents were asked if, regardless of location, they felt the wall had increased, decreased, had no effect upon, or helped maintain the value of their home. Only 13% felt the barrier had decreased the value of their home, 39% felt it had increased the value, 40% said it had had no effect, and 8% said it had maintained the value. (Maintaining the value means that if the wall hadn't been built, the value of the house probably would have decreased. In essence, the possible negative effect of the dwelling being adjacent to an interstate highway has been offset by the building of the wall.)

Wooden Barriers

Locations

Two wooden barriers were evaluated. One, located along a 4-lane urban arterial road in the Tidewater area, is made of planks nailed to a superstructure. The other is made of plywood panels and is located on a 4-lane urban arterial in Richmond. Both roads have noncontrolled access.

Plank Type Wooden Barrier

The average daily traffic in the vicinity of the plank barrier is 14,320 vehicles per day and the speed limit is 40 mph (64 km/h). The barrier was constructed during the spring and summer of 1978 as a result of the widening of the road from 2 to 4 lanes. The barrier is a total of 6,335 ft (1.91 km) in length (both sides of the road) and is 8 ft (2.42 m) in height. It is made of 8 ft (2.42 m) long 2 by 8 in (5 cm by 2.42 m) pine planks nailed to a wooden superstructure (Figure 3) and cost $13.45 per lin ft ($44.38 per lin m). Where the planks abut, the seams are covered with 3 by 1 in (7.62 by 2.50 m) 8 ft (2.42 m) long battens that were recently added to prevent noise leakage (Figure 4). The total cost of this barrier was approximately $85,000 installed.

The barrier was erected to protect approximately 120 homes adjacent to the newly widened roadway. Of these, 56 were located directly adjacent to the barrier, with their backs toward it, 36 were one row of houses from the barrier, 15 were more than one row of homes away and 13 were across the roadway facing the barrier.

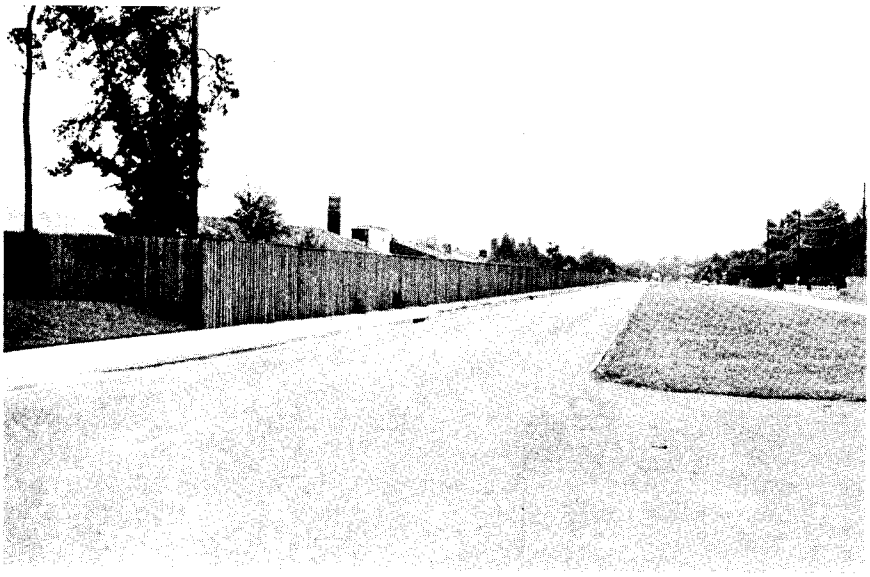

Figure 3. Plank type wooden barrier.

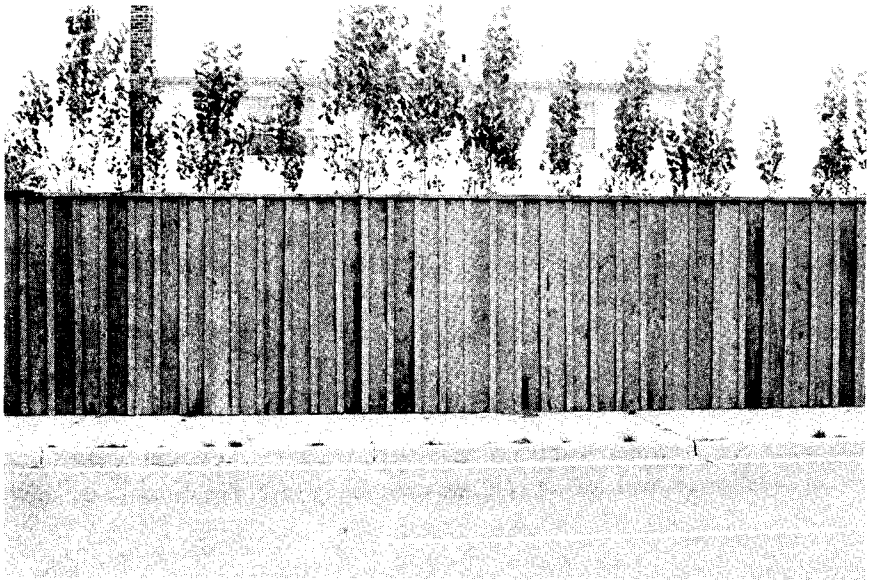

Figure 4. Close-up showing appearance of battens.

These 13 houses were not afforded any barrier between their property lines and the roadway because their respective driveways entered directly onto the roadway, thus making construction of a continuous barrier impossible.

General Attitudes

Fifty-six percent of the respondents were, in general, satisfied with this barrier; 28% were dissatisfied; and 17% had no opinion. The satisfaction stemmed mainly from the ability of the barrier to reduce noise, provide privacy, and give the neighborhood an appearance of uniformity. As was the case for another barrier of this type used in a pretest for this research, most respondents referred to the barrier as being a fence, not a barrier or wall. Hence, uniformity was mentioned by several respondents as being a positive feature of the barrier. Many stated that instead of seeing several different types of private fences along the roadway, it was more pleasing to see one, continuous, uniform fence.

There was much dissatisfaction over the length of time it took for the barrier to be erected. In fact, the author suspects that most of the overall dissatisfaction expressed by the residents can be traced to the fact that they thought the building of the barrier was so drawn out. Their dissatisfaction was heightened when the boards in the barrier began to warp and separate (allowing for noise leakage) and ultimately had to be replaced at several locations, and the frustration which had mounted over time was quite apparent to the interviewers during their contacts with the respondents — especially those living immediately adjacent to the barriers.

Noise Attenuation

Only a little more than one-fourth of the respondents felt the barrier to be highly effective in reducing noise. The remainder, almost 70%, felt it was having minimal or no effect. The people in the latter group were likely to be living immediately adjacent to or one row of houses removed from the barrier. On cross tabulations, the relationship between the location of the dwelling and the perceived effectiveness of the barrier was significant at the 99% level of confidence. What the relationship seems to suggest is that individuals living away from the immediate vicinity of the barrier are the ones who are getting the benefits. The author suspects, however, that other reasons underlie the view expressed. The reader will remember that mention was made of the residents' dissatisfaction over the length of time it took to construct the barrier. It is probable that for the people living close to the

barrier, this dissatisfaction carried over and biased their responses to the questions on noise attenuation. It would also seem plausible that those respondents who did not live close to the barrier and have daily contact with the construction simply expected the barrier to mitigate noise and thus felt more positive about it.

The same pattern of responses was obtained when people were asked, When you are indoors, how effective do you think the noise barrier is in shielding traffic noise, compared to when there was no barrier? Those living away from the barrier were more likely to be positive about its ability to mitigate noise than were those living adjacent to it or only one row of houses away. In cross tabulations this relationship was significant at the 99% level of confidence. Interestingly enough, all individuals living across the road from and facing the barrier gave negative responses to this question. In fact, 64% of them said that they had experienced an increase in noise after the barrier was built. This contention quite possibly is valid, because traffic noise can be reflected toward the dwellings across the street.

Respondents were also asked about the effectiveness of the barrier in reducing the noise perceived in their yards. Cross tabulated with dwelling location, the responses revealed a relationship similar to that found for the dwelling location-indoors noise question. Those living away from the barrier were more likely to respond positively than were those living close to it. This relationship was significant at the 99% level of confidence.

Only about 10% of the respondents said that the barrier helped them sleep better, and only 23%, most of whom live adjacent to the barrier, said the barrier made their yard more usable than before. The data further showed that the farther the residence was from the barrier, the less influence the barrier had on the usability of the yard.

Aesthetics and Other Attributes

Forty-one percent of the respondents found the barrier unattractive as viewed from the road and 42% found it unattractive as viewed from their houses. Among residents finding the barrier attractive, the figures were 39% and 36% for the respective views. The remainder for both views were ambivalent. When asked to suggest ways for making the barrier more attractive, several respondents suggested the use of landscaping and vegetation. Other suggestions were to use a redwood stain on the barrier or cover it with vegetation to eliminate the potential for graffiti.

About half the respondents felt that with certain modifications the barrier could be made a great deal more desirable than at present. They cited warped and separated boards as items in need of immediate attention.

It is interesting to note that when respondents were asked what effect the barrier had had on their community, 59% indicated they felt it had had a positive effect from many standpoints. Key enhancements mentioned were the attractiveness and uniformity it lent to the community. Other positive comments related to improved security and safety, dust control, and noise mitigation.

Only 19% of the respondents felt that the barrier had decreased the value of their home, 24% said it had increased the value, 35% said it had had no effect, and 8% said it had helped maintain the value. Cross tabulations between the responses to this question and dwelling location revealed no significant statistical relationship.

Panel Type Wooden Barrier

The average daily traffic in the vicinity of the panel type wooden barrier is 9,985 vehicles per day and the speed limit is 45 mph (72 km/h). The barrier was constructed during the spring of 1978 as a result of the widening of the road from 2 to 4 lanes. It is 700 ft (210 m) long and 12 ft (3.6 m) high. It is made of 8 ft by 4 ft (2.42 m by 1.21 m) plywood panels joined in an offset configuration and stained reddish brown (Figure 5). The cost of the barrier was $63 per lin ft ($207.90 per lin m), or $44,000. installed.

The barrier was erected to protect 10 homes from the increased traffic noise and 8 of these were included in the survey. Three were directly adjacent to the barrier, 4 were one row of houses away, and 1 was more than one row away. All but one of the respondents had lived in their current dwellings prior to the construction of the barrier. Six were homeowners and 5 of the 8 were females. Because the small size of the sample made cross tabulations between variables infeasible, only frequency distributions are reported for this barrier.

General Attitudes

All respondents were generally satisfied with this barrier — four because of the noise reduction and two because of the privacy it affored. These citizens were, in general, quite happy with the entire situation and no negative general attitudes were discovered.

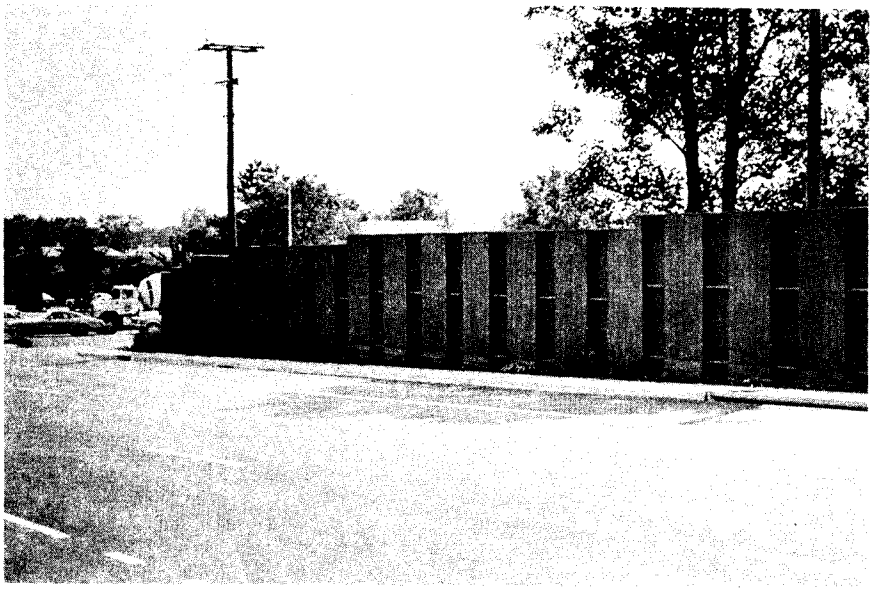

Figure 5. Panel type wooden barrier.

Noise Attenuation

About half the respondents said they had noticed a difference in the noise level after the barrier was built, from both indoors and outdoors. Only two individuals felt that the barrier had had no effect on noise, and they lived one row of houses or more from the barrier. Only one respondent felt that the barrier had made sleeping easier, and five said that the barrier had made their yard more usable than before.

Aesthetics and Other Attributes

All but one respondent felt that the barrier was attractive as viewed from the road and not one felt it was unattractive. Similarly, no one said that the barrier detracted from the community. Several people suggested, however, that the area between the wall and the roadway should be mowed and be properly maintained. It was pointed out that the hedges and magnolia trees planted were being overrun by weeds. Based on community sentiment and personal observations, the author and interview team believe this type of barrier had more aesthetic appeal than the other barriers evaluated.

Five of eight individuals felt that the barrier had had positive effects on the community, the major effect being isolation. When asked to state the most significant effect of the barrier on their homes, four respondents cited noise reduction and four privacy. No one felt that the barrier had decreased the value of their property, two felt their property had increased in value, one felt the barrier had helped maintain the value of the property, and five had no opinion.

The only negative attributes mentioned were the lack of maintenance given the vegetation around the barrier and the fact that children had been seen climbing and walking alongthe top of the barrier. Access to the top was noticeably simple; the bolts used in the construction of the barrier were long enough to provide a natural ladder to the top. This situation could be rectified by simply sawing off the bolts. The Department was complimented by the community for building the barrier prior to the widening of the adjacent highway. This was seen as keeping much of the dirt and dust from construction out of the community.

Metal Barrier

Locations

Two metal barriers were evaluated. One, located along a newly 4-laned urban arterial in the Tidewater area, is made of steel and is designed to simulate a planked wooden barrier.(Figure 6) The other is also made of steel and is located along an interstate highway in the Tidewater area. It was erected in panels which are offset. (Figure 7)

Plank Type Metal Barrier

The average daily traffic in the vicinity of the plank type metal barrier is 2,810 vehicles per day, including 785 trucks and 25 buses. The speed limit is 40 mph (64 km/h). The barrier was constructed during the spring of 1978 as a result of the widening of the road from 2 to 4 lanes. The barrier is 2,810 ft (843 m) long and 15 ft (4.5 m) high. It is made of steel panels and cost $170 per linear foot ($231 per lin m), or just under $478,000 installed.

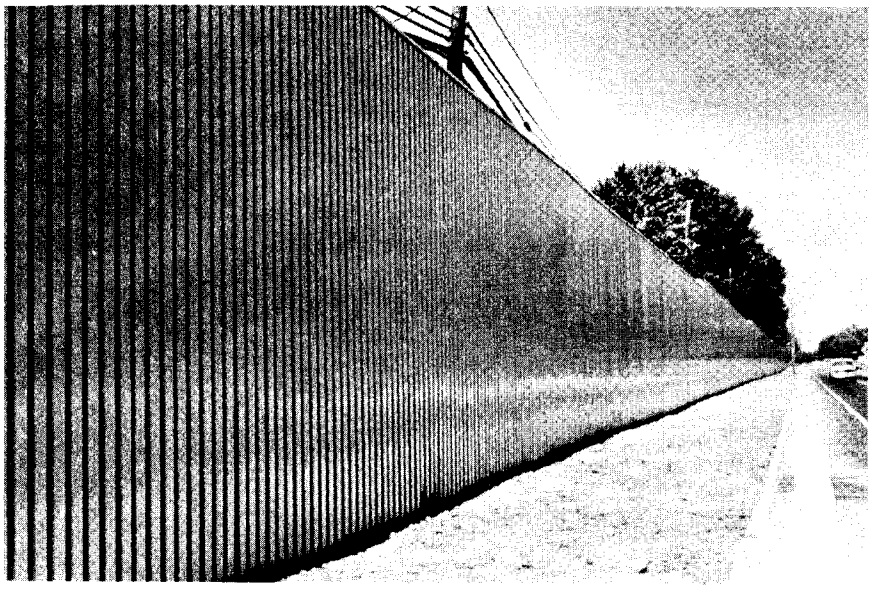

Figure 6. Steel barrier simulating wooden planked barrier.

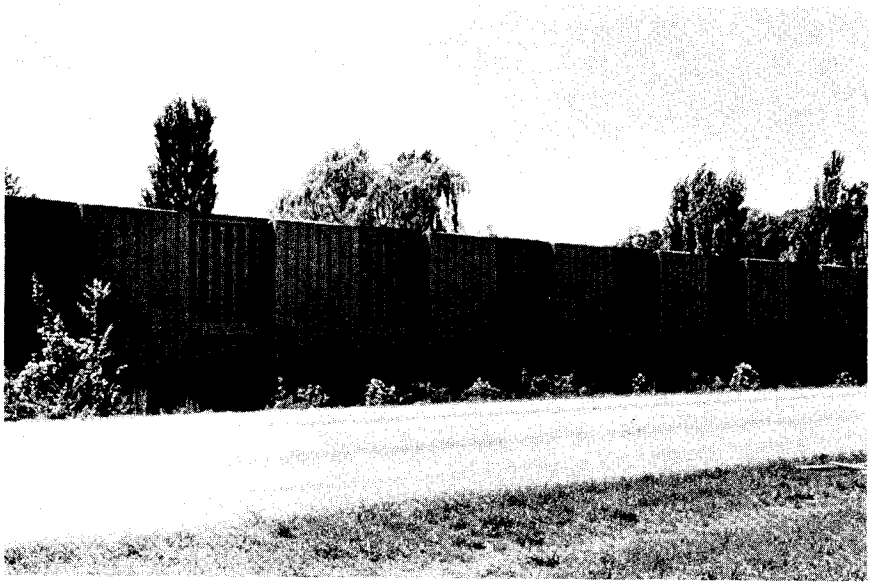

Figure 7. Steel barrier with offset paneling.

The barrier was erected to protect 88 homes from the increased traffic noise generated by the widened roadway. Thirty of the houses were adjacent to the barrier, 15 were one row of houses from it, and 35 were more than one row away. The average age of the homes was about 12 years. Eighty households representing 91% of the total sample were interviewed. Ninety-six percent of the respondents were homeowners, 53% were female and most were between 31 and 50 years old. Almost half were white-collar workers, 37% were housewives, and 10% were retired. Sixty-three percent knew before its construction that the barrier would be installed. Only 18% said they had been involved in public forums held by the Department concerning the barrier; 28% who were not involved said they would like to have been; and 54% said they didn't care one way or the other.

General Attitudes

Forty-four percent of the respondents were generally satisfied with the barrier, 14% were dissatisfied, and 42% had no opinion. Cross tabulations revealed a significant relationship between satisfaction of the residents and location of the dwellings. At the 95% level of confidence, those living adjacent to the barrier were more likely to be satisfied with the barrier than those living further from it.

Some negative attitudes relating to the design of the barrier were noted. Several respondents stated that an offset, steel panelled barrier was shown at early public meetings but that this type was not installed. They indicated that the offset design was preferable to that of the simulated plank barrier.

Noise Attenuation

Only 23% of the respondents felt that the barrier had greatly reduced the noise, 45% felt it had had no effect, and the remainder (32%) saw the effect as being minimal. Dwelling location definitely had some bearing on these responses. Cross tabulations revealed that people living an appreciable distance from the barrier were more likely to feel that the barrier had had no effect than were those living closer to it. This relationship was significant at the 95% level of confidence. Thirty percent of the respondents said that they could tell a difference in the noise level indoors after the wall was built. For the out-of-doors, this figure was 38%. The 8% of the respondents in the latter figure probably were individuals who lived adjacent to the barrier and used their back yards a great deal. For this barrier, the answers to questions pertaining to noise are probably inconclusive because the road was

still under construction. A follow-up survey would probably produce answers more useful to the Department. Such a survey will likely be undertaken during Phase II of this project.

Aesthetics and Other Attributes

Thirty-eight percent of the respondents felt the barrier was attractive as viewed from the road, 36% thought it unattractive, and 26% had no opinion. Of those who could see it from their homes, 38% thought it was attractive, 40% that it was unattractive, and 23% had no opinion.* Only about half the respondents had suggestions for beautification, most of which included landscaping between the sidewalk and the wall. (That landscaping has been done since the survey was conducted.) Many respondents were not pleased with the color or texture of the wall, and pointed out that the reflection of headlight glare from the wall was a problem at night, especially during rainy periods. The wall was also perceived as a noisemaker when objects were thrown or rubbed against it. Several respondents suggested that for these reasons the wall should be covered with vegetation.

Thirty-nine percent of the respondents felt that the wall had had a positive effect on the community. Safety, isolation, and noise reduction were the top three reasons for a positive response to this question. Only 18% felt the wall detracted from the community, the main contention being that it was unattractive. Twenty-one percent of the respondents felt that the wall had decreased the value of their property. Of that group, 75% lived adjacent to the barrier. Interestingly enough, however, of the 24% who said that the wall had increased the value of their property, 59% lived adjacent to it. With increasing distance from the barrier, the perceived impact on property values, either positive or negative, became less significant.

Most of the negative commentary concerning this wall revolved around its nearness to pedestrian and vehicular traffic. Items such as graffiti, headlight reflection from the wall, items thrown against the wall, lack of vegetation next to the wall, etc. are readily noticeable at close range. It is possible that the same wall installed along a limited access roadway would not meet with any of these criticisms. From the foregoing, it appears that abating noise to the satisfaction of the public may be more difficult to accomplish in the inner city than along rural or suburban roads.

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*Totals do not equal 100% due to rounding.

Panel Type Metal Barrier

The average daily traffic in the vicinity of the panel type metal barrier is 48,980 vehicles per day, 40,000 of which are cars. The shielded facility is an 8-lane interstate highway in the Tidewater area with a 55 mph (88 km/h) posted speed limit. The barrier was constructed in late 1977 as a result of the widening of the interstate from 4 to 6 lanes. The barrier is 18 ft (5.4 m) high and 950 ft (285 m) long. It cost approximately $189 per lin ft ($623.70 per lin m), or just under $180,000 installed.

The barrier was installed to mitigate noise in approximately 30 homes. Interviews were conducted in 27, or 90%, of those homes. Ten of the dwellings were adjacent to the barrier, 9 were one row of houses away from it, and 8 were more than one row away. Eighty-nine percent of those interviewed had lived in their current dwelling before the barrier was built and only one resident had lived there prior to the building of the interstate. All but two respondents were homeowners, 56% were female, and most were between the ages of 31 and 50. About 41% were white-collar workers, 26% were housewives, and none were retired. About one-fourth had had prior knowledge of the construction of the barrier.

General Attitudes

Only one respondent was dissatisfied with this noise barrier, and only 8% felt that the barrier had not been effective in reducing noise. The respondents in this community were generally very pleased with the Department's noise attentuation effort. The few specific negative attributes cited will be discussed in succeeding paragraphs.

Noise Attenuation

Respondents were definitely impressed with this barrier's ability to attenuate noise. Seventy percent said that when indoors they were able to tell a difference in the noise level after the barrier was built. Cross tabulations revealed relationships between dwelling location and sleeping conditions and yard usability. At the 90% level of confidence, individuals living adjacent to the barrier were more likely to find sleeping made easier and the usability of their yard increased by the barrier than were those individuals living one or more rows of homes from the barrier. Oddly enough, however, no statistical relationship was found between dwelling location and overall satisfaction with the noise wall, nor between dwelling location and the perceived effect of the barrier on noise. This absence of relationship seems to indicate that respondents view the barrier as an enhancement to the

overall community, regardless of where they live. Also, the respondents apparently perceived a reduction in the noise level, regardless of the location of their homes. No statistically significant relationships were found to exist between age, occupation, sex, and tenure and the responses to the questions concerning noise perception.

Aesthetics and Other Attributes

Sixty-three percent of the respondents felt that the wall was attractive as viewed from the road, and no respondent felt that it was unattractive as viewed from the yard. The latter finding was unexpected, because at certain locations the barrier was as close as 20 ft (6 m) to the edge of the dwelling. One would tend to hypothesize that daily eye contact with an 18-ft (5.4-m) steel wall might result in some degree of negativism on the part of those living adjacent to it. About the only suggestions for enhancing the wall were that some vegetation could be planted along it and that the area around the base could be better maintained.

Almost 52% of the respondents felt the wall had had a positive effect on their community. Isolation and noise reduction were the two most frequently mentioned positive effects. Not one respondent felt that the wall detracted from the community. Likewise, no one felt that the wall had decreased the value of his home. In fact, 37% felt that the wall had increased property values, 7% said it had helped maintain property values, 37% felt it had had no effect, and 18% had no opinion.*

Respondents were generally quite impressed with the Department's noise mitigation efforts in this area. Many commented that the isolation from the interstate highway was a welcome "addition" to their community and made the community a more desirable place in which to live. Those living more than one row of houses from the wall did indicate that truck noise was still a problem and recommended heightening the wall. Many commented positively about the color of the wall and its ability to keep dust and road grit out of the community. On the negative side, a few respondents were concerned over the undergrowth which had accumulated between the wall and private fences. (This problem was mentioned at all but one of the survey sites and is one for which a solution should be provided before a barrier is constructed.)

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*Percentages do not total 100 due to rounding.

ALTERNATIVES FOR HIGHWAY NOISE MITIGATION

Respondents were queried as to their knowledge of and preferences for alternatives to barriers in their community. First, respondents were asked, If you had it to do over again, would you prefer a cash settlement in lieu of a noise barrier? Only 15% of the respondents answered yes to this question, 74% said they would prefer the barrier, and about 11% had no opinion. Many of the respondents in the first two groups qualified their answers by stating "it depends upon the amount." Later in the interview, respondents were asked if they thought it was appropriate for a government agency to attempt to compensate those living in noise affected areas instead of building barriers. About one-fourth of the respondents felt that it was appropriate for people to be compensated for noise damage. In viewing the results of cross tabulations it was interesting to note that people living in the communities adjacent to the barriers on interstate highways were less prone to find compensation an alternative to noise barriers than were those living in the neighborhoods adjacent to urban arterial roads. It was the interviewers' opinion that in many cases compensation could be made a viable alternative to noise barriers — at least this is the viewpoint expressed by a number of respondents. It is the writer's opinion that the legal ramifications of this alternative would have to be studied.

Respondents were also asked what other alternatives they felt might be appropriate rather than or in conjunction with noise barriers. Table 3 shows a breakdown of the responses to this question. As can be seen, of those offering an opinion, the majority mentioned vegetation as being another method for mitigating highway noise. It was noted by the interviewers that vegetation, in the form of tree belts, shrubbery, hedges, etc. was cited by numerous respondents at all five sites as being "just as good a noise reducer as wood, metal, or concrete barriers." In fact, in cases where hedgerows, thickets, or trees had been removed and barriers installed, people residing close by often emphasized that the vegetation had abated noise better than the barrier. In instances where urban communities need to be shielded from traffic and where noise may not be the primary concern, perhaps consideration should be given to a more pleasing, less expensive barrier — one that beautifies the right-of-way, provides isolation and seemingly (what you can't see you can't hear) abates noise. In instances where sufficient right-of-way is available, vegetation certainly should be considered, both as a noise reducer and as a visual shield. In all instances where a sound barrier is installed, existing vegetation should be left in place to the extent possible, and additional plantings should be made in combination with the sound barriers.

Other alternatives listed by respondents included shifting of the alignment, which generally is an item to be addressed during the public hearing stage of planning; enforcement of the speed limit, which would have to be the job of the local jurisdictions involved; installation of a different type of barrier, usually the preference was for another material; and making a change in the road surface, such as from portland cement concrete to a bituminous mixture.

Table 3

Alternatives for Highway Noise Mitigation

Category	Percent
Plant Vegetation	17
Shift Alignment	8
Enforce Speed Limit	5
Alter Road Surface	1
Install Different Type Barrier	3
No Opinion	66
Total	100

APPENDIX I

INTERVIEW SCHEDULE

1039

Respondent I. D. # _____ 1 2 3

1. Interviewer Code _____
2. Dwelling Location A B C D
3. Nearness to Transit (A) Block (B) 2 Blocks (C) 3 or more

Date _____
Time of Day _____
4. Neighborhood (A) Good (B) Fair (C) Poor
5. Sex (A) Male (B) Female (C) Joint

4 5

6. On the whole, how satisfied or dissatisfied are you with the noise wall?
(A) very satisfied (B) somewhat satisfied (C) no opinion (D) somewhat dissatisfied (E) very dissatisfied

6

7. Why do you answer as you do? (circle primary)
(A) attractive (B) unattractive (C) windbreaker (D) no effect on noise (E) less noise (F) provides privacy (G) lives opposite barrier (H) controls debris (I) not resident prior to barrier (J) other _____

7

8. Do you (A) own or (B) rent this home? (circle)

8

9. What effect do you think the wall is having on noise? (A) great effect (B) minimal effect (C) no effect

9

10. When did you move into this neighborhood? _____ mo. _____ yr.

10

Was that before or after the wall was built?

If "after" to previous question skip #'s 11-17

11. When you are indoors how effective do you think the noise wall is in shielding traffic noise, compared to when there was no wall? (A) very effective (B) fairly effective (C) not effective (D) noise level greater (E) N/A

11

12. Have you changed the use of any rooms in your house since the wall was built? (Wait for answer) Was this due to reduction or increase in noise? (A) reduction in noise (B) increase in noise (C) Wall was irrelevant; no (D) N/A

12

13. Has the existence of the wall affected your sleeping habits? (A) made it harder to sleep (B) made it easier to sleep (C) no effect (D) N/A

13

14. When you are out-of-doors how effective do you think the noise wall is in shielding traffic noise, compared to when there was no wall? (A) very effective (B) fairly effective (C) not effective (D) noise level greater (E) N/A

14

15. If you had the chance to do it over again would you prefer a (A) cash settlement with no wall or would you (B) prefer the wall? (circle) Comments: _____

15

16. Were you aware that the walls were to be built before they were actually constructed? (A) yes (B) no

16

17. How were you made aware of the construction of the noise walls?
(A) the actual construction (B) noise meter reader (C) neighbor (D) contacted by Hwy Dept. (E) public meeting (F) public hearing (G) newspapers (H) other _____ (I) N/A

17

18. Would you have liked to have been brought into the planning process to help the Department in deciding what kind of walls, if any, would be built, where they would be placed, and what the effects of such walls would be? (A) yes (B) no (C) were involved

18

19. Do you have children that play outdoors? (A) yes (B) no

19

20. Do you think the wall makes your yard more or less usable for outdoor activities, such as picnics, parties, and sitting outdoors, etc. (A) more usable (B) less usable (C) makes no difference

20

21. Do you feel that the noise walls are attractive or unattractive from the road?
(A) very unattractive (B) unattractive (C) neither (D) attractive (E) very attractive

21

1040

22. How about as viewed from your house?
(A) very unattractive (D) attractive
(B) unattractive (E) very attractive
(C) neither (F) cannot see from house

23. What suggestions do you have for making the wall more attractive?
(A) vegetation (D) heighten (F) other _____
(B) different material (E) shorten (G) none
(C) staining or painting

24. If you were given the choice to have the wall or not to have it, what would you choose?
(A) Prefer no noise wall (C) No preference (E) Other _____
(B) Prefer noise wall as it is (D) Prefer noise wall with modifications

25. (If "prefer the noise wall with modifications") what modifications would you make?
(A) vegetation (D) heighten (G) repair (J) Other _____
(B) different material (E) shorten (H) add a wall on other side (K) N/A
(C) staining or painting (F) lengthen (I) safety features

26. What effect do you feel the noise wall has on the quality of your neighborhood?
(A) reduces litter (C) increases noise (E) unattractive (G) Other _____
(B) reduces noise (D) makes safer (F) attractive (H) None

27. Do you feel the wall as (A) increased or (B) decreased the value of your home? Or perhaps had (C) no effect? (circle)

28. Do you think it would be more appropriate for the Hwy Dept. to provide homeowners with cash payment for noise damage instead of building walls? (A) yes (B) no

29. What other things do you think could have been done by Route 495 to control traffic noise? _____

Now a few questions about you and your family so we can describe the people we've talked to. These answers are for research and classification only and are not used to identify you as a family.

30. What is your occupation? _____

31. What is your spouses occupation? _____

32. How many cars are in your family? (A) 0 (B) 1 (C) 2 (D) 3 (E) 4

33. How old is this house? _____ yrs.

34. In summary then, what do you feel is the most significant effect of the wall on your home?
(A) less noise (D) no effect
(B) increased privacy (E) no effect, wall should not have been built
(C) both of the above (F) other _____

35. FINISHING QUESTION: Do you have any other comments about the walls that you would like to make? The Highway Department is very interested in how noise affects people.

36. Respondent age: (A) 21-30 (C) 41-50 (E) 61-70
(B) 31-40 (D) 51-60 (F) over 70

Length of interview _____ min.

Interviewer Comments: _____