

## COMMUNITY PERCEPTION OF NOISE BARRIERS

## VOLUME II

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 eight noise barriers installed along interstate and primary roads. A total of 488 interviews were conducted in eight communities adjacent to the barriers to determine citizens' perception of the effectiveness of these structures.

For all eight sites, 57% of the people interviewed were satisfied with the noise barriers and a little more than half felt the barriers were reducing noise. Citizens were most satisfied with a beige metal barrier and least satisfied with a blue metal barrier. Aesthetically, a wood plank barrier was rated the most desirable and the concrete wall the least.

Noise barriers were seen as having a far more positive than negative effect on the adjacent communities. However, noise attenuation was found to be the primary positive effect in but three of the communities surveyed, and these three were adjacent to an interstate highway. In addition to attenuating noise, barriers were said to give uniformity to the appearance of the neighborhood, increase property values, enhance the environment and safety, and increase privacy and isolation. Perceived negative effects included degradation of community aesthetics and decreases in property values. About 23% of the respondents said they could have settled for a cash award in lieu of a barrier. A significant number of respondents indicated that vegetation should be considered as both an alternative for and as an addition to noise barriers.

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## SUMMARY AND CONCLUSIONS

The Federal Aid Highway Act of 1970 mandates that where improvement to highways results in an intrusion of traffic noise into communities lying adjacent, an effort must be made to reduce that intrusion. The Department has made that effort through the installation of wood, metal, concrete, and earthen roadside barriers. Such barriers have been effective in reducing noise from highways by as much as 5 to 15 db(A). To evaluate the effectiveness of these barriers as noise attenuators and to suggest any needed modification in their design, the study reported here, the second of two on highway noise barriers, was undertaken. The findings from the initial study can be found in the report entitled "Community Perception of Noise Barriers, Volume I", September 1979. That report contains the results of surveys at five barrier sites; this report contains the results of home interviews conducted at eight additional barrier sites.

In the present study, surveys were conducted in two communities lying adjacent to combination wooden and concrete barriers, one adjacent to a wood plank barrier, one adjacent to a wood panel barrier, three adjacent to metal barriers, and one adjacent to a concrete barrier. These barriers ranged from 2 to 24 ft. (.66 to 7.9 m) in height and from 1,900 to 6,335 ft. (627 to 2090 m) in length. A total of 488 interviews representing 81% of the 604 households lying within the 70 dB(A) noise contours were administered at the eight sites.

For the eight sites surveyed, 57% of the respondents were generally satisfied with the noise barriers and about 51% felt the barriers were reducing noise significantly. A beige metal barrier received the most plaudits from the standpoint of general satisfaction, while a blue metal one received the least. From the standpoint of noise reduction, the same beige metal barrier was judged the most effective, while the same blue metal one was judged the least with the one made of concrete running a close second. The distance between the barrier and dwelling had very little to do with respondents' opinions regarding the noise-reducing capabilities of the barriers. All except the blue metal and the concrete barriers were rated fairly equally. The respondents generally felt that the Department had made a good effort and had achieved some reduction in noise levels. Where pre-construction contact with the community was found to be low, general dissatisfaction with the barrier was found to be high.

The appearance of the noise barriers and berms was very important to the citizens. Not only were aesthetics judged as being nearly as important as noise attenuation features, but in several

instances the appearance of the barriers was found to be related to the citizens' perceptions of the noise reduction being achieved. Overall, about 44% and 49% of the respondents judged barriers as being attractive when viewed from their residences and the roadway, respectively. Aesthetically, the wood plank barrier was rated the most desirable and the concrete one the least desirable. In the interstate highway setting, metal barriers were judged to be more aesthetically pleasing than the wooden or concrete ones. Most suggestions regarding aesthetic enhancement involved improvements in landscaping rather than changes in barrier materials. A substantial number of respondents suggested covering barriers with ivy or some other type of climbing vine to beautify them, increase the noise attenuation, and prevent graffiti.

The barriers were seen as having a far more positive than negative effect on the adjacent communities. However, noise attenuation was found to be the primary positive effect in but three of the eight communities surveyed, and these three were in the interstate setting. On the positive side, the barriers were said to give uniformity to the appearance of the neighborhood (principally in the non-interstate setting), increase property values, enhance the environment and safety, and increase privacy and isolation. Negative effects included degradation of community aesthetics and decreases in property values. About a third of the citizens felt that the barriers had had a positive effect on the value of their properties. In the interstate setting, metal barriers were found to give the greatest enhancement to property values and concrete to give the least. The greater the overall satisfaction with the barrier, however, the more positive was the perceived effect of the barrier on property values.

About 23% of the respondents indicated that they would have settled for a cash award in lieu of a noise barrier. The greater the degree of satisfaction with the barrier, however, the less prone the respondents were to opt for cash.

A significant number of respondents indicated that vegetation was both an alternative for and an addition to noise barriers. Vegetation was found to greatly influence citizens' opinions of barriers.

## RECOMMENDATIONS

Since the respondents voiced no clear preference for barriers constructed of one type of material as opposed to barriers of another type, no general recommendation concerning the type of material to use in the construction of barriers can be made. For reasons of aesthetics, the wood plank barrier should be given first consideration for barriers being constructed in non-limited access urban settings. Additionally, when it is anticipated that sound might be reflected from barriers toward nearby homes, absorptive barrier materials or some other type of noise buffer should be considered. Citizen opinions on aspects of the barriers other than noise attentuations led to several recommendations as follows:

1. Where possible, existing vegetation at barrier sites should be left in place. Where this cannot be done, vegetation should be planted and landscaping completed on both sides of the barrier as early as possible. Specific attention should be given to shielding the community side of the barrier where feasible.
2. The amount of land lying between barriers and citizens' property lines should be kept to a minimum. This area should be continuously maintained as it is often a source of citizen discontent.
3. The construction of barriers should be carried forward as expeditiously as is feasible once it is begun.
4. Efforts at involving citizens in the preliminary planning and design of noise barriers through surveys and meetings should continue to be standard procedure.
5. Citizens should be informed early in the planning stage of the long-term durability of wooden noise barriers.
6. The possible secondary effects of noise barriers, both positive and negative, as pointed out in this study, should be related to citizens in early meetings and in surveys.





## COMMUNITY PERCEPTION OF NOISE BARRIERS

## VOLUME II

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During the last five years the Virginia Department of Highways and Transportation has greatly increased its use of noise barriers as a means of abating the impact of highway traffic noise on communities. These barriers have been constructed alongside both new and existing highways at various sites throughout the Commonwealth. Several types of barriers have been used in Virginia — timber, metal, earth berms, concrete, combination timber and concrete, combination earth berm and metal, combination concrete and earth berm, and combination timber, concrete and earth berm. Analytical and field studies have demonstrated that barriers of these types can reduce highway noise by as much as 5 to 15 dB(A).

The Department's efforts in noise abatement have added substantially to the cost of certain highway projects. Because of the potential of a long-range investment in various types of abatement material, documentation of the performance characteristics of the barriers was considered to be timely. Such a documentation should necessarily include measuring the attenuation achieved by barriers through the use of listening devices and by obtaining opinions about barriers from citizens residing adjacent to them. While the Research Council has undertaken both methods of documentation, the research reported here employed the latter method.

This report is the second of two volumes which document the study entitled "Community Perception of Noise Barriers." Volume I, published in September 1979, contains the results of surveys at five barrier sites. That report included conclusions and recommendations regarding those barriers. It was felt, however, that for two of the sites the information obtained was probably inadequate as a basis for conclusions because the roads were still under construction. For this reason, a follow-up survey was made of citizens residing adjacent to eight additional barrier sites.

## PURPOSE AND SCOPE

The purpose of this study was to investigate the effectiveness of noise barriers from the citizen's 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 was reported on in Volume I, comprised surveys of communities located adjacent to five noise barriers. Phase II, which is reported on here, included surveys of eight similarly located communities. In Volume I it was stated that Volume II would include an economic analysis of noise abatement strategies whose purpose is to interrupt the path of noise between the source and the recipient. Included in this analysis would be a report on the impact, if any, that noise barriers have on the value of adjacent property. That information should be forthcoming in a report entitled "Relationships Between Highway Noise, Noise Mitigation, and Residential Housing Value" by Gary R. Allen, research economist.

## METHODOLOGY

The surveys reported upon here sought citizens' opinions on two wooden barriers, three metal barriers, one concrete barrier, and two combination wood and concrete barriers. Six of the eight barriers were also in combination with a slight earth berm. Six of the barriers were adjacent to interstate highways, and the remaining two — one metal and one wooden — were alongside four-lane, heavily traveled urban streets. The last two barriers, those next to urban streets, were evaluated for the Volume I report but were thought to need reevaluation because the projects were incomplete at the time of the initial survey.

Once the barrier sites to be surveyed had been selected, an aerial photo of each with the noise barriers 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 to generally scout the area and gather addresses of the residences to be included in the survey. Next, 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 two female employees of the Research Council.

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\*The 70 dB(A) 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.

The 488 household interviews administered represented 81% of the 604 households lying within the 70 dB(A) noise contours of the eight sites. The interviews were conducted on weekdays between 10:00 a.m. and 12 noon, 1:00 p.m. and 4:00 p.m. and 7:00 p.m. and 9:00 p.m. over a 13-week period during the summer of 1979. The interviews were short, averaging approximately ten minutes each, and were structured ones employing a detailed list of both closed- and open-ended questions pertaining to various features of the barriers (Appendix A). While care was taken to see that all questions were asked in each interview, the interviewers, when possible, participated in a discussion with the respondents 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

### The Respondents

All of the people surveyed lived in single-family dwellings. Roughly 94% of them had lived in their current dwellings before the noise barriers were built. Ninety-one percent owned their homes, and about 64% were female. As Table 1 shows, almost 75% were between the ages of 31 and 50, with the average age falling in the late thirties. Less than 1% were over 70. Sixty-three percent were employed and only slightly more than 1% were unemployed. As the table also shows, over one-third of the respondents were professional workers. Both spouses were employed in 61% of the households. The average age of the homes surveyed was 17 years, with the range being between 1 and 36 years. The average length of occupancy was 9 years, with the range being from less than 1 year to 36 years. Three ethnic groups were represented in the sample: Caucasians made up about 98% of the total, blacks 1%, and Asians 1%.

### The Barriers

The barriers evaluated during this survey are described in Table 2. As this table shows, the barriers ranged from 2 to 24 ft. (0.66 to 7.9 m) in height and 1,900 to 6,335 ft. (627 to 2,090 m) in length. The average cost per linear foot was \$179 (\$590/lin m), with the total cost being \$4,493,824.

Table 1  
 Characteristics of Respondents  
 (N = 488)

<u>Category</u>	<u>Percentage of Respondents</u>
Age	
21-30	15
31-40	30
41-50	29
51-60	19
61-70	6
over 70	1
Sex	
Male	36
Female	64
Employment Status	
Employed	63
Unemployed	1
Retired	9
Housewife	27
Tenure	
Owner	91
Renter	9
Total for All Categories	100

Table 2

## Characteristics of Survey Barriers

Type of Barrier	Height of Barrier (Ft) (a)	Length of Barrier (Ft) (a)	Cost Per Linear Ft. (a)	Total Cost	No. of Homes Protected	Interviews Completed
Combination wood, concrete, and earth berm (Barrier A)	4-24	4,000	\$186.00	\$ 744,000	30	24
Combination wood, concrete and earth berm (Barrier B)	13-20	2,307	315.00	727,000	107	91
Wood plank	8	6,335	14.00	89,000	133	116
Combination wood panel and earth berm	4-23	5,623	230.00	1,298,000	87	76
Metal panel (grey)	15	2,810	170.00	478,000	82	56
Metal panel on earth berm A (beige)	2-12	1,944	208.00	404,449	52	41
Metal panel on earth berm B (blue)	12	3,099	141.00	436,375	60	40
Concrete on earth berm	12-20	1,900	166.00	317,000	53	44
TOTALS		28,018	\$179.00 (avg)	\$4,493,824	604	488

(a) 1 ft. = .3048 m

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## RESULTS OF INTERVIEWS

The responses obtained in the surveys were compiled and are discussed below on the basis of barrier type. Often the percentages given do not total 100% because of rounding.

Combination Wood and Concrete Barriers

Two combination wood-concrete barriers were evaluated. Both were combined with an earth berm and were located along an eight-lane interstate highway in Northern Virginia. Because of slight differences in the composition of the communities adjacent to these barriers, they are reported on separately here even though they were constructed nearly identically.

Barrier A

## Barrier and Community Characteristics

The average daily traffic in the vicinity of this barrier is 111,200 vehicles, 21% of which are trucks or buses. The speed limit is 55 mph (88 km/h).

The barrier was constructed during the winter of 1978 and spring of 1979 as a result of the widening of the interstate from six to eight lanes. It is 4,000 ft. (1,219 m) long and 4 to 24 ft. (1.2 to 7.3 m) high. It is made of precast concrete and plywood panels and cost approximately \$186 per linear ft. (\$610/lin m), or \$744,000 installed. The barrier was erected to protect approximately 30 homes from the noise generated by the traffic on the highway. Interviews were held with the occupants of 24 of the homes representing 80% of the residents in the survey area. Almost 92% of the persons responding had lived in their current dwellings before the barrier was built. One-third lived adjacent to the barrier and about 42% lived across the street facing the barrier some 100 or so ft. (33 m) away. Fifty-eight percent owned their homes and about 46% of the respondents were female. The respondents had lived in this community an average of 8 years and most of the dwellings were between 25 and 30 years of age. One-fourth of the respondents were housewives, only 3 were either retired or unemployed, and the remainder were white-collar workers. Over half of the respondents were between the ages of 31 and 40, 17% were 21 to 30 years of age, 17% were 41 to 50, and the remainder were over 60. Forty-two percent were aware that the barrier was to be built before construction on it began.

## General Attitudes

Roughly 63% of the respondents were generally satisfied with the concrete and plywood noise barrier. Twenty-nine percent were dissatisfied and the remainder had no opinion. Of the 29% who felt the barrier was less than adequate, all felt it was having no effect on noise. On the other hand, of the respondents who were satisfied with the barrier, all felt that it was having an effect. Cross tabulations between the locations of dwellings and the responses to the question on satisfaction, however, revealed no significant statistical relationships.

Only 17% of the respondents felt the noise barrier was having a great effect on noise, while 46% felt it was having a moderate effect. The remainder felt that it was having minimal or no effect.

## Noise Attenuation

Respondents were fairly impressed with the ability of the barrier to attenuate noise. Several commented that at locations along a ramp, noise reduction was more difficult than at locations along the interstate. However, about 29% felt that the most salutary effect of the barrier on the community was its ability to reduce noise. Respondents were asked how effective the noise barrier was in shielding traffic noise from persons indoors. Only about 18% responded that the barrier was very effective, 18% felt it was fairly effective, and 65% felt it was not effective. Similarly, respondents were asked about the reduction of noise perceived by persons out-of-doors. Again, only about 13% felt the barrier was very effective, 33% felt it was fairly effective, and only 25% felt it was not effective. The remainder replied that they were not affected by the barrier and thus couldn't answer the question. Only one respondent commented that the barrier had made sleeping easier.

Only about 21% of the respondents felt that the barrier made their yards more useable for outside activities. Sixty-seven percent said the barrier made no difference, and 13% said it made their yards less useable. Dwelling location was related to the answers on yard useability in that the further the residence was located from the barrier, the less influence the barrier had on the useability of the yard. This relationship was significant at the 90% level of confidence.

## Aesthetics and Other Attributes

Thirty-nine percent of the respondents felt the barrier was attractive as viewed from the interstate, 22% felt it was unattractive, and 39% found it neither objectionable nor unobjectionable.

Moreover, of those who could view the barrier from their houses, 33% found it attractive, 42% found it unattractive, and 25% were ambivalent. Thus the barrier was perceived as being slightly more attractive as viewed from the interstate side as opposed to the community side. Discussions with respondents revealed that several of those who found it unattractive from the community side were citing the area between their property line and the barrier, which had not been maintained properly and in which trash and debris had been allowed to accumulate. Suggestions to make the barrier more attractive were few. About half of the respondents felt that nothing could be done and a few suggested landscaping and perhaps building the barrier of a different material.

It appears that from the standpoint of the citizens' perceptions, the aesthetics of the barrier are adequate. In fact, when respondents were asked to choose between the barrier in place or some other type, slightly more than 54% indicated they preferred the same type of barrier, 13% preferred no barrier, 8% had no preference, and about 25% preferred the same type of barrier with a few changes. Half of those respondents in the last category indicated they preferred a concrete to a combination wood and concrete barrier. It was the opinion of the investigators that the citizens doubted the long-term durability of a wooden structure.

When respondents were asked what effect the barrier had had on their community, 46% indicated that it had had a positive effect from many standpoints. Key enhancements mentioned were noise reduction and isolation for the community. Thirty-eight of the respondents indicated that the barrier had had neither positive nor negative effects on the community.

No one felt that the barrier had decreased the value of his home, 29% felt that it had increased the value, 38% said it had had no effect, and the remainder had no opinion. Cross tabulations between the responses to this question and dwelling location revealed no significant statistical relationships.

## Barrier B

### Barrier and Community Characteristics

The second concrete and wood panel combination barrier is located along an eight-lane interstate highway in Northern Virginia. The average daily traffic in the vicinity of the barrier is 106,250 vehicles, 21% of which are trucks or buses. The speed limit is 55 mph (88 km/h).



The barrier was constructed in the winter of 1978 and the spring of 1979 as a result of the widening of the roadway from six to eight lanes. It is 2,307 ft. (703 m) long and, in combination with the earth berm, is 13 to 20 ft. (3.9 to 9 m) high. It is made of precast concrete and plywood panels and cost approximately \$315 per linear foot (\$1,033/lin m). The total cost was \$727,000.

This barrier was erected to protect approximately 107 households from the noise generated by the traffic on the highway. Interviews were held with the residents of 91 of those homes, or 85% of the total. Ninety-nine percent of the persons responding had lived in their current dwellings before the barrier was built. Twenty-eight percent lived adjacent to the barrier (rear view), 14% lived one row of houses from the barrier, 18% lived more than one row of houses from the barrier, and 41% lived across an urban street facing the barrier. Respondents had lived in this community anywhere from 1 to 22 years, with the average length of occupancy being about 9 years. The houses range in age from 9 to 25 years, with the average being about 16 years. Eighty-two percent of the respondents owned their homes, and 44% were female. Fifty-nine percent of the respondents were white-collar workers, less than 6% were blue-collar workers, 12% were retired, 1% were unemployed, and 22% were housewives. Both spouses worked in 62% of the households. The majority of the respondents were between the ages of 31 and 60, with the average age being around 40. Only slightly over half of the respondents were aware that the barrier was to be built before construction on it began.

### General Attitudes

Respondents were queried regarding their general attitudes toward the combination wood-concrete barrier. Among the general questions were the following: (1) On the whole, how satisfied or dissatisfied are you with the noise barrier? and (2) What effect do you think the barrier is having on noise? Fifty-six percent of the respondents were satisfied with the noise barrier, 29% were dissatisfied, and 15% had no opinion. Of those answering positively, 77% said the barrier had significantly reduced noise in the community.

In responding to question (2) above, 21% of the respondents said the barrier was having a great effect on noise, 28% that it was having a moderate effect, and about 45% that it was having minimal or no effect. The remainder had no opinion. These figures also were about the norm for the entire eight-case sample. As compared to the other interstate barriers, this barrier elicited a

higher frequency of responses in the "great effect" category. Generally, the commentary received from respondents with respect to various aspects of the barrier were positive. Particular items will be discussed later in the report.

Cross tabulations between general attitude and dwelling location showed a significant relationship. At the 99% level of confidence, individuals living more than one row of houses away from the barrier were more likely to be dissatisfied than those living adjacent to, one row away, or facing it. This finding seems to indicate that those living more than one row away from the barrier, even though they were included in the noise contour, thought they were not getting much effect from the barrier. It is likely that the old adage "out of sight out of mind" applies in this case. Other cross tabulations also revealed that individuals living more than one row of houses from the barrier were getting little or no effect from it. As a result, those same individuals don't view the noise barrier as an enhancement to their property (see section on Aesthetics and Other Attributes).

#### Noise Attenuation

Respondents in this sample were only fairly impressed with the ability of the barrier to attenuate noise. Of those who felt the barrier was having some effect on the community, about 24% cited noise reduction as being the most salutary effect, 19% cited an increase in the value of their dwelling, and another 14% added that the barrier provided isolation for the community. Thus, while noise reduction was the most often mentioned effect, it was not the dominant effect in the opinion of the people of the community. However, while the majority of the respondents didn't seem to feel that the noise barrier necessarily had had a positive effect on their community, more than one-third indicated that its most significant effect on their home was that it reduced noise.

Sixty percent said that they could not tell that the noise level experienced indoors was lower after the barrier had been built. In fact, only about 14% said that the barrier had made sleeping easier. In regard to the effect of the barrier on the noise level outdoors, the responses were a little more favorable. Only 40% indicated that when outside they could not tell a difference. In addition, about 21% said that the barrier had improved the useability of their yards.

Cross tabulations of data on age, occupation, and dwelling location with responses to several questions on noise perception revealed no statistically significant relationships.

## Aesthetics and Other Attributes

Forty percent of the respondents found the barrier unattractive as viewed from the interstate, and 36% found it unattractive as viewed from their houses. For residents finding the barrier attractive, the figures were 42% and 46% for the respective views. The remainder for both views were ambivalent. About 60% of the respondents suggested ways of making the barrier more attractive. Almost half of the ways suggested involved landscaping. Other respondents (11%) suggested covering the barrier with vegetation, while the remainder suggested improvements in maintenance such as staining, painting, and mowing around the barriers. There were more negative remarks concerning the color of the barrier than there were positive ones, but landscaping received the most comments. It was the interviewers' feeling that the bulk of these negative remarks were concerned with the respondents' suspicion that wood would deteriorate to a much greater degree than would metal or concrete. When asked to choose among the existing barrier, no barrier, or a barrier with changes, about 46% preferred the barrier as it was, 13% would rather not have had a barrier, and 37% preferred a barrier different in some way from the existing one. The preferred modification in half of these responses was to build a barrier of different material.

Almost 40% of the respondents indicated that they felt the barrier had had a positive effect on their community. Key enhancements mentioned were, in order of frequency, noise reduction, increased property values, and isolation. Other positive comments related to improved safety and environmental enhancements.

Only 5% of the respondents felt that the barrier had decreased the value of their homes, 37% said it had increased the value, and 59% said it had had no effect. Cross tabulations between the responses to this question and dwelling location revealed one significant statistical relationship. At the 99% level of confidence, respondents who were generally satisfied with the noise barrier were more likely to feel that it had had a positive effect on the value of their properties than were those who were generally dissatisfied with the barrier. In fact, of the 6% which felt the barrier had decreased the value of their properties, all were generally dissatisfied with it. Further perusal of the data revealed that the dissatisfaction related to construction and maintenance rather than a negative effect on property values. It was these respondents who felt that concrete and metal were better alternatives from the standpoint of long-term durability.

Wooden BarriersLocations

Two wooden barriers were evaluated. One, located along a four-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 along an eight-lane interstate highway in Northern Virginia.

Plank Type Wooden Barrier

The average daily traffic in the vicinity of the plank barrier is 14,320 vehicles 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 two to four lanes. The barrier is 6,335 ft. (1.91 km) in length (both sides of the road) and is 8 ft. (2.44 m) high. It is made of 8 ft. (2.44 m) long, 2 in. by 8 in. (5.00 cm by 20 cm) pine planks nailed to a wooden superstructure, and cost \$13.50 per linear ft. (\$44.29/lin m). Where the planks abut, the seams are covered with 3 in. by 1 in. by 8 ft. (7.62 cm by 2.50 cm by 2.44 m) battens to prevent noise leakage (Figure 1). The cost of this barrier was approximately \$89,000 installed.

The barrier was erected to protect approximately 120 homes adjacent to the newly widened roadway. Interviews were obtained from 116 households. Forty-nine of the homes were located directly adjacent to the barrier with their backs toward it, 49 were more than one row of homes away, and 18 were across the roadway and facing the barrier.

Eighty-five percent of the respondents had lived in their current dwellings prior to the construction of the barrier. The lengths of residence ranged from 1 to 35 years, with the average being 7 years. The houses ranged in age from 1 to 20 years, with the average being 11 years. Ninety-seven percent owned their homes, and 60% were female. Forty-six percent of the respondents were white-collar workers, 9% were blue-collar workers, about 10% were retired, 3% were unemployed, and 32% were housewives. In 63% of the households both spouses were employed. The average age of the respondents was approximately 40 years, with most of them being between 31 and 50. Less than 10% of the respondents were over the age of 60. Fifty-five percent indicated that they were aware that the barriers were to be built before construction began.

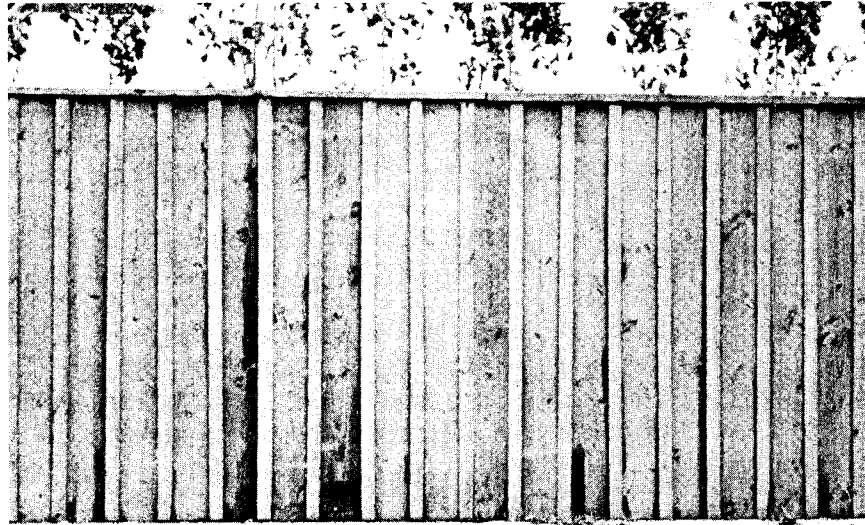


Figure 1. Close-up of plank type wooden barrier.

General Attitudes. Sixty percent of the respondents were, in general, satisfied with the plank barrier; 22% were dissatisfied; and 17% had no opinion. The satisfaction stemmed mainly from the ability of the barrier to reduce noise and provide privacy. Also, several respondents commented that the safety and security of the community had been increased through the construction of the barrier by keeping children and pets separated from the roadway. Much of the dissatisfaction stemmed from three major items. First, as had been the case in a similar survey conducted at this site a year prior, there was general dissatisfaction over the material used in the barrier. Cited most often by the respondents was the tendency of the boards and battens to warp and break. The second item was the length of time it took for the barrier to be erected. In fact, this had been a finding of the survey a year earlier, and the extension of this dissatisfaction over a period of a year led the author to believe that even time had not erased the memory of the frustration the residents had felt during construction of this barrier. Thus, it is felt that most of the overall dissatisfaction expressed by many of the residents can be traced to the fact that they thought the building of the barrier was so drawn out. The third item resulting in dissatisfaction was the impact of the barrier on individuals whose residences faced it from across the road. These individuals complained of increases in noise levels after the barrier was erected. They also indicated that increases in dust and dirt were apparent after the barrier was completed. It is suspected that any increase in the noise level might be due to the increased traffic on the urban arterial and not to the barrier. Noise readings made across the road from the barrier have shown that reverberations from it account for only a one-decibel increase in the noise level, which is inaudible to the human ear.

Cross tabulations revealed a significant relationship between the degree of 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 feel dissatisfied than those living more than one row of houses from it. The author suspects that this relationship results from the former group of respondents' daily eye contact with the barrier.

Noise Attenuation. Twenty-seven percent of the respondents felt that the barrier had greatly reduced the noise, 29% felt it was having a fair effect, and 38% felt it was having minimal or no effect. The remainder had no opinion. Cross tabulations revealed no significant relationships between location of the dwelling and the perceived effectiveness of the barrier. What this finding seems to suggest is that no matter where a respondent resides in relation to the barrier (within the noise contour), his benefits from it, from the standpoint of noise, are basically the same. In fact, in the respondents' opinion, noise attenuation was not the primary effect of the barrier on the neighborhood. Many items such as increases in property values, isolation, and uniformity of the neighborhood were listed ahead of noise reduction. However, when asked to cite the most significant effect of the barrier on their homes, more than one-fourth of the respondents stated "less noise".

Respondents were asked how effective they felt the noise barrier was in shielding people indoors and people outdoors from the traffic noise. For shielding people indoors, 9% felt the barrier was very effective, 18% that it was fairly effective, and 73% that it was not effective. For people outdoors, 15% felt the barrier was very effective, 36% that it was fairly effective, and 49% that it was not effective. As one can easily see, the benefit is perceived to be greater for people outdoors. Cross tabulations revealed no significant statistical relationships between dwelling locations and answers to these two questions on noise perception.

When asked if the barrier had affected their sleeping habits, 76% related that the barrier had had no effect, and in only 11% of the cases did the respondents feel that the barrier had made sleeping easier. In fact, 12% of the respondents, all of whom lived across the street from the barrier, indicated they had had difficulty sleeping after the barrier was constructed.

It should be noted that those individuals living across the street from and facing the barrier were unanimous in their negative opinion of it. In fact, the questions regarding indoor and outdoor noise levels and the effect of the barrier on sleep habits elicited 100% negative responses from all of them. These people were convinced that they had experienced an increase in noise after the

barrier was built, even though their contention was not supported by the noise readings taken at these sites.

Aesthetics and Other Attributes. Twenty-six percent of the respondents found the barrier unattractive as viewed from the road and 18% found it unattractive as viewed from their houses. Among residents finding the barrier attractive, the figures were 59% and 54% for the respective views. The remainder for both views were ambivalent. It is interesting to note that in the 1978 survey, this barrier was judged the least attractive of the five surveyed. It appears that the addition of battens has definitely improved the barrier aesthetically. When asked to suggest ways for making the barrier more attractive, several respondents suggested the use of landscaping and vegetation. General maintenance around the barrier area was often cited as in need of attention. About a fifth of the respondents suggested a different color for the barrier, including redwood and white. But only a very few suggested that the barrier be made of a different material or be constructed differently.

When asked if they preferred the existing barrier or possibly a different type of noise attenuator, 13% said they preferred no barrier at all, 54% said they preferred the barrier as it was, about 2% had no preference, and about 30% said they preferred the existing barrier with some modifications. Twenty percent of those preferring modifications indicated that a different type of material was desirable. Materials mentioned included metal and brick or masonry. Almost 25% of these individuals said they would prefer vegetation of some sort in conjunction with the barrier. Some even suggested covering the barrier with vegetation so as to reduce graffiti and enhance the looks of the barrier. Such a treatment, they said, would also conceal warped and separated boards.

When respondents were asked what effect the barrier had had on their community, 47% indicated that they felt it had had a positive effect from several standpoints. Key enhancements mentioned were the uniformity and isolation it lent to the community and increases in house values. It is interesting to note that noise reduction was not among these key enhancements. About 21% felt the barrier had had a negative effect, the key to discontent being a perceived decrease in house values. This negative effect was noted primarily by those individuals living on the opposite side of the street and facing the barrier.

Thirty-four percent felt that the barrier had increased the value of their homes, 36% that it had had no effect, 10% had no opinion, and 20% felt the barrier had decreased the value of their homes. Of this last 20%, almost 70% lived on the opposite side of

the street facing the barrier. The responses relating to the effect on value of homes were cross tabulated with dwelling locations and a statistical relationship was found. At the 99% level of confidence, those individuals living adjacent to the noise barrier were more likely to feel the barrier had had some effect on the value of their homes (either positive or negative) than were those living more than one row away from the barrier. The same relationship was found when the effect on value of homes was cross tabulated with general satisfaction. Again at the 99% level of confidence, those who were satisfied with the noise barrier were more likely to feel that it had had a positive effect on the value of their homes than were those who were dissatisfied with it.

#### Panel Type Wooden Barrier

The average daily traffic in the vicinity of the panel type wooden 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 during the winter of 1978 and spring of 1979 as a result of the widening of the highway from six to eight lanes. It is 5,623 ft. (1,714 m) long and is 4 to 23 ft. (1.2 to 7.0 m) high. It was constructed with plywood paneling at a cost of approximately \$230 per linear foot (\$755/lin m). The total cost of the barrier was \$1,298,000 installed.

The barrier was erected to protect approximately 87 homes from the noise generated by the traffic on the highway. Interviews were conducted with residents of 76, or 87%, of those homes. Ninety-five percent of the respondents had lived in their homes prior to the construction of the barrier. Thirty-eight percent of the homes were adjacent to the barrier, 29% were more than one row away, and 33% were across an urban street facing the barrier. Respondents had lived in the neighborhood anywhere from 1 to 22 years, with the average length of occupancy being about 9 years. Houses ranged in age from 13 to 25 years, with the average age being about 19 years. Ninety-one percent of the respondents owned their homes and 66% were females. Fifty-seven percent were white-collar workers, less than 2% were unemployed, 9% were retired, and 30% were housewives. In 55% of the households, both spouses were employed. The average age of the respondents was around 40 years. It should be noted here that in this sample almost a third of the respondents were between the ages of 51 and 60. Fifty-five percent indicated that they were aware that the barriers were to be built prior to the time the construction on them began.



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General Attitudes. Fifty-seven percent of the respondents were, in general, satisfied with this barrier; 32% were dissatisfied; and 12% had no opinion. The satisfaction stemmed mainly from the ability of the barrier to reduce noise. Cross tabulations revealed no significant relationships between the general satisfaction of the residents and either the locations of the dwellings or age of the respondents. The citizens in this sample were generally quite happy with the entire situation and very few negative attitudes were discovered. The few which were will be discussed in succeeding sections.

Noise Attenuation. Even though respondents appeared to be generally satisfied with the noise barrier, they were not greatly impressed with the barrier's ability to attenuate noise. Only 10% felt the barrier to be highly effective in reducing noise, 37% that it was fairly effective, and 49% that it was having minimal or no effect. The remainder had no opinion. If the responses to this question for all eight barriers were averaged, this particular barrier would be a good deal below the norm in the "great effect" category and a fair amount above the norm in the "minimum or no effect" category. Respondents did feel, however, that the primary effect of the barrier on both their neighborhood and their homes was noise reduction.

Other responses were indicative of the citizens' being only fairly impressed with this barrier's ability to attenuate noise. Only 8% said that when indoors they could tell a great deal of difference in the noise level after the barrier was built, 35% said they could tell a fair difference, and 57% said they were able to tell little or no difference. In addition, only 9% found sleeping easier after the barrier was constructed, and 89% said the barrier had had no effect on their sleeping habits. Responses to a similar question regarding the impact of the barrier on noise as perceived outdoors were a little more favorable. Fifteen percent found the barrier very effective, 32% fairly effective, and 52% not effective. Furthermore, only 16% found their yard more useable, 79% said the barrier made no difference, and about 5% found their yard less useable. Cross tabulations between responses to these questions on noise abatement and dwelling locations revealed no statistically significant relationships. In general, then, the respondents were fairly ambivalent about the noise attenuation features of this barrier, regardless of where they resided.

Aesthetics and Other Attributes. Forty-one percent of the respondents felt the barrier was attractive as viewed from the interstate, 42% that it was unattractive, and 17% that it was neither. Respondents felt that the barrier was a bit more attractive from their homes than from the road; only 28% found it unattractive, 22% were ambivalent, and 50% found it attractive.

When asked for suggestions to make the barrier more attractive, 45% suggested landscaping. When asked if they would choose the same type of wall or a wall with modifications, if given a choice, 21% said they would prefer no barrier at all, 43% said they would prefer the barrier as it is, 4% had no preference, and 30% indicated they would prefer a similar barrier with certain modifications. These modifications included vegetation and different barrier material. Certain of the respondents indicated they would prefer the metal barrier used on other parts of the interstate to the wooden one. Most of these comments involved a certain degree of anxiety over the durability of a wooden structure. Roughly 30% of the respondents felt the barrier had had a positive effect on the community. Enhancements cited included the reduction of noise (16%) and the providing of isolation from the interstate highway (6%). Only 9% of the respondents listed negative community effects, while the remaining 61% felt that the barrier had had neither positive nor negative effects on the community. About 28% felt that the barrier had had a positive effect on the value of their homes, 5% felt that it had decreased the value of their homes, and 49% felt it had had no effect. The remainder answering the question had no opinion. A statistically significant relationship was found between general satisfaction with the noise wall and the responses on the perceived effect of the wall on the value of homes. At the 99% level of confidence, those who were generally satisfied with the noise barrier were more likely to feel the wall had increased the value of their homes than were those who were dissatisfied with the noise barrier.

As was said earlier, respondents in this sample were certainly not highly pleased over the ability of the barrier to attenuate noise. Many felt that it was a good effort on the part of the Department, but that the money expended probably was not warranted from the standpoint of noise reduction. Several indicated that they had been living near the interstate highway for several years, had learned to put up with the noise, and felt that the rest of the community should do the same. It is the author's opinion that in this particular area, the general satisfaction of the respondents will be raised if enhancements are made with respect to landscaping around the barrier, even though such landscaping would have nothing to do with the attenuation of noise.

### Metal Barriers

#### Locations

Three metal barriers were evaluated. One, located along a newly four-laned urban arterial road in the Tidewater area, is made

of steel and designed to simulate a wood plank barrier (Figure 2). The other two are also made of steel and are located along an interstate highway in Northern Virginia. Both of these are erected in panels which are offset; one is beige and the other is blue (Figure 3).

#### Plank Type Metal Barrier

This barrier was built during the summer of 1978 as a result of the widening of the urban arterial from two to four lanes. The average daily traffic on the road is 2,810 vehicles, 29% of which are trucks and buses. The speed limit is 45 mph (72 km/h). The barrier is 2,810 ft. (856 m) long and 15 ft. (4.5 m) high. It is made of steel panels and cost \$170 per linear foot (\$558/lin m), or just under \$478,000 installed.

The barrier was erected to protect 82 homes from the increased traffic noise generated by the widened roadway. Of these, 56, or 68% of the total, were interviewed. Ninety-three percent of the respondents had lived in their current dwellings prior to the construction of the barrier. Forty-one percent of the houses were located adjacent to the barrier, 21% were located one row of houses away from the barrier, and 38% were located more than one row away. The respondents had lived in the community anywhere from 1 to 16 years, with the average length of occupancy being 8 years. The houses varied in age from 7 to 20 years, with the average age being about 13 years. Ninety-eight percent of the respondents owned their homes and 64% were females. Fifty-two percent of the respondents were white-collar workers and 34% were housewives. There were no unemployed respondents in this sample. In 61% of the households, both spouses were employed. Most respondents were between the ages of 31 and 50, with the average being around 40 years. It should be noted that in this sample there were very few respondents under the age of 30 nor over the age of 60. Seventy-three percent of the respondents indicated that they had been aware the barriers were to be constructed before construction on them began.

General Attitudes. Sixty-four percent of the respondents were generally satisfied with the barrier, 16% were dissatisfied, and 20% had no opinion. Cross tabulations revealed no significant relationships between satisfaction and dwelling location. It should be noted that this barrier site had been surveyed a year previous to the current survey. Responses for questions on satisfaction for the initial survey had been 44% satisfied, 14% dissatisfied, and 42% no opinion. It was apparent to the author that there had to be reasons other than the 1-year interval between surveys for this shift from the negative to positive point of view. Those reasons will become apparent as the report continues.

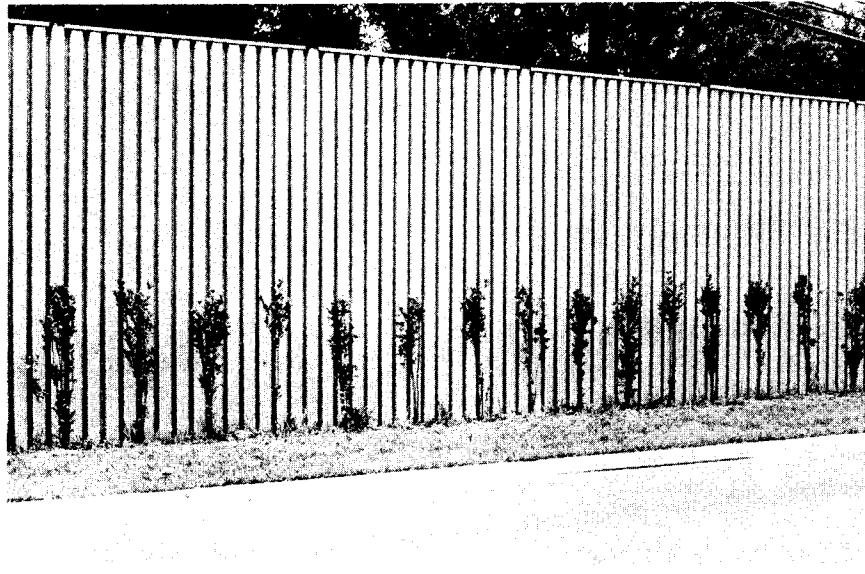


Figure 2. Steel barrier simulating wood plank barrier.

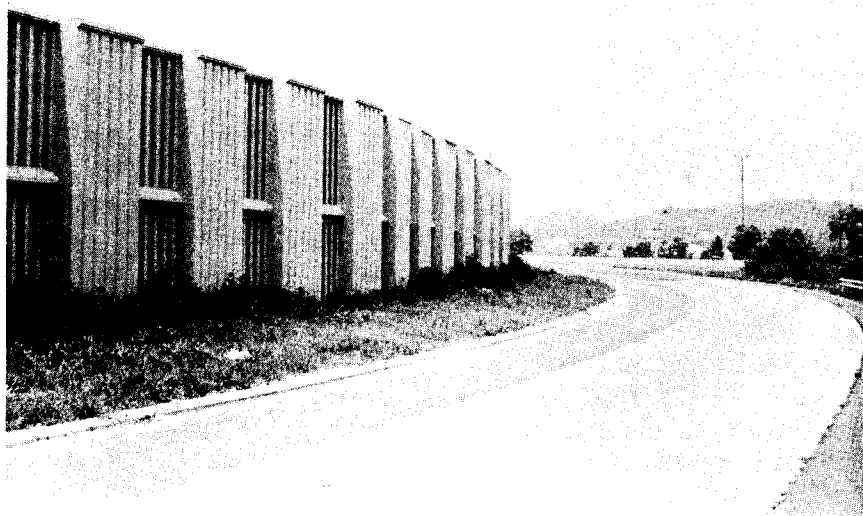


Figure 3. Steel barrier with offset paneling.

There was more positive than negative commentary regarding the barrier. The respondents seemed generally pleased with the Department's effort, and about the only negative comments related to safety aspects of the barrier. These will be discussed in the section on Aesthetics and Other Attributes.

Noise Attenuation. Twenty-three percent of the respondents felt that the barrier had greatly reduced the noise, 41% that it had had a fair effect, and 16% saw the effect as being minimal. The remainder had no opinion. As had been the case in the previous survey, respondents did not feel that the primary effect of the barrier on the neighborhood was noise reduction. Primary positive attributes mentioned included isolation, increases in property values, and safety. However, when asked the most significant effect of the barrier on their individual homes, 29% said less noise, 27% said no effect, and 16% said it had increased their privacy. Fifty-nine percent said they could tell a difference in the noise level indoors after the barrier was built. For outdoors, this figure was the same. Only 7% of the respondents said the barrier made sleeping easier; the remainder indicated that it had had no effect on sleeping habits. In addition, 23% found their yards more useable after the barrier was erected, while 71% said the barrier had made no difference. The remaining 6% found their yards less useable.

The overall responses to questions on noise attenuation for this survey were somewhat better than those for the survey a year previous. The reader should keep in mind that the barrier had undergone no acoustic-related changes during the interval. However, two items should be mentioned. First, during the initial survey the speed limit on the road was reduced because construction was still under way. Second, since the project has been completed, several visual enhancements have been made to the noise wall, mostly in the form of landscaping. While the second item has little or nothing to do with the noise level experienced in the community, the author submits that such items often enhance respondents' perceptions about noise barriers. This results, in many cases, in a perceived reduction in noise, most of which is due to the respondents' general satisfaction with the appearance of the barrier.

Aesthetics and Other Attributes. Forty-one percent of the respondents felt the barrier was attractive as viewed from the road, 36% thought it unattractive, and 23% had no opinion. Of those who could see it from their homes, 39% thought it was attractive, 32% that it was unattractive, and 29% had no opinion. Two-thirds of the respondents had suggestions for beautification, most of which included additional landscaping. A few suggested staining or painting the barrier a different color. In the initial survey, several

respondents had suggested that the barrier be covered with vegetation due to the potential for graffiti being inscribed on it. Over the intervening year, no graffiti has been noted and no respondents in the current survey mentioned graffiti as being a problem.

When asked to choose between the existing barrier or a different one, 38% preferred the barrier as is, 9% preferred no barrier at all, 4% had no preference, and 46% preferred the existing barrier with a few changes. Changes most often cited were additional vegetation and safety features. The comments with respect to vegetation probably resulted from the fact that a row of young hedges planted along the wall have, in many places, either died or been destroyed by automobiles or people (Figure 4). As these hedges are replanted and get larger, citizens' concern about vegetation will likely dwindle.

Forty-two percent of the respondents felt that the barrier had had a positive effect on the community. Isolation was the top reason for positive response to this question. Only 23% felt that it detracted from the community, the main contentions being that it was unattractive and that it had decreased property values. Cross tabulations revealed a statistical relationship between general satisfaction with the barrier and the effect it had had on property values. At the 99% level of confidence, those who felt the barrier had decreased their property values were more likely to be dissatisfied than were those who felt the barrier had either increased their property values or had had no effect. Twenty-one percent of the respondents felt the barrier had had a positive effect on the value of their homes, 50% that it had had no effect, and 13% that it had decreased their property values. It could not be determined why these individuals felt their property values had been decreased by the barrier. While stories regarding real estate appraisers' estimates abounded among the residents of these seven dwellings, the interviewers were never presented with any statistical data to substantiate them.

Many respondents felt that the barrier provided a safety problem for the community. Several related that at certain of the intersections, the sight distance down the arterial had been severely decreased by the erection of the barrier (Figure 5). There were several suggestions for modifying the barrier at the exits by angling the barrier into the community as in Figure 6. It should be noted that almost half the respondents felt that this exit feature was one of the negative attributes of the barrier and should be looked into immediately.

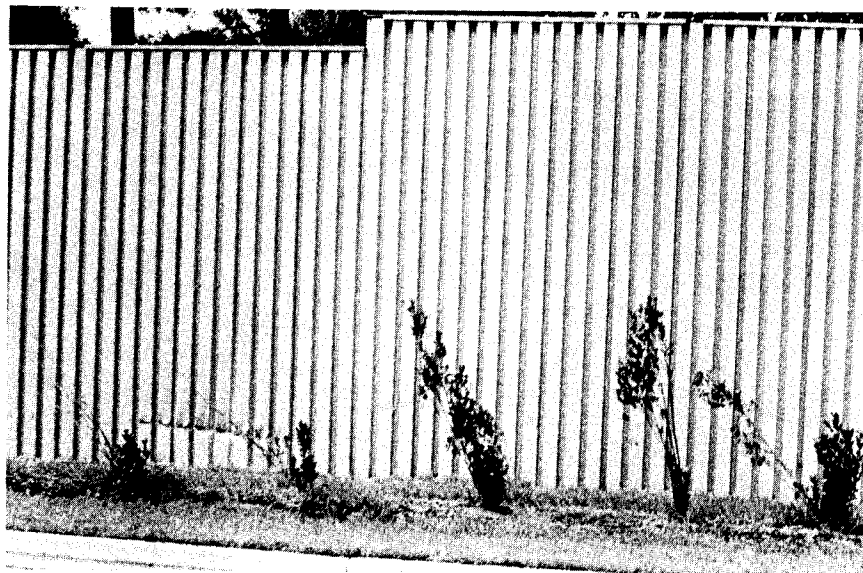


Figure 4. Plank type barrier and damaged vegetation.

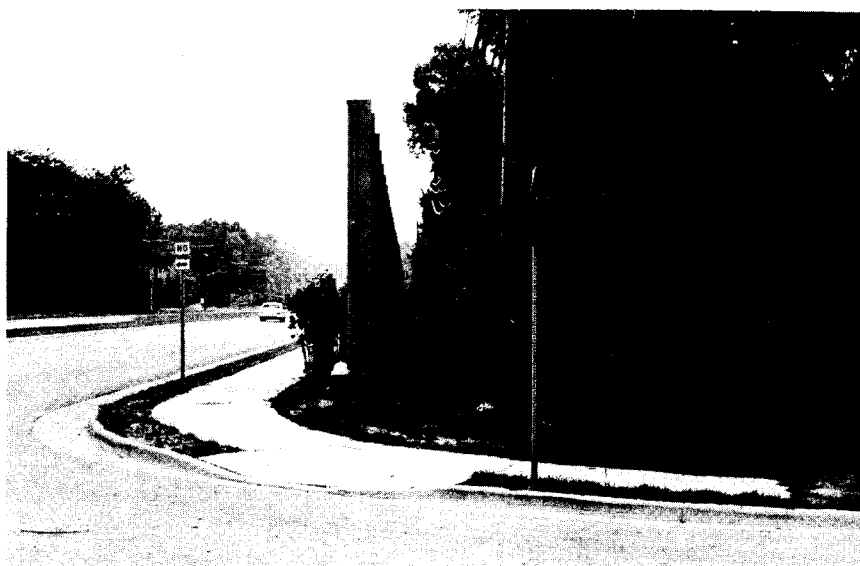


Figure 5. Plank type barrier at entrance to community.

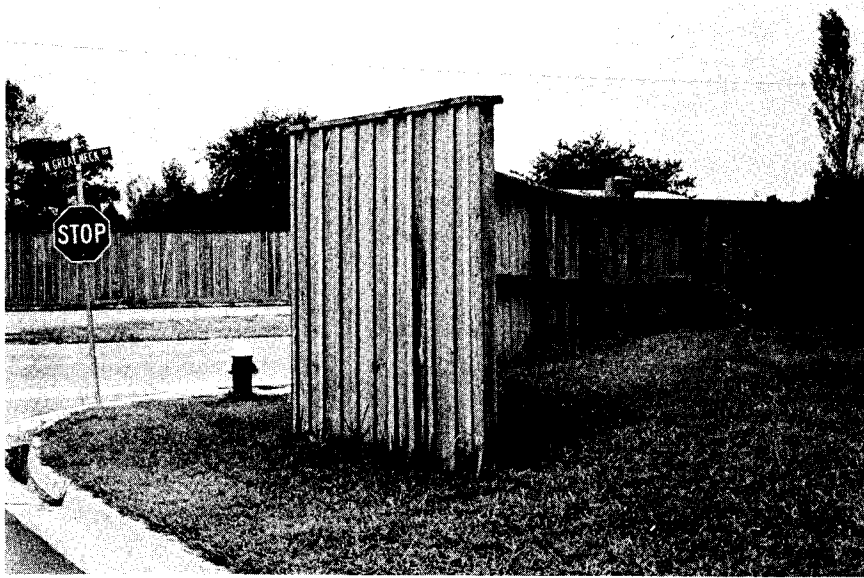


Figure 6. Barrier angled into community entrance so as not to reduce sight distance.

Finally, the respondents were generally more positive in the current survey than they had been in the initial survey. Indeed, the frustration surrounding the construction phase of the project was probably having a great effect on the community at the time of the initial survey. However, it should be noted that the reduction in negative commentary was not highly significant. Enhancement of the barrier site by the Department over a year's time certainly improved the Department's image among the residents of the community. It stands to reason that further enhancements such as those mentioned here could only further improve that image.

#### Panel Type Metal Barrier A

The average daily traffic in the vicinity of this panel type metal barrier is 113,790 vehicles, 21% of which are trucks or buses. The barrier was constructed during the summer of 1979 as a result of the widening of the interstate from six to eight lanes. It is 1,944 ft. (593 m) in length and varies in height from 2 to 12 ft. (0.6 m to 3.7 m). It cost approximately \$208 per linear foot (\$682/lin m), or just over \$404,000 installed.

The barrier was constructed to mitigate noise in approximately 52 homes. Interviews were conducted in 41, or 79%, of those homes. All respondents had lived in their current dwellings prior to the



construction of the barriers. Only 3 dwellings were located adjacent to the barrier, another 12 were one row of houses from it, 6 more than one row away, and 20, or nearly half, were located across an urban street facing the barrier. The respondents had lived in their current neighborhood anywhere from 1 to 22 years, with the average length of occupancy being about 8 years. Houses varied in age from 17 to 28 years, with the average being about 21 years. Ninety-three percent of the respondents owned their homes and 54% were females. Nearly 59% were white-collar workers and 24% were housewives. None were retired or unemployed. In 66% of the households, both spouses were employed. Their ages ranged from 31 to 50. No respondents were over the age of 60, so it was rather a young population. About 65% of them were aware that the barrier was to be built prior to the time construction began.

General Attitudes. Sixty-six percent of the respondents were satisfied with the noise barrier, 24% were dissatisfied, and 10% had no opinion. The degree of satisfaction was the highest encountered in the eight site surveys. It was also far and above the most satisfactory metal barrier as perceived by citizens. The respondents were generally very pleased with the Department's effort.

Noise Attenuation. Sixty-one percent of the respondents felt the barrier was having some degree of effect on noise, 32% felt it was having a great effect, and 29% that it was having a fair effect. Thirty-four percent said the barrier was having minimal or no effect on the noise level in the community. In fact, when asked to state the primary effect of the barrier on the community, 18% cited an increase in property values; only 8% cited noise reduction. However, when asked to give the most significant effect of the barrier on their homes, more than 51% cited noise reduction. It appears, then, that for the community as a whole, noise reduction was not a big issue, while on an individual basis it was.

Fifty-seven percent said that when indoors they were able to tell a difference in the noise level after the barrier was built. In fact, a little more than 19% said that the barrier had made sleeping easier. This is the highest affirmative response rate for all eight samples. Respondents were also asked how the wall affected their outdoor activities. Thirty-two percent said the barrier had a very positive effect, 41% that it had a fairly positive effect, and 27% that it had no effect. Positive responses to this question were also the highest of all samples investigated. In fact, the "very effective" response (32%) was more than twice the norm for all eight samples (15%).

No statistically significant relationships were found between dwelling location and overall satisfaction with the barrier, nor

between dwelling location and the perceived effect of the barrier on noise. However, judging from the responses to the questions on noise, it appears that respondents view the barrier as an enhancement to the overall community noise level, regardless of where they live in relation to it. In fact, this particular metal barrier, from the standpoint of noise reduction, had the highest rating of all barriers evaluated and should certainly be considered the most popular of the metal barriers.

Aesthetics and Other Attributes. Thirty-nine percent of the respondents felt the barrier was attractive as viewed from the interstate and 65% found it attractive as viewed from their homes. On the other hand, 44% found it unattractive as viewed from the interstate and 26% unattractive as viewed from their homes. The remainder of the respondents to both questions had no opinion. This barrier ranked first in aesthetics of all the barriers evaluated. While it is difficult to say why this is the case, commentary concerning its beige hue would leave the author to believe that color could be one reason. When asked for suggestions to make the barrier more attractive, only a few respondents commented; most of them mentioned additional landscaping.

Respondents were asked if in a similar situation they would choose a barrier such as the one in place, an alternative, or a barrier with modifications. Forty-six percent said they would prefer the barrier as it now stands, 41% would prefer the existing barrier with certain modifications, 7% would prefer no barrier at all, and the remainder had no opinion. The percentage of respondents preferring no barrier was the lowest in all eight samples. Similarly, those responding "prefer as is" represented the highest percentage for this category.

Of those respondents who felt the barrier had had any kind of effect on their community, 81% indicated that this effect had been positive. Increases in property values and reduction in noise were the two most frequently mentioned positive effects. Furthermore, 53% of respondents felt the barrier had increased the value of their homes, 3% that it had decreased property values, and 35% that it basically had had no effect. The remainder of the respondents for this question had no opinion. Responses in the "increased" category for this question represented the highest percentage response in this category of all eight samples.

#### Panel Type Metal Barrier B

The average daily traffic in the vicinity of this panel type metal barrier is 90,480 vehicles, 22% of which are trucks or buses.

The barrier was constructed as a result of the widening of the interstate from six to eight lanes. The speed limit is 55 mph (88 km/h). The barrier was constructed during the summer of 1979 and is 12 ft. (3.66 m) high and 3,099 ft. (944 m) long. It cost approximately \$141 per linear foot (\$462/lin m), or just over \$436,000 installed.

The barrier was installed to mitigate noise in approximately 60 homes. Interviews were conducted in 40, or 67%, of these homes. Ninety-eight percent of the respondents had lived in their current dwellings prior to the construction of the barrier. Fifteen of these homes were located adjacent to the barrier, another 16 one row of houses from the barrier, and 9 across an urban street and facing the barrier. Respondents had lived in their current dwellings anywhere from 1 to 57 years, with the average length of occupancy being about 17 years. The houses varied in age from 4 to 57 years, with the average age being about 25 years. Ninety-five percent of the respondents were home owners and 60% were female. About 48% were white-collar workers, another 20% were blue-collar workers, 5% were retired, and 28% were housewives. This community contains the lowest percentage of white-collar workers of any of those surveyed. In 55% of the households, both spouses were employed. The average age of the respondents was about 40 years, and it should be noted that there was only 1 respondent over the age of 60 and none over the age of 70. Only 32% indicated that they were aware that noise barriers were to be built prior to the time construction on them began.

General Attitudes. This barrier yielded the lowest percentage of general satisfaction responses of those surveyed. Only 40% of the respondents were satisfied with this barrier and 48% were dissatisfied. The remainder had no opinion. Those giving negative responses said that the barrier had no effect on noise or that it was unattractive. Those giving positive responses, cited the positive effect of the barrier on noise levels. It should be noted that, with respect to noise attenuation, the positive responses to this question were outweighed by the negative responses. The sources of this general dissatisfaction are discussed in succeeding paragraphs.

Noise Attenuation. The respondents were definitely not impressed with the ability of this barrier to attenuate noise. Sixty percent felt the barrier was having minimal or no effect on noise levels in the community, 25% said it was having a fair effect, and only 10% said it was having a great effect. The remaining 5% had no opinion.

Aesthetics and Other Attributes. Forty-five percent of the respondents found the barrier attractive as viewed from both the interstate and their homes. The same number found it unattractive from both views. The remainder were ambivalent about both views. When asked to suggest ways for making the barrier more attractive, most respondents (78%) didn't. Of those who did, most suggested landscaping and painting. It was further determined that about a third of the respondents preferred that the barrier did not exist, 42% preferred it as is, and about 18% preferred some modification to the existing barrier. Again, the suggested modifications consisted mainly of landscaping and painting the barrier a different color. The barrier is blue, and this color did not appear to be particularly appealing to the respondents. This is not to say that the color of the barrier was the source of the dissatisfaction among the respondents, but it did appear to have some negative effect.

Twenty-one percent of the respondents felt the barrier had had a positive effect on their community, 5% that it had had a negative effect, and 73% that it had had no effect whatsoever. Positive attributes mentioned included increased safety, isolation, and increase in property values. The only negative commentary pointed out that the barrier was unattractive. Twenty-two percent of the respondents did indicate that they felt the barrier had had a positive effect on the value of their properties. Only one respondent felt that the barrier had caused his property to lose value, while the remaining 75% felt that the barrier had had no effect on property values whatsoever. Cross tabulations between the responses to this question and dwelling location revealed no significant statistical relationship.

One final comment is that of all the communities surveyed, this one had had the least foreknowledge of the construction of a barrier. This may be part of the reason for the extreme ambivalence and negativism on the part of these respondents. While the author does not know the extent to which these respondents were contacted by the Department during the pre-construction stage, their responses indicated that the contact was minimal. It is reasonable to believe that additional contact might have resulted in a lessening of the negativism found at the time of the survey.

#### Concrete Barrier

The concrete barrier included in the survey is combined with an earth berm and is located along an eight-lane interstate highway in Northern Virginia. The average daily traffic in the vicinity of the barrier is 143,350 vehicles, 19% of which are trucks or buses. The speed limit is 55 mph (88 km/h).

The barrier was constructed in the spring of 1979 as a result of the widening of the interstate and resulting increased traffic volume. It is 1,900 ft. (579 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 \$167 per linear ft. (\$548/lin m). The total cost was about \$317,000 installed. The barrier, referred to by the majority of the respondents as a wall, was erected to protect approximately 53 homes from the noise generated by the traffic on the highway. Interviews were held with 44 of the homes representing 83% of the total. All respondents had lived in their current dwellings prior to the construction of the noise wall. The respondents had lived in this community anywhere from 1 to 24 years, with the average length of occupancy being about 12 years. Houses in this area vary in age from 19 to 25 years, with the average house being about 23 years old. Of the dwellings surveyed, 21% were located adjacent to the barrier (rear portion of home), 23% were located one row of houses from the barrier, 18% more than one row away, and 39% across an urban street facing the barrier. Ninety-three percent of the respondents were home owners and 59% were females. Sixty-eight percent of those surveyed were white-collar workers, 11% were retired, and only 9% were housewives. In 57% of these households both spouses were employed. This community contains the highest percentage of white-collar workers of the eight communities surveyed. About 80% of the respondents were between the ages of 31 and 60, with the average age being about 40. Very few were under 30 or over 60. Seventy-three percent indicated that they were not made aware that the noise wall was to be built prior to the time construction began.

### General Attitudes

Forty-five percent of the respondents in this survey were dissatisfied with the noise wall. Forty-one percent were satisfied with it, and the remaining 14% had no opinion. The most predominant reasons for dissatisfaction were that the wall was having no effect on noise and that it was unattractive. This community was among the least generally satisfied of the eight surveyed.

### Noise Attenuation

The respondents were less than impressed with the ability of the wall to attenuate noise. Only 5% felt the wall was having a great effect on noise, 30% that it was having a fair effect, and 41% that it was having minimal or no effect. The remainder had no opinion. Only 5% of the respondents cited noise reduction as being the most salutary effect of the wall on the community, while 20% cited it as being the most salutary effect on their home. Such items

as increased privacy, security, and isolation took precedence over perceived noise benefits. Eighty-one percent said that they could not tell that the noise level experienced indoors was lower after the wall had been built and only 9% said that the wall had made sleeping easier. Similarly, but a bit more on the positive side, 67% said that when outside they could not tell a difference in the noise level after the barrier was built. In addition, only 14% said that the wall had improved the utility of their yard. Cross tabulations between the attitudes about noise levels and dwelling location revealed no statistically significant relationship. Indications are that the dissatisfaction exhibited was a result of attributes of the wall other than noise reduction.

### Aesthetics and Other Attributes

Sixty-one percent of the respondents found this barrier unattractive as viewed from the interstate, while 75% felt that it was unattractive as viewed from their homes. Among residents finding the barrier attractive, the figures were only 21% and 6% for the respective views. The remainder, for both views, had no opinion. The percentage of respondents judging the barrier to be unattractive was higher in this community than in the other seven communities surveyed. Eighty percent of the respondents offered suggestions for making the wall more attractive. About two-thirds of the suggestions involved additional landscaping, while the other third involved covering the wall with vegetation such as ivy. This, they said, would both eliminate the potential for graffiti and enhance the rather stark appearance of the wall. The interviewers noticed that graffiti etchings had already become a problem, thus the suggestions for covering it were well founded.

Fifty percent of the respondents related that they preferred no wall at all; only 18% preferred the wall as is; and 32% preferred the existing wall with modifications. The principal modification mentioned was the addition of vegetation to both the wall and the surrounding area.

A little less than a third of the respondents pointed out certain positive features of the concrete wall — none of which involved noise reduction. A few respondents felt the wall added a measure of security to the community by providing isolation from the interstate highway and about 10% felt that the wall had increased their property values. On the other hand, about 14% felt that the wall had decreased the value of their properties and only two respondents mentioned noise reduction as being one of the positive attributes of the wall.

The respondents were asked if, regardless of location, they felt the wall had increased, decreased, or had no effect upon the value of their homes. Fourteen percent felt the wall had increased the value of their properties, 21% felt it had decreased the value, 49% said it had had no effect, and the remainder had no opinion. These figures are a great deal different than the ones gathered during a survey at an adjacent site one year earlier. Another section of this concrete wall had been erected during the spring of 1976 and a survey had been conducted in the vicinity of it during the summer of 1978. Thirteen percent of the respondents in that survey had felt the wall had decreased the values of their homes, and 47% that it had increased the values. Further probing was aimed at determining this and other differences in opinion between the two surveys. It was determined that, as was the case in the previous barrier survey (the second metal panel barrier), very little contact was made with the citizenry prior to construction. This practice was again found to be critical in shaping community opinion of both the noise attenuation features of the wall and the Department.

#### ALTERNATIVES FOR MITIGATING HIGHWAY NOISE

Respondents were queried as to their knowledge of and preference for alternatives to barriers. First, respondents were asked, If you had it to do over again would you prefer a cash settlement for noise damage in lieu of a barrier? Twenty-three percent of the respondents answered yes to this question (up from 15% in the 1978 survey), 60% said they would prefer the barrier (down from 74% in the 1978 survey), and about 16% had no opinion. Later in the interview, respondents were asked if they thought it was appropriate for the Department to attempt to compensate those living in noise affected areas instead of building barriers. Only about 20% of the respondents felt that it was appropriate. In viewing the results of cross tabulations, it was interesting to note that people living in the communities where dissatisfaction with barriers was high were more prone to find compensation an alternative to noise barriers than were those living in neighborhoods where satisfaction was high. In fact, it was obvious in most instances that those individuals preferring cash in lieu of noise barriers were also the ones who were the most frustrated and dissatisfied. It should be remembered that more than 60% of the respondents preferred a barrier to monetary compensation; however, the granting of compensation in lieu of noise barriers should not be ruled out and should continue to be studied by transportation agencies as an alternative to noise mitigation.

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 again noted by the interviewers that vegetation in the form of tree belts, shrubbery, hedges, etc. was mentioned by numerous respondents at all eight sites as being both an alternative and an addition to noise barriers. In instances where trees had been removed, people residing close by often commented that the vegetation had abated noise as well as the barrier did. It is the opinion of the author that vegetation in combination with noise barriers is the best alternative. In fact, at one survey site a great deal of the improvement in overall satisfaction of the community from the 1978 survey to the current survey was apparently due to the addition of vegetation and landscaping at the barrier site. The removal of trees is generally always upsetting to people; therefore, in all instances where sound barriers are installed, existing vegetation should be left in place to the extent possible.

Another alternative listed by respondents was the installation of a different type of barrier. In most instances, these respondents were referring to a different type of material or utilization of vegetation in lieu of a barrier. The former item can be easily addressed during the public contact and subsequent public hearing stage of planning. Also mentioned as an alternative was shifting the alignment of the barrier, which also can 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; rerouting of traffic — assumably, this means the rerouting of truck traffic — which also would have to be the job of the local jurisdictions; making a change in the road surface, which studies have shown does not have a great effect on noise levels; and depressing the roadway, which often is very expensive. Regarding this last alternative, the same effect can be achieved through the installation of earthen berms where sufficient right-of-way is available.



Table 3  
Alternatives for Mitigating Highway Noise  
(N = 488)

<u>Category</u>	<u>Percent</u>
Plant Vegetation	12
Install Different Type Barrier	8
Shift Alignment	5
Enforce Speed Limit	5
Reroute Traffic	4
Alter Road Surface	1
Depress Roadway	21
No Opinion	64
	<hr/>
TOTAL	100

2526

## APPENDIX

### INTERVIEW SCHEDULE

Respondent I.D. # \_\_\_\_\_ Date \_\_\_\_\_  
1. Interview Code \_\_\_\_\_ Time of Day \_\_\_\_\_  
2. Dwelling Location A B C D \_\_\_\_\_ 3. Sex (A) Male (B) Female (C) Joint \_\_\_\_\_

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

5. Why do you answer as you do? (circle primary)  
(A) attractive (G) lives opposite barrier (M) prefers different barrier  
(B) unattractive (H) controls debris (N) not affected  
(C) windbreaker (I) not resident prior to barrier (O) poor construction  
(D) no effect on noise (J) reduce air pollution (P) more noise  
(E) less noise (K) provide security (Q) adds uniformity  
(F) provides privacy (L) reduction in vehicle-pedestrian interface (R) other \_\_\_\_\_

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

7. What effect do you think the barrier is having on noise? (A) great (B) fair (C) minimal  
(D) no opinion (E) none

8. When did you move into this neighborhood? \_\_\_\_\_ mo. \_\_\_\_\_ yr.

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Was that before or after the wall was built?

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

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

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

11. When you are out-of-doors how effective to you think the noise barrier 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

12. If you had the chance to do it over again would you prefer (A) a cash settlement with no barrier or would you (B) prefer the barrier (C) no opinion (D) N/A (E) neither

13. Were you aware that the barriers were to be built before they were actually constructed?  
(A) yes (B) no (C) N/A

14. How were you made aware of the construction of the barriers?  
(A) actual construction (E) public meeting (I) civic association  
(B) noise meter reader (F) public hearing (J) realtor  
(C) neighbor (G) newspaper (K) N/A  
(D) contacted by Highway Dept. (H) requested barrier (L) contacted by city

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15. Do you have children that play outdoors? (A) yes (B) no (C) NR

16. Do you think the barrier made 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

17. Do you feel that the noise barriers are attractive or unattractive from Great Neck Road?  
(A) very unattractive (C) neither (E) very attractive  
(B) unattractive (D) attractive (F) N/A

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

19. What suggestions do you have for making the barriers more attractive?  
(A) landscaping (E) shorten (I) better construction  
(B) different material (F) maintain; mow (J) other \_\_\_\_\_  
(C) staining or painting (G) none  
(D) heighten (H) cover with vegetation

20. If you were given a choice to have the barrier or not to have it, what would you choose?  
(A) prefer no noise barrier (D) prefer noise barrier with modification  
(B) prefer noise barrier as is (E) vegetative barrier  
(C) no preference (F) other

21. (If "prefer the noise barrier with modification") what modifications would you choose?  
 (A) vegetation (E) shorten (I) safety features  
 (B) different material (F) lengthen (J) other \_\_\_\_\_  
 (C) staining/painting (G) repair or maintain (K) N/A  
 (D) heighten (H) add a barrier on other side (L) better construction
22. Do you feel the noise barrier has an effect (adds or detracts) on the quality of your neighborhood? (circle primary)  
 (A) reduces litter (F) attractive (J) increases house values  
 (B) reduces noise (G) enhances environment (K) decreases house values  
 (C) increases noise (H) none (L) no opinion  
 (D) makes safer (I) provides isolation (M) adds uniformity  
 (E) unattractive
23. Do you feel the barrier has (A) increased or (B) decreased the value of your home? Or perhaps had (C) no effect (D) maintained value (E) no opinion (F) N/A
24. Do you think it would be more appropriate for the highway department to provide homeowners with cash payment for noise damage instead of building barriers? (A) yes (B) no (C) no opinion
25. What other things do you think could have been done to Great Neck Road to control traffic noise?  
 (A) vegetation (E) no opinion (H) depress roadway  
 (B) shift alignment (F) different type barrier (I) other \_\_\_\_\_  
 (C) alter road surface (G) reroute commercial traffic  
 (D) enforce speed limit

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.

26. What is your occupation? \_\_\_\_\_
27. What is your spouse's occupation? \_\_\_\_\_
28. How old is this house? \_\_\_\_\_ years
29. Respondent age: (A) 21-30 (C) 41-50 (E) 61-70  
 (B) 31-40 (D) 51-60 (F) over 70
30. In summary then, what do you feel is the most significant effect of the barrier on your home?  
 (A) lessens noise (I) unattractive  
 (B) increases privacy (J) adds uniformity  
 (C) both of the above (K) reduces litter  
 (D) no effect (L) beautifies  
 (E) no effect, barrier should not have been built (M) decreases property values  
 (F) increases air quality, improves health (N) decreases security  
 (G) provides security (O) increases property values  
 (H) reduces vehicle-pedestrian interface (P) other \_\_\_\_\_
31. 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.

Length of interview \_\_\_\_\_ minutes

Interviewer Comments: \_\_\_\_\_