MANUAL FOR DEVELOPMENT OF FORMAT FOR THE PRESENTATION OF COMMUNITY NOISE ASSESSMENT DATA

July 1981

U.S. ENVIRONMENTAL PROTECTION AGENCY
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16. ABSTRACT

This report was prepared by EPA, Office of Noise Abatement and Control, in support of its function to provide technical assistance to communities. It is one of nine which comprises the Community Noise Assessment Manual. The Manual provides a comprehensive and computerized system for assessing the noise problems of a community and then planning a noise control strategy for its abatement. The purpose of this manual is to provide a guide to various presentation techniques for all the data generated by the Community Noise Assessment Manual. In this way effective communication of noise data to elected officials, administrators and other community personnel will be facilitated.

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1.0 INTRODUCTION

1.1 Purpose of the Manual

The successful implementation of EPA's Community Noise Assessment Program by local noise abatement personnel will be dependent on the effective communication of data obtained in a noise assessment program. The purpose of this manual is to provide a guide to various presentation techniques that will ensure effective communication of this data to elected officials, administrators, health officials, and other local personnel. The principal users of this manual are expected to be the city officials entrusted with the responsibility for noise control administration.

1.2 How to Use This Manual

There are two factors that should be considered in planning an effective presentation. They are:

- o The type of information to be presented;
- o The best presentation techniques for a particular situation.

Section 2 of this manual, Information to Be Presented, overviews the type of information that should be presented to local officials at various points in the community noise assessment program. Section 3, User's Guide for Selection of Presentation Aids, assists the presenter in achieving an optimal match between his communication needs and a presentation technique or combination of techniques.

Appendix A contains a glossary of terms used throughout this report. Appendix B, Inventory of Presentation Aids for Assessment Data, provides a detailed discussion of the various presentation methods. Appendices C, D and E provide technical summaries from a Community Noise Assessment Program carried out in Allentown, Pennsylvania. This data provides the reader with actual examples of the type of information obtained from each element of the Community Noise Assessment Program.

Readers should note that this manual is a guide to presenting a community noise assessment program. The workbooks for such a program (as referred to in the text) should be consulted to administer the program itself and to answer readers' questions relating to survey methodology.

2.0 INFORMATION TO BE PRESENTED

Figure 2-1 shows when information presentations should be made to city executives during a Community Noise Assessment Program. The actual program work that precedes and follows each such presentation flows vertically down the page. The presentations themselves are indicated by the four boxes.

The subject to be presented to city executives is overviewed in this section in three parts: 2.1, The Community Noise Problem; 2.2, EPA's Community Noise Assessment Program; and 2.3, Material to be Presented.

2.1 The Community Noise Problem

What is Community Noise?

Whenever unwanted sounds intrude into our environment, noise exists. Noise, like other pollutants, is a waste product generated by the activities of a modern industrialized society. It is defined in the EPA "Report to the President and Congress on Noise" (1972)[1] as "any sound . . . that may produce an undesired physiological or psychological effect in an individual . . . or group."

"Community noise" is the total noise environment in the community. This includes traffic noise, industrial noise heard outside the plant, aircraft noise, and the noise of your neighbors' activities such as lawn mowing, partying, and barking dogs. The term is generally taken to exclude occupational noise, i.e., noise in the workplace, and the noise you make and hear by yourself at home.

Community noise varies greatly in magnitude and character among various locations throughout a community - from the quiet suburban areas bordering on farmland to the din of traffic in the downtown city streets. It generally varies with time of day in each location, being relatively quiet at night when people activities are at a minimum, and noisier in the late afternoon during traffic rush. Its effects may be experienced by people either in or out of doors.

A brief glossary of the acoustical terminology used here is given in Appendix A.

Health and Welfare Effects of Noise

Noise is an extremely pervasive pollutant. In one form or at one time, noise adversely affects virtually the entire U. S. population.

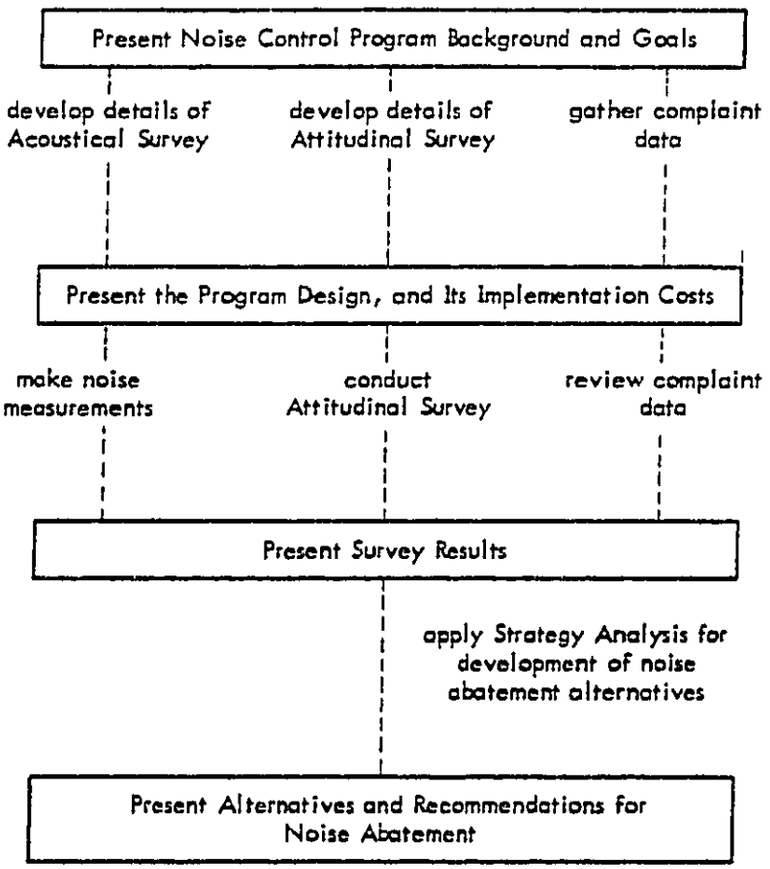


Figure 2-1. Stages in Presenting Community Noise Assessment Program Information to City Officials

Certain noise effects are well-documented:

- o Noise can cause damage to the inner ear, resulting in permanent hearing loss.
- o Noise interferes with conversation and social interaction.
- o Noise can disturb and prevent sleep.
- o Noise can disrupt learning and teaching activities.
- o Noise can obscure warning signals and cause accidents to occur.
- o Noise can be a source of annoyance.

Other effects of noise are less well-documented, but may become increasingly important as more information is gathered:

- o Noise can cause regular and predicted stress in the human body.
- o Noise can produce high blood pressure.
- o Noise may threaten fetal development.
- o Noise hampers work efficiency.

Annoyance caused by noise is a particularly complex phenomenon. Although difficult to quantify or predict, community annoyance caused by noise is very prevalent and, in many instances, it has provided a powerful impetus to the noise abatement movement. In a national 1976 Annual Housing Survey,[2] noise ranked consistently number one as the leading undesirable neighborhood condition among residents, with approximately 24 percent of the population expressing this opinion (see Figure 2-2).

In a Gallup poll, 57 percent of the respondents reported that noise is a more serious problem in their communities now than it was 5 years ago - and 47 percent believed that not enough was being done to control it.

Growth of Noise Pollution

In the last 20 years, there has been a very large growth in pollution due to the introduction of new types of noise sources into suburban and urban residential communities. These sources - such as jet aircraft, urban freeways, new industrial

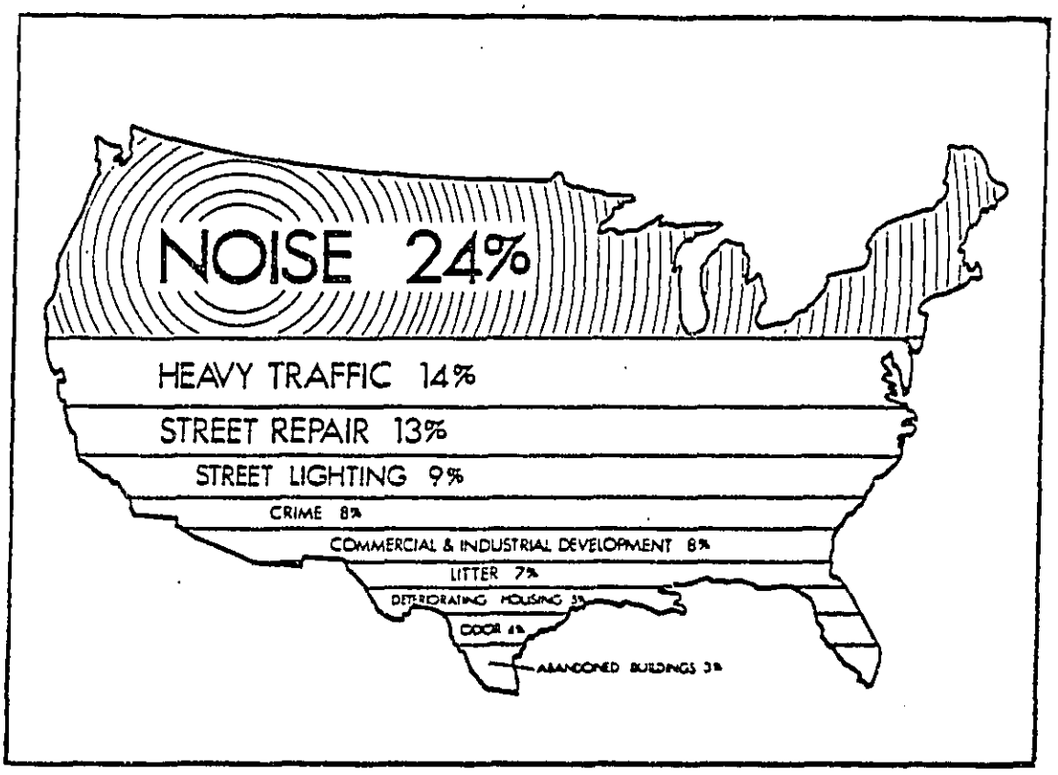


Figure 2-2. 1976 Undesirable Neighborhood Conditions; United States Comparative Ranking

plants, and homeowner equipment - have created numerous community noise problems. Noise levels will continue to increase unless effective and coordinated federal, state and local noise control programs are implemented; for example:[3]

- o Urban noise intensities will increase roughly in proportion to growth in population density.
- o A three- to four-fold increase is projected in the number of residents adjacent to freeways and major highways in the U. S. who will be exposed to noise levels 65 dB (day-night average level) or greater by the year 2000.
- o A 50 percent increase will occur in the number of person-hours of exposure to construction noise by the year 2000.
- o Occupational hearing loss and other adverse effects can be expected to increase as the number of exposed workers increases.

What Can Be Done?

There has been an increase in the implementation of state and local programs for noise control over the past several years; however, in many communities, budgetary problems have restricted the growth of programs and, in some cases, have led to their termination. In response to the increase in the number of communities desiring noise abatement programs, and with the associated need to solve complex problems of implementation and enforcement, the Environmental Protection Agency (EPA) has established a Quiet Communities Program to help local communities. As part of this program, EPA has designed a Community Noise Assessment Program, which allows local governments to assess environmental noise levels and trends accurately, evaluate their noise problems, and design programs to solve these problems. The Community Noise Assessment Program is summarized in the next section.

2.2 EPA's Community Noise Assessment Program

The Community Noise Assessment Program was developed for communities with populations between 50,000 and 150,000 people, to assess, control and improve their noise environment. The program materials are designed to be utilized by personnel from many local government departments, including administrators, planners, environmental personnel, health personnel, financial managers and/or public information personnel. It is a program that can be totally self-administered by the local government, thus constituting a tool that can be uniquely tailored to a city's own needs.

In order for local government officials to effectively design and administer a comprehensive noise management program, they must be equipped with a complete inventory of decision-making or assessment tools to deal with the following:

1. They must be able to find out what the problems are:
   - o What noises are people complaining about?
   - o What noises are people annoyed by?
   - o How loud are the noise sources?
   - o Which noise sources should be considered as problems and therefore as candidates for noise reduction?
2. They must be able to find out what the solutions are:
   - o What solutions are appropriate for the identified problems?
   - o How much do they cost?
   - o How effective are they?
   - o Are they politically and socially feasible?
3. They must be able to choose the best solutions - how much money should be spent on each alternative solution to achieve the maximum benefit and still remain within the budget?

The goals of a noise assessment program are to assist local officials in finding out what the noise problems of a community are, and what the most effective solutions to the problems are in terms of cost and benefit to the community. EPA has developed documentation for use in accomplishing the three basic elements in the Community Noise Assessment Program.

- o A community-wide noise survey;
- o A community-wide attitudinal survey; and
- o A noise abatement strategy analysis.

The attitudinal and acoustical surveys identify the noise problems in a community, and the strategy analysis identifies the most cost-effective solution to these problems. The purpose of each manual is described below; the basic elements involved in a noise assessment program are shown in Figure 2-3.

Attitudinal Survey

The attitudinal survey procedures are contained in "The Social Survey Workbook,"[4] which provides a standardized survey technique for assessing community attitudes toward noise. This survey provides information on the number of people who are annoyed by various sources of noise; what types of noise abatement solutions they support; and how much they are willing to pay for noise abatement. The number of people annoyed by various noise sources can be used as a criterion for identifying specific community noise problems. Community attitudes regarding noise will vary widely among communities and a social survey is the most effective means for obtaining a balanced and reliable estimate of these attitudes.

Acoustical Survey

The EPA acoustical survey methodology is provided in "Community Noise Assessment - Acoustical Survey."[5] This document presents the specific technical instructions and guidelines needed by municipal authorities to carry out a community noise survey. The acoustical survey will establish average noise levels for zones within the city and identify major noise sources throughout the community. The noise levels produced by each of the sources is another criterion which can be used to identify noise problems.

Information obtained from the attitudinal and acoustical survey, in conjunction with information about public complaints, can be used to determine priorities for noise abatement action, and to plan noise abatement measures. In addition, this information can be integrated in a noise reduction strategy analysis.

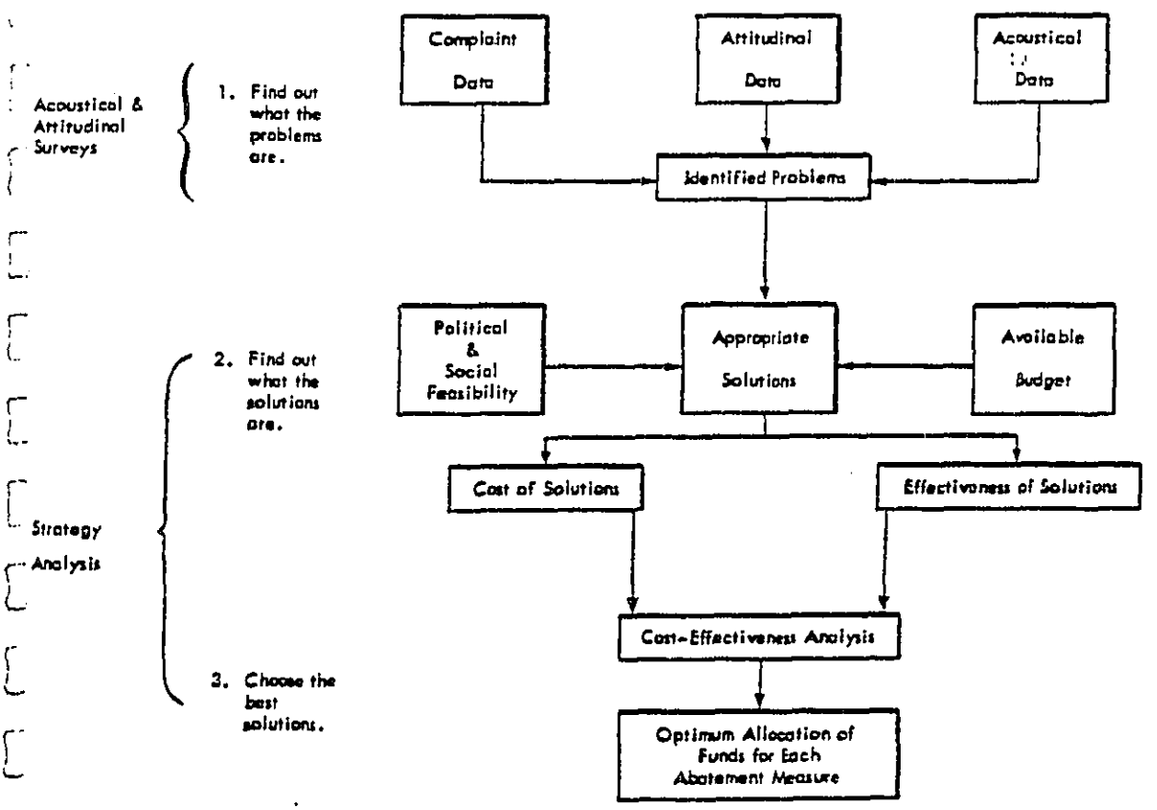


Figure 2-3. Basic Elements of a Noise Assessment Program

Noise Reduction Strategy Analysis

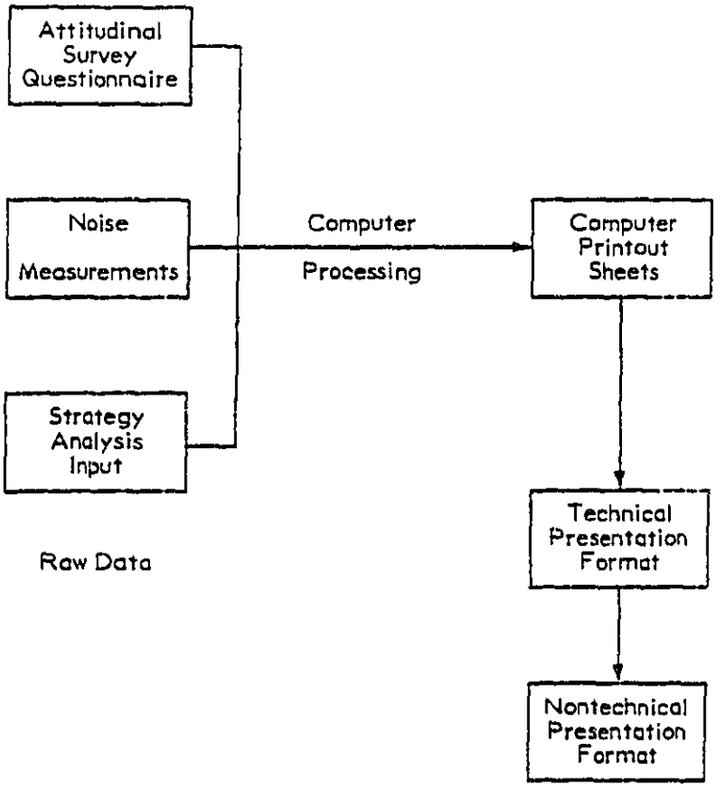
The methodology for application of a strategy analysis is provided in the "Strategy Guidelines Document."[6] The purpose of the strategy analysis is to assist local governments in determining in an objective manner the most efficient allocation of funds for reducing the adverse effects of noise in their communities. The manual provides guidelines to identify the most promising solutions to the noise problems, to estimate the costs of implementing each solution, and to estimate the noise level reductions obtained as a result of implementing each solution. Abatement measures which are found to be unfeasible from a political or social standpoint are eliminated from consideration, while additional measures which the community specifically wishes to support are added to the list of solutions to be analyzed.

To aid in choosing the best solution, a computer program called NOIZOP is used. This program analyzes possible alternatives, and combinations of alternatives, and distributes the available budget in such a way as to obtain the greatest possible benefit for the community.

The strategy guidelines manual can be utilized when addressing a single noise source problem that has a number of possible solutions, or in a comprehensive noise program addressing a variety of different noises.

2.3 Material to be Presented

The information obtained from the attitudinal survey, the acoustical survey, and the strategy analysis, can be presented in either a technical or nontechnical format. The following diagram indicates the various stages in the development of this information - from the acquisition of raw data to the presentation of this data to city officials.



Representative formats that can be utilized in presenting and interpreting Community Noise Assessment data for local officials are described and illustrated in this section.

2.3.1 Acoustical Survey Data

The computer printout from the Acoustical Survey provides L_{dn}* and L_{eq} values for each defined noise zone* in the community and, where possible, identifies the noise sources. The relative noise level of each identified noise source is given in terms of the L_{dn} value attributable to that source. These individual noise source levels can be utilized as input into the Strategy Analysis in evaluating alternative noise abatement measures. As noted in the acoustical survey manual, a noise problem may exist if an average day-night sound level (L_{dn}) from all sources is greater than 55 dB.

The computer output also shows how noise level varies with time period (weekday, weekend, hour of day). Other noise values which can be obtained for each noise zone are the statistical measures, L_{10}, L_{50}, and L_{90}. The Acoustical Survey manual should be consulted for a further explanation of acoustical survey data.

Representative examples of information developed from the acoustical survey, to be communicated to city officials, are shown in the following figures:

Figure 2-4 Noise Zone Map

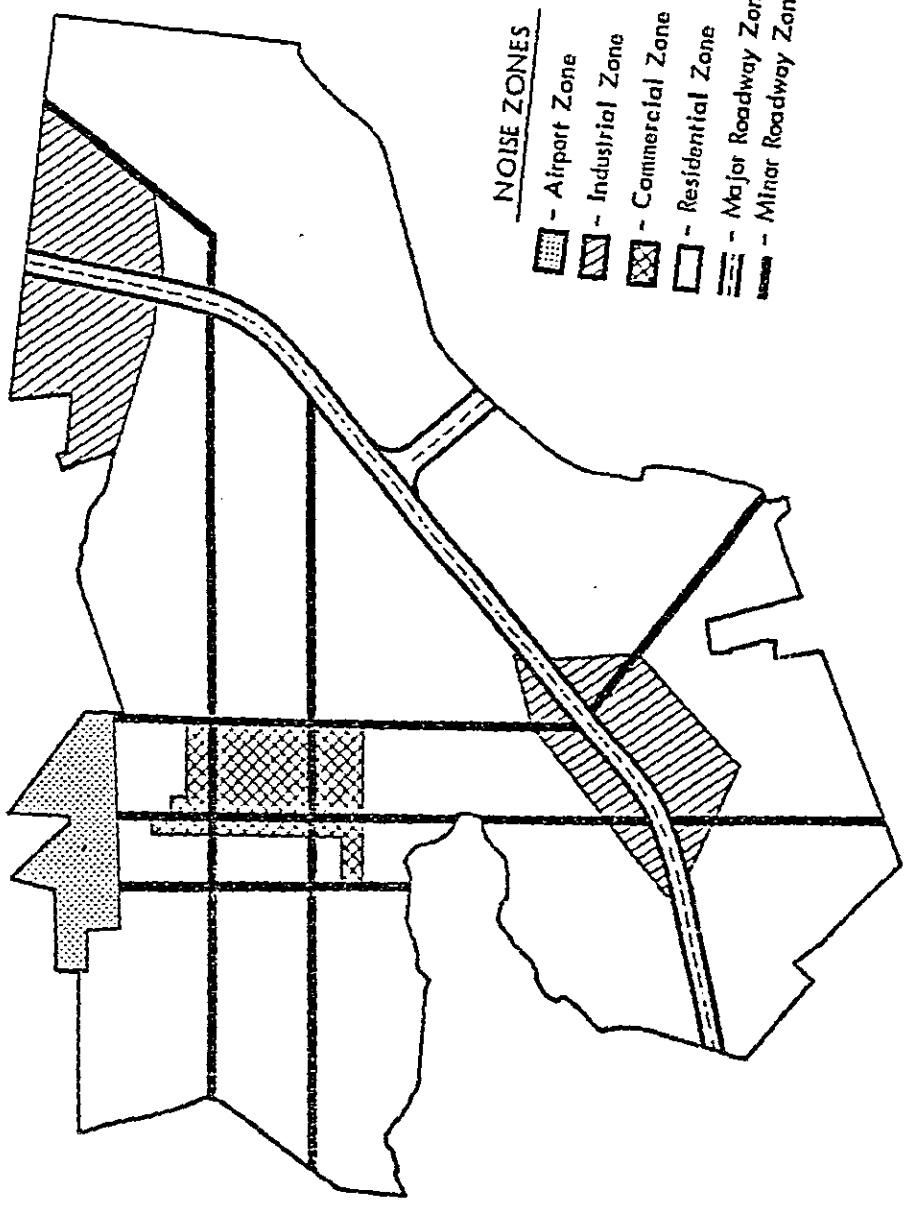
Figure 2-5 Noise Level by Zone

Figure 2-6 Noise Level and Time of Day

Figure 2-7 Individual Noise Source Sound Level Contributions

Figure 2-8 Numbers of Identified Sources of Each Type

*See Appendix A for definition of terms.


NOISE ZONES
- Airport Zone
- Industrial Zone
- Commercial Zone
- Residential Zone
- Major Roadway Zone
- Minor Roadway Zone

Computer Printout

```
NOISE ZONE: R

24-HOUR ZONE-WIDE SPATIAL AVERAGES

          WLEA        WEEKEND      COMPOSITE
LDN       64.4        55.1         61.4
LEQ       60.0        51.8         56.2
```

Technical Format

Noise Zone	L_{dn} Weekday (dBA)	L_{dn} Weekend (dBA)	L_{dn} Composite (dBA)
Residential (R)	64.4	55.1	61.4
Industrial	65.7	57.3	62.1
Commercial	66.0	55.3	60.4
Major Roadway A	66.7	56.3	62.1
Major Roadway B	69.4	60.0	66.0
Minor Roadway	56.3	51.7	54.1
Railroad	67.2	58.7	64.3
Airport	70.0	70.0	70.0 .

Nontechnical Format

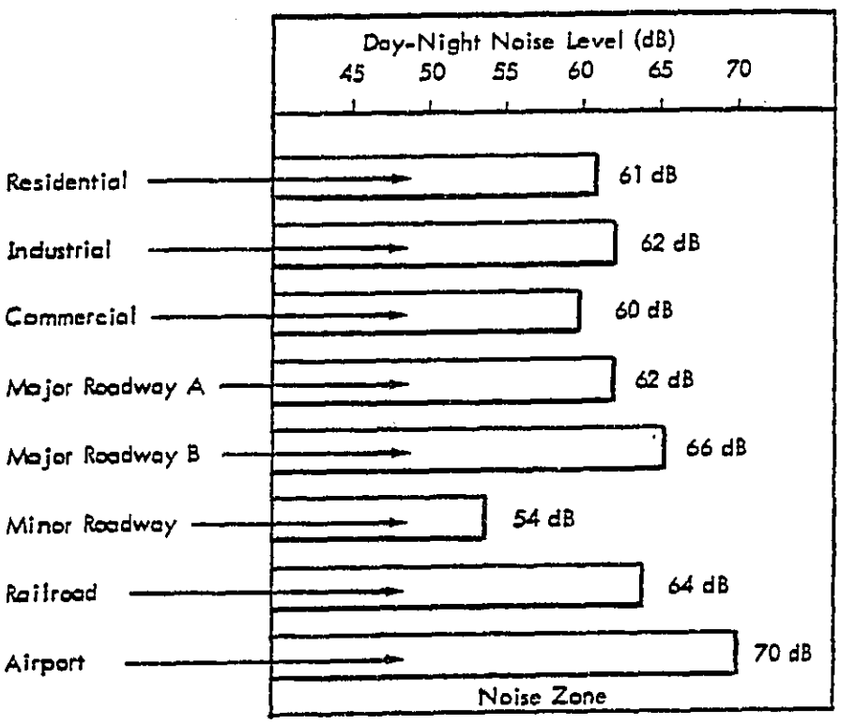


Figure 2-5. Noise Level by Zone. Noise levels are printed out by computer (top left) for each zone and time period, and can be combined in a table for a technical audience (top right). A nontechnical format is shown in the lower figure. A bar chart presentation of noise level imparts this information with minimal audience effort. Coloring the bars can add interest and increase receptiveness. The technical "dBA" has given way to just "dB," and only a part of the information in the technical table is used in the nontechnical presentation.

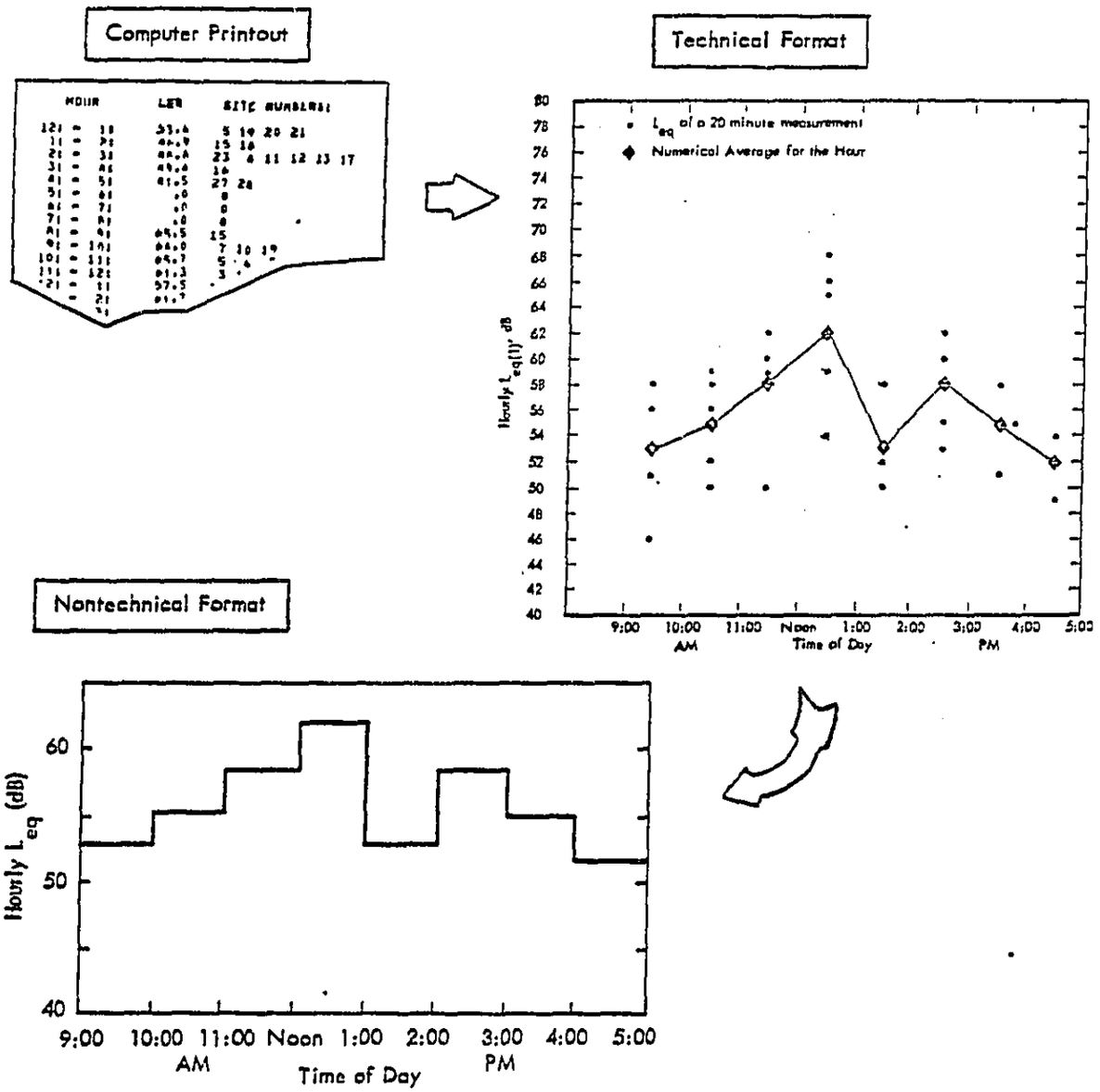


Figure 2-6. Noise Level and Time of Day. Hourly noise levels from the computer can be plotted for a technical audience. A nontechnical presentation will generally omit the individual data points, and show only the average level in each hour. In the nontechnical format above, it is assumed that the reason for the stepped curve will be explained in an accompanying lecture; it is usually unwise to clutter the figure itself with too much information.

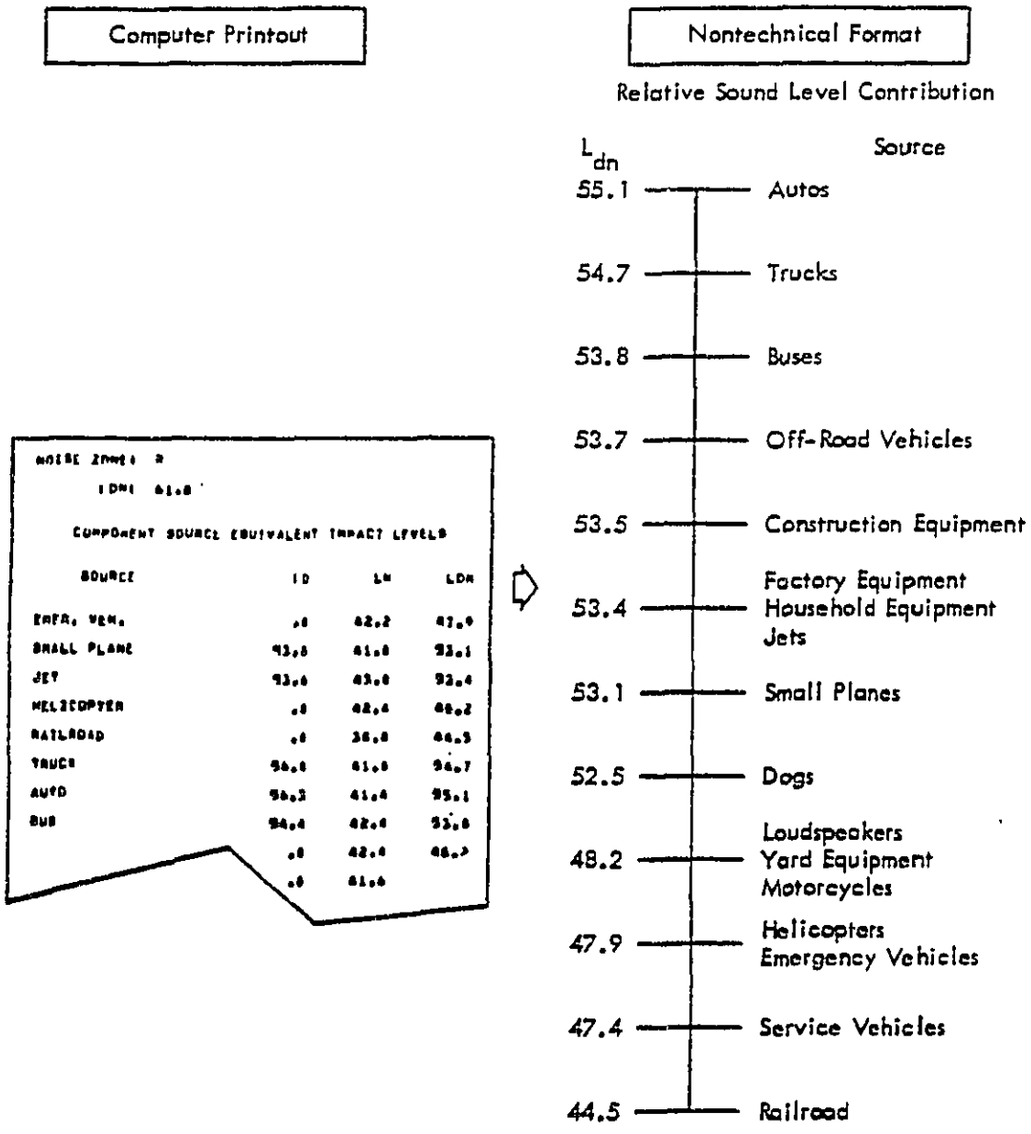


Figure 2-7. Individual Noise Source Sound Level Contributions. Relative noise source levels printed out by the computer can be presented in a nontechnical "thermometer" format to indicate the contributions of each of several types of noise source to the overall climate. In this presentation, however, the sources are simply ranked and the sound level written beside each; this may be necessary when, as in this case, the sound levels of several sources are very similar. Pictures of the various noise sources could enhance this presentation.

Computer Printout

NOISE ZONE: R SOURCE IDENTIFICATION

SOURCE	PERCENT OF TOTAL IDENTIFIED
EMER. VEH.	.1
GEN. AVIA.	.0
JET	2.2
HELICOPTER	.0
RAILROAD	2.5
TRUCK	13.0
AUTO	53.0
BUS	.4

Nontechnical Format

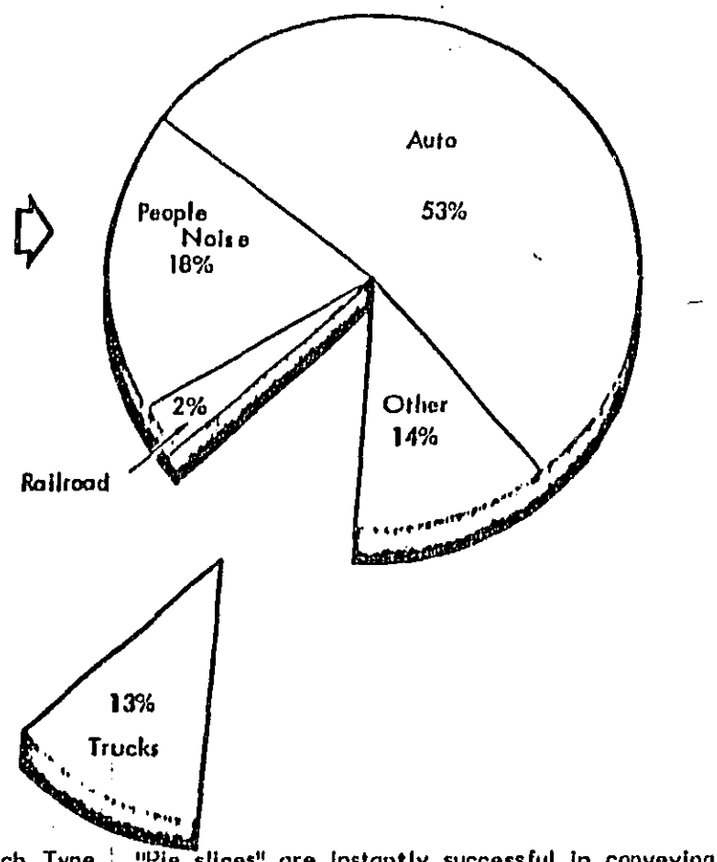


Figure 2-8. Numbers of Identified Noise Sources of Each Type. "Pie slices" are instantly successful in conveying percentage breakdowns of virtually any quantity. To heighten their effect, use a different color for each slice; add depth by using shadow and detach any slice needing special attention. This figure shows the percentage of identified noise sources which were attributed to each source in the residential noise zone.

2.3.2 Attitudinal Survey

The Social Survey provides valuable information regarding the community's attitudes toward various noise sources and abatement measures for each noize zone and defined geographical areas (i.e., West, North) of the community. In addition, the survey indicates the community's willingness to pay for noise reduction, and allows for identification of other major environmental problems. Basic trends in the community, such as population, location, and income changes, can also be seen by comparing survey data with statistics taken from earlier censuses. This information is useful for all types of community planning and allows noise problems to be understood in the broader context of urban growth and change.

Some of the valuable information local officials can obtain from the data are:

- o What are the noise sources that affect people in each area of the community?
- o How does noise affect people?
- o What are the other problems that each area of the community is concerned with?
- o Which areas will support a noise abatement program, and how much extra in taxes are people willing to pay to support it?

Negative attitudes toward a source of noise can be an indication of a noise problem in the community. Based on recent research,[4] a noise source can be considered a problem in the community if more than 4 percent of the households in an area are "highly annoyed" by it. The strategy analysis uses this information, and the attitudes of the community toward various abatement measures, to determine the optimal use of these measures for the community.

Some example formats to present attitudinal survey information to local officials are shown in the following figures:

Figure 2-9 Annoyance by Zone

Figure 2-10 Annoyance by Noise Zone Type

Figure 2-11 Jet Noise Annoyance by Area

Figure 2-12 Annoyance Due to Noise and Other Characteristics

Computer Printout

CROSSTABULATION

Q10 ANNOYANCE REACTION TO NOISE IN AREA BY NZONE

Q10	COUNT / COL PCT	NZONE 1 RESIDENTIAL=60DB	2 IND,COMM =67DB	3 RAILROAD =68DB	4	5 AIRPORT =70DB	6 MINOR RD =67DB	7 MAJOR RD =81DB	ROW TOTAL
1 TREMENDOUSLY	1	10	0	2	0	0	4	0	16
		2.9	0	18.7		0	4.6	0	3.4
2 GREATLY	2	20	1	0	0	0	2	0	23
		5.8	6.7	0		0	2.3	0	4.9
3 CONSIDERABLY	3	27	0	0	0	0	6	0	33
		7.9	0	0		0	6.9	0	7.1
4 MEDIUM	4	30	3	1	3	3	9	1	47
		8.8	20.0	8.3		42.9	10.3	25.0	10.1
5 PARTIALLY	5	37	1	1	1	1	13	0	53
		10.8	6.7	8.3		14.3	14.9	0	11.3
6 A LITTLE	6	100	5	3	1	1	25	1	137
		29.2	33.3	25.0		14.3	28.7	75.0	29.3
7 NOT AT ALL	7	118	5	5	2		26	0	156
		34.5	33.3	41.7		28.6	29.9	0	33.8
COLUMN TOTAL		342	15	12		7	87	4	467
		73.2	3.2	2.6		1.5	18.6	.9	100.0

Nontechnical Format

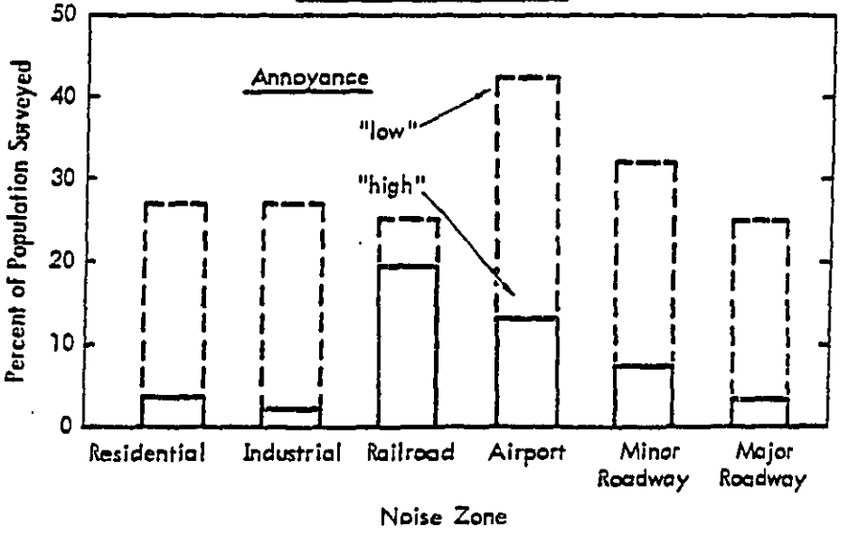
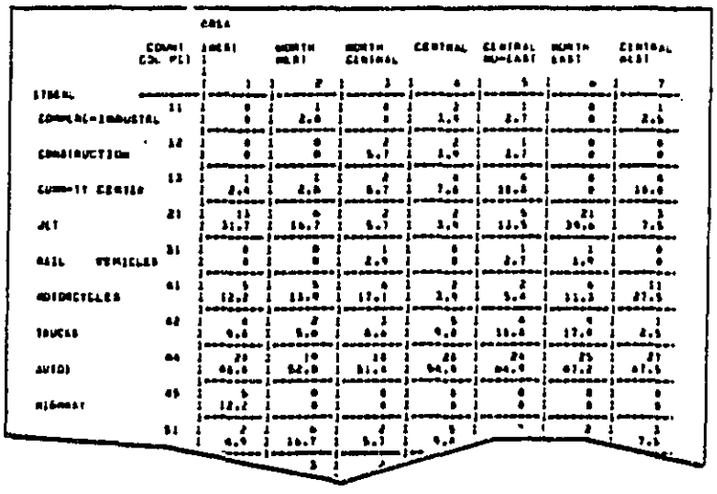


Figure 2-9. Annoyance by Zone. The percentage of the surveyed population expressing "high" and "low" annoyance to noise in various zones. In the original survey, annoyance was measured in seven levels, as shown in the computer printout, ranging from "not at all" to "tremendously." A nontechnical format presenting all seven levels would be unclear. In this nontechnical format, the "high" annoyance population could be all those "tremendously," "greatly," and "considerably" annoyed, while the "low" annoyance population could be all those "medium," "partially" and "a little" annoyed. An explanation could appear in the caption or be presented verbally. Percent of population could also be presented in terms of geographical areas, as well as noise zones.

Computer Printout



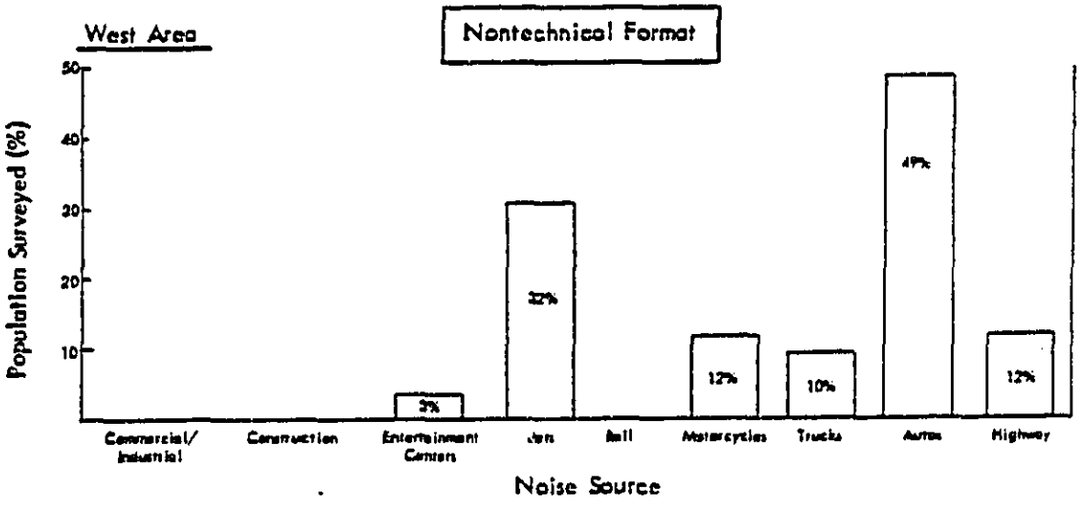


Figure 2-10. Annoyance and Noise Source Type. The percent of those "highly" annoyed in a given area (i.e., West) by each noise source can be indicated on a bar chart. Noise sources could be easily pictorialized, which would enhance understanding and receptiveness. The information presented in terms of geographic area, rather than noise zone, may be more useful to city officials.

Nontechnical Format

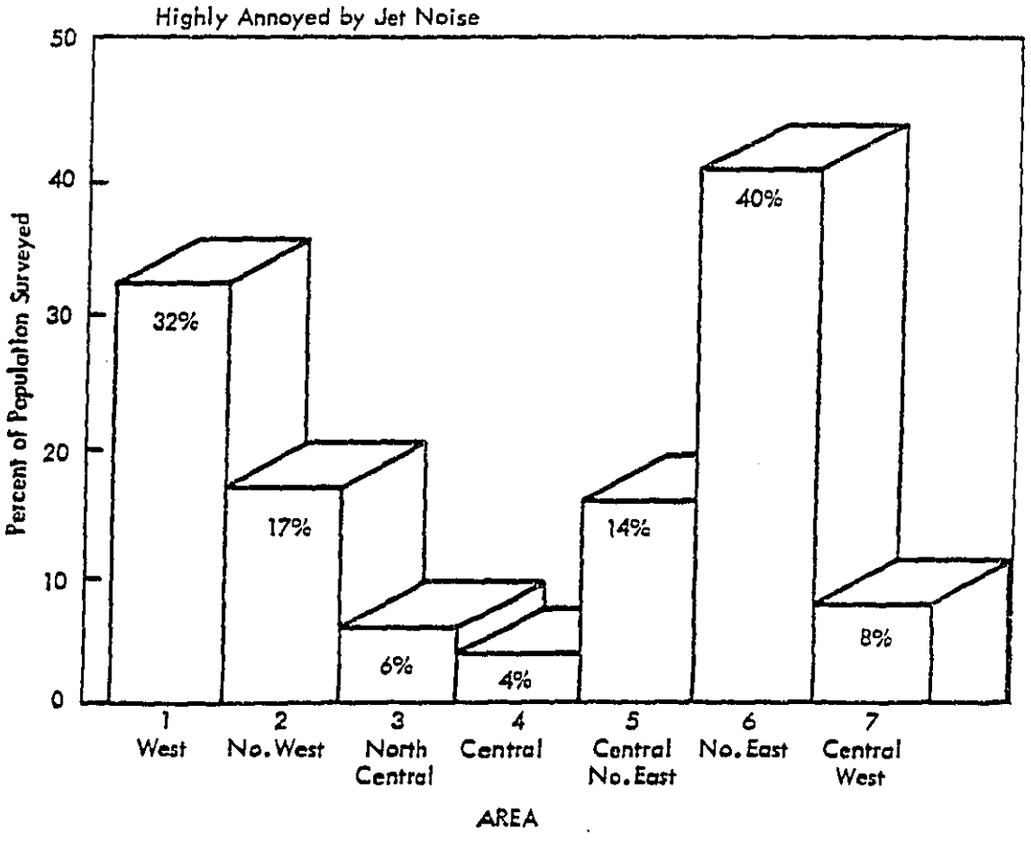


Figure 2-11. Jet Noise Annoyance by Area. The percent of those "highly" annoyed by a given noise source (i.e., jet noise) in each of the city areas can also be expressed on a bar chart. Note that bar charts can be "three-dimensionalized;" they then resemble familiar real-life objects, e.g., skyscrapers, and are more pleasing to the eye than the normal, more abstract two-dimensional bar chart. "3-D" representations of this sort work best on simple figures.

Attitudinal Survey

Would you say that (...) is a Problem?	YES	NO	EXTREMELY SEVERE	QUITE SEVERE	MODERATELY SEVERE	NOT VERY SEVERE	DON'T KNOW
a. Traffic Congestion?	Y	N	5	4	3	2	8
b. Polluted Water?	Y	N	5	4	3	2	8
c. Noise?	Y	N	5	4	3	2	8
d. Crime?	Y	N	5	4	3	2	8
e. Run-Down Areas in Need of Improvement?	Y	N	5	4	3	2	8
f. Unclean Air?	Y	N	5	4	3	2	8
g. Parking?	Y	N	5	4	3	2	8
h. Inadequate Low-Income Housing?	Y	N	5	4	3	2	8

Percent of Population Rating Problem as Severe

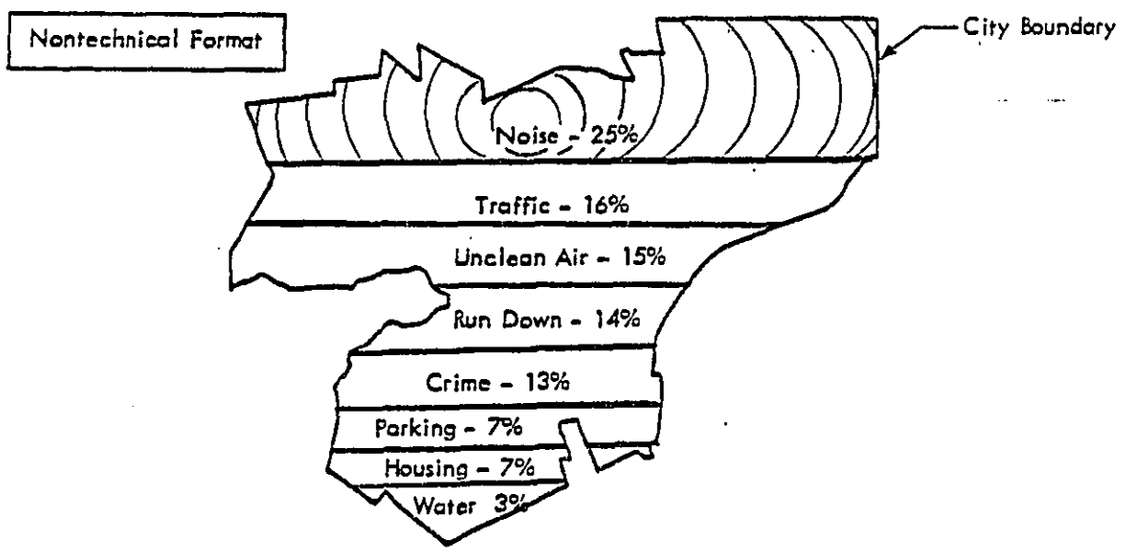


Figure 2-12. Annoyance to Noise and Other City Characteristics. The figure conveys the percentage of the surveyed population rating each of the stated city characteristics as the most severe of the city's problems. This nontechnical format uses a city map as a backdrop, to personalize and emphasize its relevance for city executives. The problem of most interest can be accentuated in some way. In drawing such a figure, note that map area rather than any linear dimension conveys the impression of "weight," so the horizontal lines should divide city areas in proportion to the various sources of annoyance.

2.3.3 Complaint Data

Complaints regarding noise can come from individual residents or from organizations. Records of the source of the complaint and the location (residence) of the complainer are not often kept; therefore, the task of establishing the total number of complaining households for each noise zone and noise source may be difficult. However, all data that may be available should be sought, and all suitable data which are obtained should be tabulated according to acoustical survey instructions.

Complaint data should be tabulated, wherever possible, in terms of the number of people complaining about a particular source in each noise zone. It is then converted into the percent of population for each zone (or geographic area) that has complained about each source as shown in Figure 2-13. Problem sources are identified as those causing more than a given proportion, say 1%, of the households in an area to complain. It should be noted, however, that only a small percentage of people who are highly annoyed by noise actually complain about it, so complaint data can sometimes be misleading.

2.3.4 Composite Data

Complaint, attitudinal, and acoustical information can be presented together to indicate which areas in the city, and which major noise sources, should be considered candidates for noise abatement treatment. This composite data can best be presented using overlays on geographic area or noise zone maps (as shown in Figure 2-4) to illustrate problem areas.

2.3.5 Strategy Analysis

The strategy analysis identifies the most offending noise source problems in a community and recommends the most cost-effective abatement measures. It determines the cost to the local government and to society of implementing each abatement, and it assesses the benefit of the noise control program to the community. The factors addressed in the analysis are as follows:

Noise Source Problems

Through an evaluation of the acoustical survey data, attitudinal data, and complaint data, NOIZOP (the strategy analysis computer program) lists the most offending noise sources in order of severity. This information can be utilized by city officials in determining the priority of abatement actions.

Technical Format

Noise Source	Location in the Community			
	West	N. West	N. Cent.	Etc.
1	(5)	-	-	-
2				
3				
Etc.				

Percent of Households in Location Complaining about Source #1

Nontechnical Format

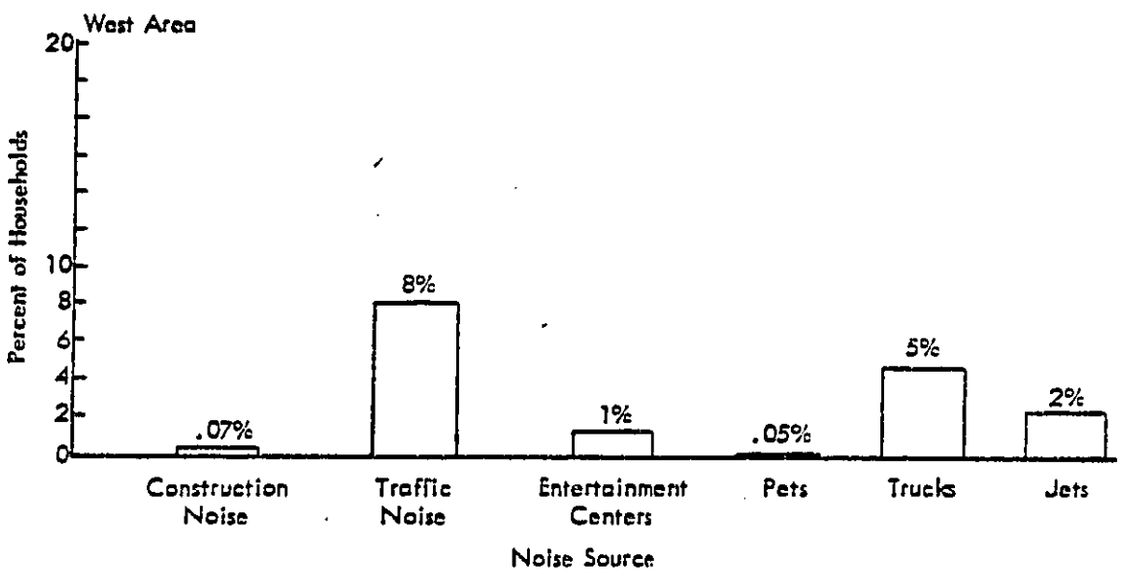


Figure 2-13. Complaint Data. Problem noise sources, in terms of complaints, can be readily illustrated when displayed in a bar graph format.

Recommended Actions

Given a hypothetical amount of city funds, the computer program selects (from all the possible combinations of alternatives) the most cost-effective combination of abatement measures that should comprise a noise control program.

Cost

The funds which the local government proposes to allocate to a noise abatement program are entered into the computer. The actual cost to the local government of each selected abatement measure is then provided by the computer printout. These local government costs are supplemented with the estimated costs of each abatement measure to the community as a whole.

Benefit

The benefit to the community is measured in terms of the reduction in the proportion of the population that is adversely affected by noise, as defined by the reduction in the Noise Impact Index (NII). The benefit of the noise abatement program can be shown by comparing the NII value both before and after all the abatement measures are implemented. These values can also be multiplied by the total population to determine the actual number of people adversely affected by noise both before and after implementing the noise abatement measures.

Cost/Benefit Ratio

The output from the strategy analysis can also indicate if the budget established by the city for a noise control program is the most desirable in terms of noise impact reduction per dollar. This can be clearly illustrated by plotting the benefit achieved (in terms of NII reduction) for various levels of expenditure. The computer printout provides this information by giving NII values and costs to both the local government and society at the various steps in expenditures from $0 to the allotted amount. If, after a certain point, the cost of additional benefits is much higher than before, a somewhat reduced budget for noise control may be more acceptable.

Some example output from the NOIZOP Strategy Analysis, and formats for presenting this information to city officials, are given in the following figures:

Figure 2-14 Noise Source Problems

Figure 2-15 List of Abatement Alternatives which Local Governments May Apply to Community Noise Sources

Figure 2-16 Recommended Noise Abatement Actions and Associated Costs

Figure 2-17 Presentation of Recommended Actions

Figure 2-18 Benefits of Noise Control

Figure 2-19 Population Impacted by Noise After Various Levels of Noise Control Expenditure

Computer Printout

```
$BASELINE NLI = 1.142951
$---- RANK =0=0
$MOST OFFENDING SOURCES:
$     1  AUTOMOBILES                              ( 4)
$     2  HOUSEHOLD PETS                           (11)
$     3  JET AIRCRAFT                             (14)
$     4  GENERAL AVIATION                         (16)
$     5  RAILROAD                                 (17)
$     6  GARDEN EQUIPMENT                         ( 9)
$     7  TRUCKS                                   ( 5)
$     8  MOTORCYCLES                              ( 3)
$     9  GARBAGE TRUCKS                           ( 7)
$    10  EMERGENCY VEHICLES                       ( 8)
$    11  HELICOPTERS                              (15)
$    12  FACTORY EQUIPMENT                        (13)
$    13  RECREATIONAL VEHICLES (OFF-ROAD)         (18)
$    14  CONSTRUCTION EQUIPMENT                   (12)
$    15  PEOPLE NOISES                            (10)
$    16  MUSIC CLUBS                              ( 2)
$    17  BUSES                                    ( 6)
$    18  FAIRGROUNDS                              ( 1)
$---- DN1  =0=0
```

Figure 2-14. Noise Source Problems. The NOIZOP computer program ranks the most offending noise sources based on data from the acoustical and attitudinal surveys.

Abatement Alternatives	Example *
Operational Restrictions	
Noise Standard	Motor vehicles shall not exceed 86 dB at 15m in speed zones above 64km/h (40 mph).
Operational Controls	1. Speed limit in residential areas changes from 72 to 56km/h (45 to 35 mph). 2. Vehicles shall not operate with excessive acceleration (except where safety requires).
Area Restrictions	No thru-trucks allowed in hillside area.
Time Restrictions	No loud music exceeding 70 dB at property line allowed after 10 P.M.
Permits	On all construction projects exceeding $10,000 value, equipment must meet municipal noise standard X.
Land Use Restrictions	
Barriers	Construct barrier between highway and school.
Building Insulation	Insulate all buildings near airport where $L_{dn} > 75$ dB.
Compensation	Reimburse residents under flight path for lowered property values.
Population Relocation	Relocate residents living in airport areas where $L_{dn} > 75$ dB.
Planning/Zoning	1. Build new highway through industrial area instead of residential area. 2. Restrict future housing developments near airport.
Building Codes	Extra insulation required in zones where $L_{dn} > 65$ dB.
Tax Measures	
Tax Incentives	Commercial establishments installing quiet outdoor furnaces receive tax break.
Tax Penalty	Plants are charged $500 per dB in excess of 70 dB (L_{dn}) measured at property line per year.
New Product Regulations	
Noise Standard	New lawn mowers sold in the city may not exceed 75 dB at 7.5 m.
Labeling	New vacuum cleaners sold in the city must be acoustically labeled.
Equipment Standard	
Maintenance	Registered automobiles must be inspected for proper maintenance once every two years.
Retrofit	All motorcycles must have a muffler that produces an insertion loss of at least 20 dB.
Other Alternatives	
Education	1. Broadcast once-a-month radio programs to help consumer choose quiet products. 2. Inform local airport and pilots of noise-sensitive areas.
Complaint Mechanism	Establish noise hotline in cooperation with police.

* These examples are illustrative and may not completely describe details which must be specified if the abatement alternative is to be properly established. Products mentioned as targets of abatement action may not be the most important noise sources to control.

Figure 2-15. List of Abatement Alternatives Which Local Governments may Apply to Community Noise Sources. The alternatives which are applicable to an individual community's noise source problems are analyzed in the NOIZOP cost-effectiveness computer program.

Computer Printout

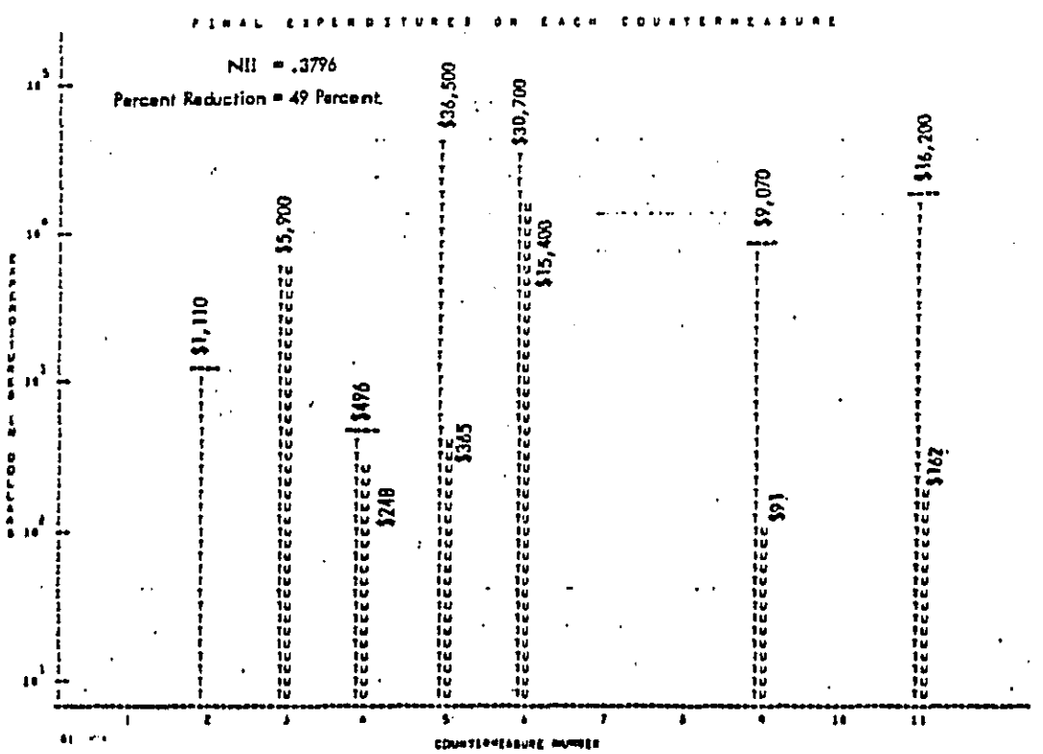


Figure 2-16. Recommended Noise Abatement Actions and Associated Costs. NOIZOP selects the most cost-effective combination of abatement measures, which are printed out in the format shown above.

Nontechnical Format

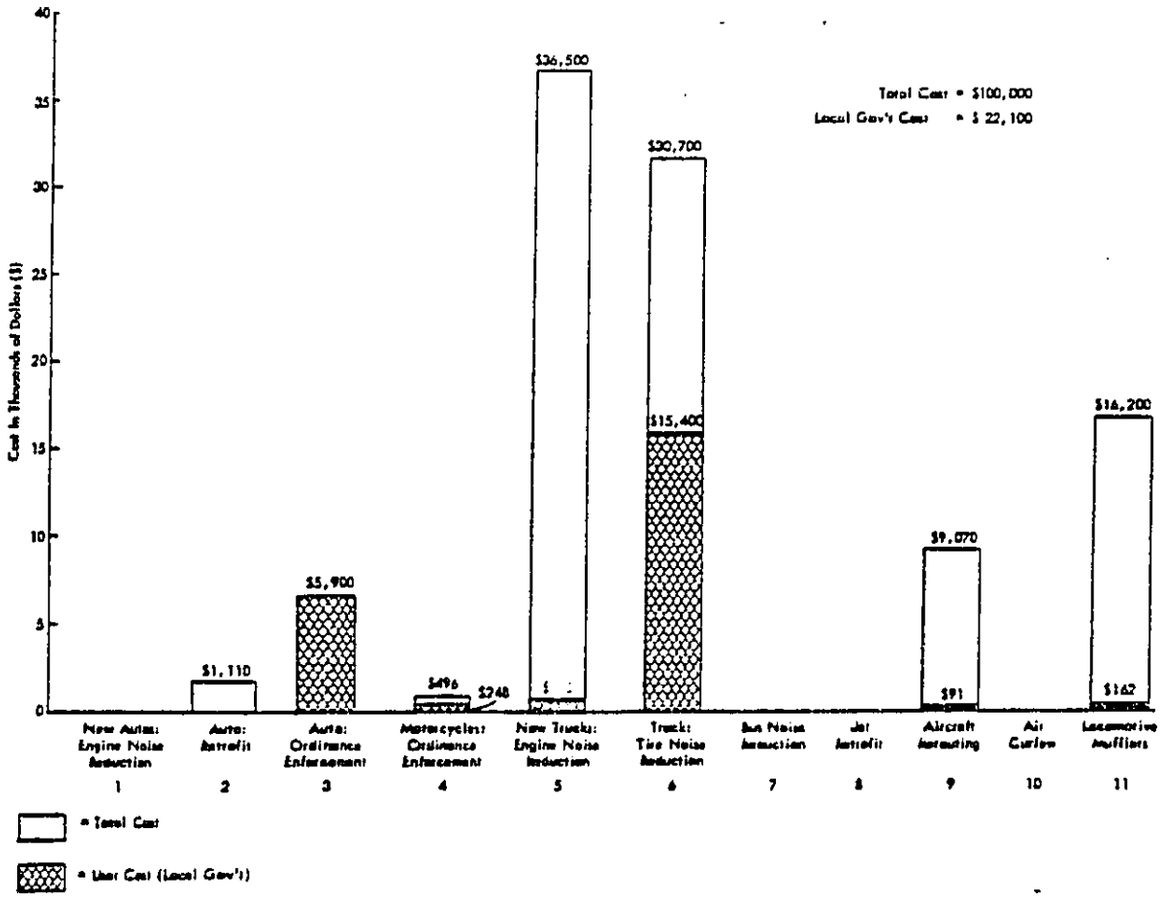


Figure 2-17. Presentation of Recommended Actions. Recommended noise abatement actions and their associated costs can be more readily illustrated to city officials through the use of a bar graph indicating both total costs to society, and the costs to the local government.

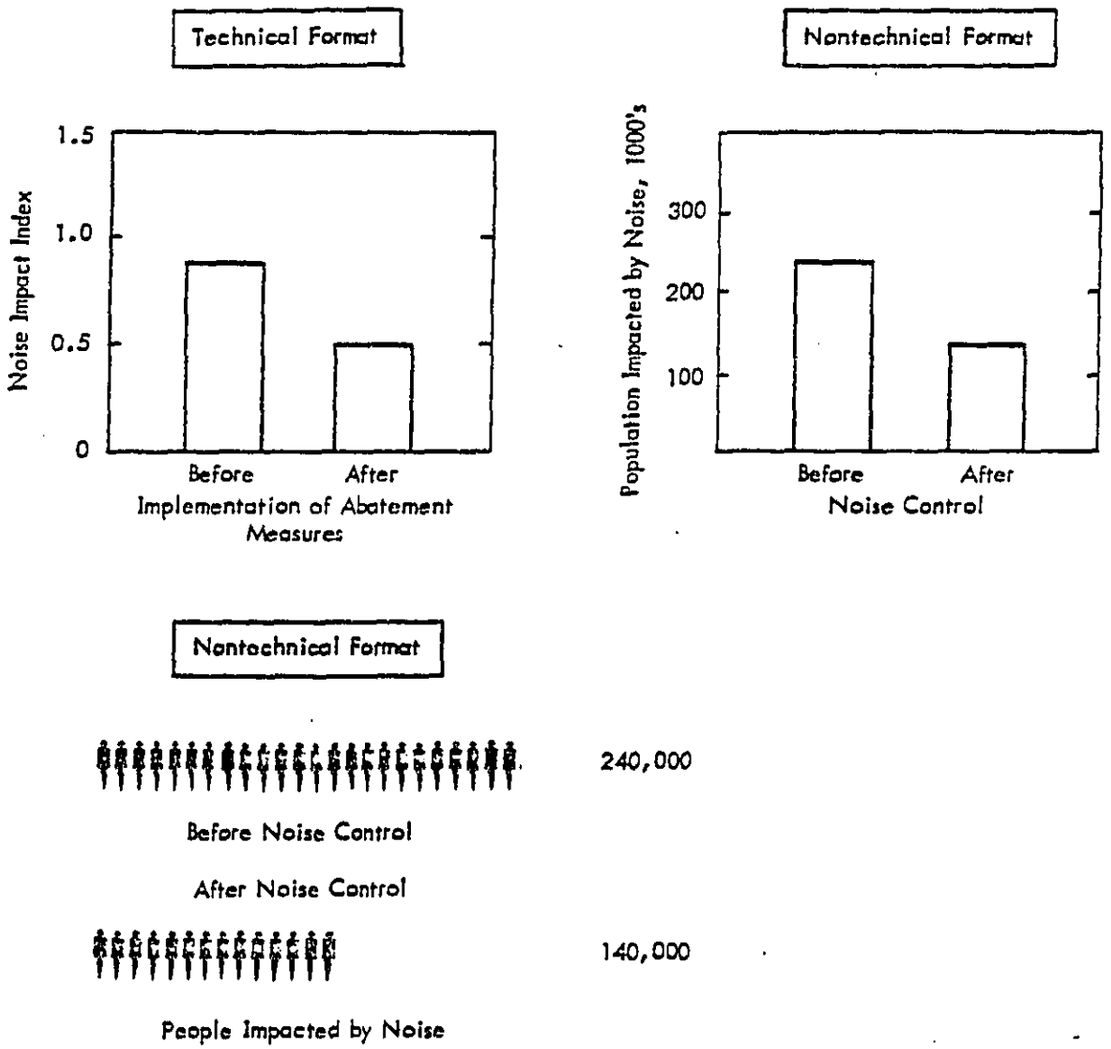


Figure 2-18. Benefits of Noise Control. The benefits of noise control are expressed in terms of Noise Impact Index; however, sometimes changing the choice of graph labels conveys the message better. A city politician may resist having to learn the meaning of Noise Impact Index, but fully understands what "numbers of people" means. As well as a bar chart, human figures can be used to convey "numbers of people."

Nontechnical Format

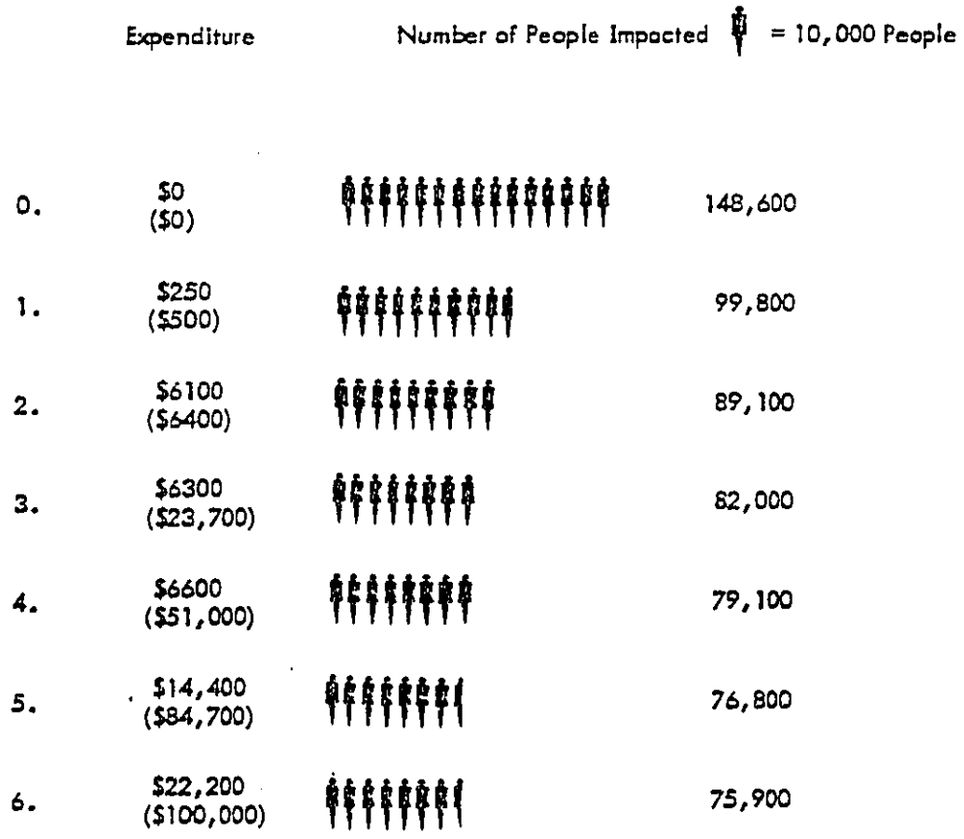


Figure 2-19. Population Impacted by Noise After Various Levels of Noise Control Expenditure. Even the relatively complex notion of cost/benefit can be presented in a nontechnical way. This figure gives the number of people impacted by noise after various amounts of city spending (and, in parentheses, total spending). With this figure, city executives could easily draw the obvious conclusion that the city noise control program should stop at the first, second or third of the depicted expenditure levels. All numbers should be sensibly rounded off.

2.4 References for Section 2.0

1. U. S. Environmental Protection Agency, "Report to the President and Congress on Noise," December 31, 1971.

2. Bragdon, C. R. and Miller, R. K., "The Regulation and Control of Animal Noise in the Community," Sound & Vibration, 12(12), 8-11, December 1978.

3. Wyle Laboratories, "Community Noise," prepared for U. S. Environmental Protection Agency, Report NTID 300.3, December 31, 1971.

4. Wyle Laboratories, "Community Noise Assessment Manual - Social Survey Workbook," Wyle Research Report WR 77-4, for the U. S. Environmental Protection Agency, July 1978.

5. Wyle Laboratories, "Community Noise Assessment Manual - Acoustical Survey," Wyle Research Report WR 77-17, for the U. S. Environmental Protection Agency, April 1978.

6. Wyle Laboratories, "Community Noise Assessment Manual - Strategy Guidelines," Wyle Research Report WR 78-1, for the U. S. Environmental Protection Agency, August 1979.

3.0 USER'S GUIDE FOR SELECTION OF PRESENTATION AIDS

Choosing the optimal media aids with which to make a presentation involves many more considerations than most people realize. The average person is likely to have experienced (either as speaker or audience) presentations where slides and viewgraphs were used, and the impulse may be to turn to one of these media automatically without considering available alternatives. In fact, these techniques are popular for good reason, and may well be the best choice for the presentation. But a knowledge of the potential advantages and weaknesses of the various media for different applications, will allow the presenter to optimize his resources and will result in a superior and cost-effective presentation which achieves its intended purpose.

The Inventory of Presentation Aids in Appendix B of this manual provides an overview of the characteristics of the major techniques which are potentially useful for presentations of community noise survey data. The User's Guide is intended to aid the presenter in achieving an optimal match between the needs of his individual presentation situation and a presentation technique or combination of techniques. Furthermore, it supplies a methodical framework within which the user can organize his presentation from initial planning through actual delivery. This includes the following set of steps (with the assumption that the actual data and content material are complete and ready to be transformed into the presentation format).

The first four steps are primarily armchair assessments of factors important to structuring the presentation and choosing presentation techniques. These include defining the purpose of the presentation and determining the type of information that should be presented as well as consideration of the constraints involved in a particular presentation situation. The user is urged to consider his situation in light of the issues raised in Sections 3.1 through 3.4 and to do some "comparison shopping" in the Inventory of Presentation Aids before embarking on any material production. The inventory may be consulted at each step as different parameters are considered or it may be studied in depth in Section 3.5

In Section 3.5, the information generated to this point is matched with the best choice from the inventory and in the remaining sections, the presentation is actually put together and delivered.

3.1 Definition of the Objective

A speaker should know what information he wants to communicate by the time he starts to prepare the materials for a presentation, and the process of formalizing a defined objective may not seem necessary. A few minutes of thoughtful consideration, however, can be invaluable for providing direction to the whole program and may actually result in a different choice of technique and presentation organization than would otherwise have occurred. A statement of purpose should be prepared.

Common presentation objectives include: (a) achieving an attitude change in the audience, (b) transmission of factual information, (c) motivation of the audience to take action on something, and (d) entertainment. In presenting community noise data to a city government group, all of the first three will at some point come into play. Ideally, a single presentation, however, should focus on one objective. Perhaps a first meeting may emphasize the need for an assessment program (motivation) with a later presentation focusing on the presentation of survey data (transmission of factual information) or providing a recommended plan, the primary objective of which would be the motivation of the executive group to action (i.e., commitment to implement the recommended plan). Alternately, both transmittal of survey results and recommendations for action may take place in a single presentation. In this case, the factual information would probably be considered as supporting the overall objective of motivating the governing body to take action.

Your presentation should be guided by the stated objective. All chosen material and techniques should support the objective. Some techniques are particularly effective for conveying factual information while others are well suited for stimulating the audience on a more emotional level, and are more likely to motivate behavior.

3.2 Assessment of the Content Information

To proceed with the planning and production of the program, you should organize your content material and analyze it. There is likely to be some redundancy and some superfluous material. Pare it down to essentials, or the important points may be lost to the audience. A time-consuming but necessary task is to simplify and devise meaningful data summaries. For nontechnical presentations, complex charts and graphs should be boiled down to a form which can be assimilated quickly and easily from a visual display. The use of color and pictorial graphs can be effective here. Remember, complete data can always be made available as back-up in a hand-out, but an overly-detailed visual presentation may confuse the audience and distract their attention with resultant inattention to the continuing presentation. Examples of how to reduce the data from complex computer printout sheets to simple, nontechnical formats for presentation is provided in Section 2.3.

When the information has been sifted and assembled, it should be evaluated so that different types of information can be identified. This will help you both in structuring the presentation and in choosing optimal presentation aids to use. Examples of types of information which will likely be found in a presentation of this type include:

- Background educational information
- The purpose, methodology and costs of a noise assessment program
- Acoustical and attitudinal data summaries
- Composite data of noise measurement, attitudinal survey, and complaint data
- Alternative solutions and recommendations

3.3 Assessment of the Presenter and the Audience

The skills and capabilities of the person(s) making the presentation must be considered in its planning. Some people are more comfortable with a highly structured program, while others are good at handling informal, question-and-answer discussion sessions. Another consideration is that of ability to smoothly operate audiovisual equipment. A presentation can suffer greatly from disruptions caused by nervous mix-ups of posters or viewgraphs; or inability of the presenter to handle problems associated with projection equipment. If there is some doubt on either point, then choose techniques which will minimize such requirements for the presenter (unless, of course, he can be provided with an assistant or a projectionist).

More complicated is the assessment of the target audience. You need to determine how to get and keep audience attention, how to ensure that they understand what you have to say, and, if it is your objective, how to stimulate them to do what you want. First of all, consider the individuals with whom you are communicating. Who are they? Occupation, age, sex, and political affiliations may dictate your approach. What level of technical sophistication do they represent? You should neither overwhelm them with facts and figures they cannot comprehend, nor bore or anger them by talking down to them. Review your materials to eliminate jargon and explain abbreviations or buzz words that may be self-evident to you but new to your audience. How much knowledge do they already have of the subject? If you are not sure, a package of pre-briefing materials may be sent to ensure a certain level of basic understanding (these materials should be kept to a minimum, and be easily readable, to increase the likelihood that they will be read).

Assess the level of formality which you expect at the meeting. If there have been numerous friendly interactions with the members of your audience in the past, then an informal format will probably be most conducive to productive interchange and understanding. Viewgraphs or posters might be quite adequate for a highly successful presentation. If the audience consists of busy city executives with whom there has been little past interaction, then a highly structured program will provide a more appropriately professional atmosphere. You may wish to invest in a synchronized audiovisual exposition (e.g., slide show cued to audiotape; movie film, or videotape).

Consider the need for persuasion tactics. Will the audience be resistant to your message? If they are likely to be receptive, your task is to provide a concise, usable recommendation, and documentation to back it up. Time and money spent developing elaborate displays will be better allocated to providing a simple factual presentation and a good package of supportive hand-out materials. On the other hand, if you expect some resistance (political pressures may be in opposition to your own goals), consider investing in some of the methods which are better at evoking change (e.g., sound film or videotape).

The audience should also be regarded briefly as a group. What size is the group? Large audiences demand a more formal, structured program; smaller groups can interact more informally and intimately. Some of the media techniques are better suited to smaller groups (e.g., videotape, because of screen size). Also, consider whether they can be treated as a homogeneous group with similar backgrounds and attitudes. If there are individuals with highly different backgrounds and interests (e.g., lawyer, mayor, layman), then some thought might be given to providing personalized sub-packets of materials with specially tailored information. If they have different opinions and interests, there could also be time-consuming discussions between audience members. The speaker should be prepared to mediate or to firmly postpone such discussions, in order not to lose control of the meeting. If this situation is anticipated, the more formal media techniques used in a tightly structured format may be desirable.

3.4 Determination of Practical and Material Considerations

Before you actually begin laying out your detailed program plan and finalizing your choice of presentation technique, there is the all-important consideration of practical limitations imposed on you by available resources. On the one hand, you are confined to working within your own:

- Monetary budget,
- Available personnel, and
- Accessible material and equipment.

On the other hand, there will be constraints, some imposed by the audience group, of:

- Preparation time before the scheduled meeting,
- Length of meeting time allotted (presentation time),

- o Number of meetings scheduled, and
- o Physical characteristics of meeting room (possibly including some projection/presentation equipment).

Make sure you know the extent of your own resources. Don't neglect the possibilities presented by production facilities and other equipment which may be borrowed or rented in your community (university libraries, etc.). Be careful in pricing the materials and services you need. Leave a safety margin. Costs often exceed original estimates. Find out, too, exactly what limitations are being dictated by the audience group.

To the extent that you can control the situation, make sure that there is ample preparation time (invariably, there will be unforeseen set-backs). Also, consider that short presentations are almost always more effective than long ones; and that two or three meetings (as opposed to one lengthy one) may:

- o Allow you to modify or restructure your approach after the first session for greater effectiveness, and
- o Create more feelings of intimacy and informality which could work in your favor, but
- o Cause problems if too much time elapses between meetings because of necessity for updating or repeating materials from earlier sessions (at the same time, judicious repetition can have the positive effect of enchancing retention of information by the recipients).

If you are limited to a single presentation opportunity, then a more highly structured "package" approach has advantages, and the distribution of a briefing kit prior to the meeting is recommended. (To increase the chance of this material being read, personalize it in some way, or hand it to the user personally.)

As regards the presentation room, you should find out, as a minimum, how large it is, whether it can be easily darkened, and what audiovisual equiment is available there, if any. If possible, visit the room; you may wish to check for wall space, and the power-handling capabilities of the electrical circuits.

3.5 Choice of Format

At this point you have evaluated the major considerations on which your choice of media technique should be based. You are now ready to choose your medium (or media): the vehicle with which to transmit your message. The goal is

to achieve the optimal match between technique(s) and your situation as you have assessed it in Sections 3.1 through 3.4 (your objective, your content material, and the other characteristics of your situation). If you haven't been using the Inventory of Presentation Aids as you go along, read through it now. It is not an exhaustive list of all media tools, but does include those most commonly used methods which are likely to be appropriate for presenting community noise data. Other techniques not mentioned in the inventory may also be available to you in your specific situation. The lecture, or oral presentation, does not appear in the inventory. Depending on the decisions made based on Sections 3.1 through 3.4, your lecture will constitute the backbone of the meeting, with the audiovisuals serving a support function, or it may be limited to an introduction and the leading of a post-presentation discussion. A prepared lecture is, of course, particularly useful if a presentation is required on short notice, or if there are no funds to prepare audiovisual materials. While a lecture can be a highly flexible presentation technique, it does not by itself command as much attention as visual material does.

Some advantages or limitations were not included in the inventory because they are generic. For example, all of the audiovisual materials, once produced, have the advantage that repeated presentations can be made with them, even by different individuals. In an extreme case, the whole presentation might take the form of a videotape or film, copies of which are simultaneously sent to several locations.

Any of the visual materials may serve as memory aids to a speaker, eliminating the need for notes. They are important for lending clarity and accuracy to verbal ideas. The disadvantage of relying too heavily on audiovisuals, however, is that it decreases the amount of direct interaction the presenter has with his audience, particularly through eye contact. This should be considered in planning a presentation which has persuasion and motivation as its purpose. If an effective speaker is available for the presentation, the program should allow for a certain amount of such personal interaction.

Often a combination of media techniques may be most effective. For example, hand-outs are recommended as back-ups to be used in conjunction with other visuals. Wall posters can present a chart or map which is then partially reproduced in a slide or viewgraph, for isolation and enlargement of important sections. When motion picture is used, still photos or slides may repeat key scenes for emphasis, and increase the likelihood of recall in the audience. If a sequence of

presentations to the same audience will be made (e.g., at different phases: planning and program layout; results of data collection; conclusions and recommendations) this may be an effective technique for evoking, with a few key slides, a more elaborate earlier presentation of a movie film or a whole slide show. Press-kits or packages of materials relating to the presentation, can be distributed to news sources or to interested groups or individuals. These could involve the use of all of the different presentation media discussed. Audiotape is likely to be a valuable aid for a presentation about noise data, and may accompany a set of slides.

If a generous budget is available and a highly professional presentation is required, a multi-image show may be produced, with automation of combinations of various audiovisual devices such as slide projectors, film projectors and audiotapes (see Reference 4 for discussion of advantages, as well as useful production instructions). A multi-image production can be extremely costly, and may result in an audience that has been entertained but shows little knowledge retention or attitude change. The danger exists of becoming so engrossed in the technology that the program goal is lost. Decisions of this type must be based on the particular situational characteristics.

3.6 Plan Layout

The content materials should have already been organized in the assessment process of Section 3.2. At this point they will need to be laid out sequentially as they will be presented, and the visuals should be storyboarded for production purposes. The storyboard is a production tool which helps to determine the precise sequence and pace of the program. With slides, for example, a series of 4 x 6-inch cards should be made up, one for each individual slide. They should be numbered, contain a rough sketch of the crucial elements of the visual (stick figures are quite adequate), notes to guide the production, and instructions for the corresponding narrative part of the presentation. These should be laid out on a flat surface or hung up on a planning board, for editing and reorganizing. The same procedure can be adapted for other media techniques and is even useful for organizing the points which will be presented in a lecture. As the presentation plan becomes finalized here, some points to check include:

- Each separate visual presents only a single item of information
- All parts of the program are relevant to, and supportive of, the overall objective

- o Content material is clear and understandable
- o Important points are emphasized (if not, some repetition might be inserted)
- o Visuals and narrative are well coordinated
- o Any recommendations made follow from the data presented

Remember, the quality of a program reflects on the competence of the presenter! References 5 and 7 provide helpful guidance at this stage of effort. The storyboard serves as a blueprint for the action in Section 3.7.

3.7 Production

The actual production of the media will not be covered in this guide. Each technique in the Inventory of Presentation Aids (Appendix B) contains reference sources which include complete production instructions. Additional sources are listed in Section 3.10, References. Some of these supply all the technical information necessary, including detailed equipment options/needs. By this point, assessment has already been made of the budget considerations which have probably dictated the answer to the question of professional help. Obviously, with some media techniques (e.g., 16mm film) the importance of professional production is much greater than with the others (e.g., overhead transparencies). Nevertheless, even limited use of consultants, or contracting out part of the artwork, may be well worth the expense. Considerations to take into account include:

- o Equipment available
- o Personnel skills
- o Wages of personnel

Whether you do the production yourself or not, allow time in your plans for unexpected delays.

At this stage, the "speech" or narrative should also be prepared. References 3, 11, and 12 may be helpful.

3.8 Assembly

If the work in the previous steps has been well done, this stage should go very quickly. The storyboard can be used as the guide for arranging slides, viewgraphs, etc., in proper order. Make sure that audiovisuals are well integrated

with the speaker's script. In reviewing the presentation, try to anticipate questions which might be brought up. Rehearse the material until you are thoroughly familiar with it. Coordinate all personnel who will be involved in the presentation. If possible, make a practice presentation to an audience from whom you can get critical, but helpful, suggestions.

3.9 Presentation

A few final points can be listed which will help to ensure a smooth presentation.

The references on speaking and group discussion (3, 11, and 12) provide useful hints for presentation and delivery. While stage fright is an occasional problem, familiarity with, and confidence in the quality of the prepared materials should dispel that. Allow time so that the speaker is not rushing around at the last minute to get ready. Get there on time!

The presenter should familiarize himself with the audiovisual equipment beforehand, and it should be checked prior to the presentation for possible malfunction. It should be set up and tried out in the presentation room before the audience arrives. Thought should be given to obstructions, e.g., heads, in the line of projection. Traffic paths should be clear of power cords and speaker cables. In some cases, it may help to tape them down. Be prepared for emergencies, with extra cables, bulbs, connectors, etc.

If the step-by-step preparation has been well executed, the delivery of the presentation should be the rewarding culmination of a successful effort.

3.10 References for Section 3.0

1. Audiovisual Equipment Directory, Yearly editions. Fairfax, VA: National Audiovisual Assoc., Inc.

   Contains listings with descriptive information and prices for audiovisual equipment. Very useful for comparison shopping.

2. Eboch, Sidney C., Operating Audiovisual Equipment, 2nd ed. San Francisco, CA: Chandler Publishing Co., 1968.

   Explains the operation of all types of audiovisual equipment. Includes instructions for mounting materials for opaque projection and for preparation of handmade slides and overhead projection transparencies.

3. Galley, Holbert E., Discussion, Conferences, and Group Process. New York: Holt, Rinehart, and Winston, Inc., 1968.

   Explains why discussions are valuable, how to prepare for leading a discussion, etc. It also includes chapters on communication theory and theories of interaction which should be useful to those interested in educational techniques by means of the group discussion.

4. Gordon, Paul (ed.), The Art of Multi-Images. Association for Multi-Image, 1978.

   Compilation of articles by communication and media experts. Covers techniques, planning, production, and equipment. Hints and techniques for separate media as well as multiple media use.

5. Kemp, Ferrold E., Planning and Producing Audiovisual Materials, 2nd Edition. Scranton, PA: Chandler Publishing Co., 251 pp, 1968.

   An excellent step-by-step description of how to produce educational media. Explains how to read a light meter, how to use press-type (rub-on letters), how to edit film, how to edit recording tape, etc. Also offers price comparison charts of various media (although these are slightly dated).

6. Kodak: "Yearly Index to Kodak Information."

   A comprehensive listing of over 800 books, guides, and pamphlets relating to the use of photographic products, which are published by Kodak. Many of these are available free of charge in single copy. Write to:

   Eastman Kodak Co.
   343 State Street
   Rochester, NY 14650

   Some specific titles of useful pamphlets include References 7 and 8.

7. "Materials for Visual Presentations: Planning and Preparation." (S-13) 1977.

Discusses planning cards, planning boards, and some hints for preparation of visual materials.

See Reference 6 for publisher.

8. "Audiovisual Projection." (S-3) 1978.

Discusses room facilities and projection equipment requirements in detail.

See Reference 6 for publisher.

9. Mambert, William A., Presenting Technical Ideas: A Guide to Audience Communication. New York: John Wiley & Sons, 1967.

Deals with communication problems in business and industry. Written for anyone who wants to be a better communicator of technical information.

10. Minor, Ed, and Frye, Harvey R. Techniques for Producing Visual Instructional Media. New York: McGraw Hill Book Co., 1970.

Describes in great detail how to create posters, transparencies, etc. Explains how to select lettering pens, how to use tape-embossing machines, dry transfer letters, water coloring, spirit duplicating, thermocopy transparencies, xeroxing, etc. The perfect handbook for an aspiring graphic artist.

11. Ott, John. How to Write and Deliver a Speech. New York: Trident Press, 1970.

Explains how to deliver speeches and lectures, how to conduct research, organize a speech, write an outline, etc. Provides hints on watching out for cliches, common word traps and other problems with language. Explains humor, transitions, stage fright, and provides a checklist for the beginning speech maker.

12. Verderber, Rudolph F. The Challenge of Effective Speaking. Belmont, CA: Wadsworth Press, 1970.

Explains how to select a topic, how to size up the intended audience, how to develop a speaking style, how to prepare the introduction, the body, the conclusions, how to use visual aids effectively, etc. It also discusses persuasive speech making and group discussions as well as speeches for smaller groups.

13. Wittich, Walter A., and Schuller, Charles F. Audiovisual Materials. New York: Harper and Row, 1967.

Although designed as a textbook for those interested in becoming classroom teachers, this book covers the use of each medium as a teaching supplement. Describes film strips, overhead transparencies, film, posters, etc.

APPENDIX A

Glossary of Terms

This appendix provides a very brief definition of the basic terminology used in community noise assessment. The reader is referred to the appropriate survey documentation for a complete technical explanation.

Decibel (dB) - the unit used to measure the relative loudness or level of a sound. The range of human hearing is from about 0 decibels to about 140 decibels.

dB(A) - a modification of the decibel scale. The human ear is more sensitive to sound energy at high frequencies than at low frequencies. An A-weighted measurement assigns weighted values to certain frequencies to reflect how the human ear really would perceive the sound. Noise is measured on a dB(A) scale.

L_{eq} - equivalent sound level (L_{eq}) is a measure which describes with a single number the sound level of a fluctuating noise environment over a time period. It is a sound level based on the arithmetic average energy content of the sound.

L_{dn} - is the L_{eq} (energy averaged sound level) over a 24-hour period adjusted to include a 10 dB penalty for noise exposures during the nighttime hours (10 pm to 7 am). The nighttime noise is weighted in this way to account for the lower tolerance of people to noise at night.

L_x (L_1, L_{10}, L_{90}) - statistical noise level values. L_x is the noise level exceeded x percent of the time. L_{90} is often considered a good indication of the "ambient" or background quality of community noise, and L_1 is an indication of the highest community noise levels achieved.

Noise Zones - geographical areas of internal similarity which have distinctive environmental noise characteristics. The names of the noise zones reflect the type of activity or land use around which they are formed.

Noise Impact Index (NII) - the NII is an estimate of the fraction of the population adversely affected by noise (number of people highly annoyed by noise divided by total number of people). The NII is a relative measure: it can be used for comparing the expected effects of implementing various noise control options in an abatement program; but it cannot be expected to show the actual reduction in annoyance, just an estimate of it. The NII levels are based on research indicating acceptable levels of environmental noise in various situations. (See Section 2 to see how this concept is illustrated.)

APPENDIX B

Inventory of Presentation Aids for Assessment Data

This appendix describes the available presentation aids, including the advantages, disadvantages, and costs of the following:

Category A: Static Visuals

- Slides
- Overhead Projection
- Handout/Briefing Report
- Posters and Flip Charts

Category B: Audio

- Audiotape

Category C: Motion Picture

- Movie Film
- Videotape

References to these aids are given at the end of each subsubsection. Other helpful, more general, references are given in Section 3.10. Note that the costs stated here are approximate and are provided primarily for comparison purposes.

B.1 Category A: Static Visuals

B.1.1 Slides

Description:

Most common are 2 x 2-inch (50 x 50 mm); negative or positive film, with or without mounts; glass, plastic or cardboard mount. May be color or black-and-white.

Production:

- Photographic process most used; any conventional slide format camera, e.g., one that takes 35 mm film, usually a close-up lens and a copy stand (or the equivalent) will be needed for short distance shooting.

- Can rephotograph existent slides and pictures (but there is some degradation of image quality, and there are potential copyright problems); high contrast film is recommended.
- Process camera can be used.
- Slides can also be made using a Diazo process (e.g., Ozalid blue-line printer) or a plain bond copier (Xerox) for line copy. They can also be produced by computer processes.
- Can be used with sound track (cassette or reel-to-reel tape).
- Can use colors and dyes on slides.
- Slide duplicating device may be useful.
- Slide storage facilities are highly desirable.
- An illuminated viewing space (e.g., light table or sorting board) is extremely helpful.

Delivery Requirements:

- Slide projector - Range from simple manual control projector to remote slide change control, random access slide selection, remote focus, automatic focus, zoom projection lenses, automatic slide change by silent tones, synchronized with sound track from an audio playback machine, dissolve control with multiple projectors.
- Screen (if necessary, a solid white-painted wall surface can be substituted).
- Rear projection screen may be used under high ambient light conditions.
- Pointer is useful.
- Semidarkened room.

Cost:

- Production - low, unless professional artwork involved. Material cost, once the copy has been prepared (or when reproducing an existing slide) can range upward from about $0.35/slide (from $0.50 for color). Black-and-white film is cheaper and development is

easier; color dyes can be added manually. Computer slides range from $17 to over $100 per slide depending on the complexity of the slide (word slides to complicated graphics). However, the cost for reproductions or adjustments and additions to existing slides is minimal.

- Slide storage boxes for temporary storage available for $4.00; slide storage cabinet from $85.00
- Delivery - slide projector from $100. Screen from $20 (40 x 40 in). High quality screen will provide sharper, brighter image. Additional equipment for a more professional program could cost up to several thousand dollars, and might include: Dissolve control unit for use with more than one projector, about $375; sound synchronizer, about $60.

Advantages:

- Sharp, clear image, high detail possible.
- Portable; equipment commonly available.
- Fast production time.
- Easy to operate. Smooth, nondisruptive presentation (particularly when used with remote control changer or, for an even more professional effect, by using two projectors with dissolve control).
- Flexible (slides can be added, removed, rearranged for different presentations). If numbered, and order noted, a slide can easily be returned to view if a later question arises concerning it.
- Durable in comparison with film, which scratches easily and deteriorates with age (although proper storage of slides is still necessary).

Limitations:

- Presentation time limited to time people will sit in dark - about 45 minutes maximum.
- Equipment may not be available, or may not be compatible (e.g., Kodak slide tray may not fit Bell and Howell projector).
- Presentation room may not be conducive to slide show (e.g., size or lighting).

- o Limited detail possible in any one slide.
- o May cause some remoteness in audience and less interaction than poster or viewgraph.
- o Leaves audience with no personal record to take home.

Recommendations and Special Considerations:

- o Versatile medium, good in many situations.
- o Any group size.
- o There are several format and mounting options (e.g., size, glass vs plastic). Whichever you choose, be consistent.
- o Keep slides simple. Too much information per slide will clutter it, make it unclear, and less effective.
- o Producing slides which have dark backgrounds will reduce glare when showing slides. If slides are used to present text, use high-contrast copy film for black background and luminous text.
- o Deliberate repetition of slides is often effective for emphasis (use slide duplicator for production).
- o Use advanced techniques, such as dissolve control with multiple projectors, synchronizer or programmer for coordinating media, for highly professional presentation.
- o Wide range of technical levels possible, but handouts recommended as back-up for complex or detailed data presentation.

Reference Sources:

Slides With a Purpose, Pamphlet (No. VI-15), 1977, single copy free from Eastman Kodak Co., 343 State Street, Rochester, NY 14650.

Discusses preparing a slide presentation: planning, production, adding sound, and presentation.

Planning and Producing Slide Programs, (No. S-30), 1976, $3.25 from Eastman Kodak Co., 343 State Street, Rochester, NY 14650.

Covers fully the preparation of slide programs for use in business, education, government, industry, medicine, television, and other fields.

B.1.2 Overhead Projection

Description:

(a) Transparencies or viewgraphs - text or drawings on transparent material are projected onto a screen by illumination from a light source (overhead projector).

(b) Materials listed in the next section (e.g., maps, prints, figures) may also be displayed in a similar manner with an opaque projector.

Production:

Can be produced by direct writing/drawing on transparent surface such as acetate with a felt-tip pen, or crayon, or pen and ink, in color if desired. Carbon-coated projection acetate can be used for dark background. Spirit duplicator can be used; a thermocopy machine will produce paper copies along with a transparency. An electronic stencil cutting machine produces a stencil as well as a finished transparency. Transparencies can be produced by a lamination process, and in a Xerox copier.

The diazo process is particularly well-suited to transparency production. There are a variety of photographic techniques which can also be used.

Delivery Requirements:

- Overhead projector.
- Screen (if necessary, a solid white-painted surface can be substituted).
- Pointer is useful.
- Special or advanced equipment could include wide angle projection lens for close screen placement; high magnification stage and lens.

Cost:

- Production for transparencies of line copy is minimal. Color photography however is much higher than for slides (may be around $12 per viewgraph).
- Thermal copier about $300.
- Laminator about $320.

- Diazo printer and developer $550.
- Overhead projector from $115.
- Opaque projector from $160.
- Screen from $20 (40 x 40 in) (higher quality screen will provide sharper, brighter image).

Advantages:

- Can be produced with minimum of equipment and cost compared to other techniques.
- Transparencies may be manipulated during the presentation by drawing with a felt-tip pen; also easy to highlight items by pointing.
- Overlap of several transparencies can be used to "build up" a presentation by progressively superimposing images over each other.
- Can be produced with a variety of equipments, even without a camera.
- Room need not be darkened during presentation for overhead transparencies (except when using opaque projection); this can permit audience referral to other material, use of adjacent blackboard, etc.
- There are no potential problems of incompatibility of equipment (as may happen with slides).
- Can easily leave audience with record of presentation by handing out photocopies of transparencies.

Limitations:

- Scratches, fingerprints, or irregularities in the artwork are magnified and easily create a sloppy product.
- Overhead projector must be placed near front of the room, so the machine may block the view of some audience members.
- Overhead projectors are somewhat less common than are slide projectors and film projectors.
- More disruptive than slides because of manual placement and removal of each projection image.
- Quite common for projection angle to distort the image.

Recommendations and Special Considerations:

- o Recommended as lecture aid when interaction between speaker/visual display/audience is desirable.
- o Keep each visual simple. If possible, limit it to one main point. Too much information will clutter it, make it unclear and less effective.
- o Wide range of technical levels possible, but handouts recommended as back-up for complex or detailed data presentation.

Reference Sources:

Bathurst, L. H., and Klein, B. A Visual Communications System. William C. Brown Book Co., Dubuque, Iowa, 1966.

A detailed nontechnical self-instructional book which describes all the procedures necessary for the production of paper and/or transparent thermocopy materials.

Denno, Raymond E. Using the Opaque Projector. Squibb-Taylor, Dallas, TX, 1958.

Deals with the use of the opaque projector for all educational levels and in industry and the professions.

Hartsell, Horace C. and Vienendaal, Wilfred L. Overhead Projection. Henry Stewart, Buffalo, NY, 1960.

A booklet describing the use of the overhead projector and its application. Included are techniques and methods for preparing projectables.

Mooney, Bob T. The Overhead Projection Series, Educational Media Laboratories, Austin, TX, 1967.

A manual concerned with the effective utilization of the overhead projector as a versatile teaching device. Contents include sections dealing with all stages of planning and producing overhead projectables.

The Opaque Projector. University of Texas at Austin, Instructional Media Center.

A booklet concerning the use of the opaque projector in various areas of education and in professional and industrial training programs.

Uhl, Ronald M. Overhead Projector Transparencies: How to Make Them. Visual Arts Press, Washington, D. C., 1963.

A manual presenting methods, techniques, and processes for preparing overhead projection transparencies.

B.1.3 Handout/Briefing Report

Description:

This category comprises a variety of written or pictorial materials, copies of which are distributed to the individual audience members before, during, or after the presentation. Some of these may also be displayed by means of an opaque projector (see Section B.1.2, Overhead Projection). Included are:

(a) graphs/charts/figures
(b) photographic prints/pictorial illustrations
(c) maps
(d) samples (e.g., case studies, questionnaires)
(e) summaries, executive briefs, outlines and brochures.

Production:

There are a wide variety of format choices for handouts and reports, and many production methods can be used, not all of which are enumerated here. Written materials may simply be typed and copied, or they may be type-set. Graphs, tables, and figures may be drawn, and transfer lettering (rub-on artist's aid letters) may be used. Computer graphics can be used to generate a map indicating various measurements taken (e.g., different noise levels in given areas) and used directly as a handout or further processed to produce a visual display such as a viewgraph or slide.

Materials can be photographed by mounting an inexpensive single-lens reflex camera on a copy stand; preferably the viewfinder should cover the entire field, a close-up or "macro" lens should be used. Aerial photography may also prove useful.

Delivery Requirements:

No special requirements.

Cost:

Very cost-effective.

- Production: Cost is low for written material and usually for other as well, unless professional artist or other consultant is used. Computer graphics cost is minimal if the data base is already accessible to the computer.

- Delivery: No cost, or minimal mailing expense.

Advantages:

- Can provide detailed back-up data and information for material summarized in presentation.
- Provides information which can be studied at length outside of the meeting at user's convenience and pace.
- Allows user selectiveness (to choose what is important to him).
- Can be used as reference.
- Permits audience to retransmit information, e.g., in reports, or to their staff.

Limitations:

- May not be used (therefore, essentials must be given in presentation).
- Requires close concentration and may not be well assimilated by some users.
- Potential for misunderstanding when presenters are not there for discussion.
- Risk losing reader if too technical or too simple, too verbose, patronizing, etc.

Recommendations and Special Considerations:

- Highly recommended, particularly to convey cognitive information, especially quantitative data.
- Good strategy to provide clear, written form of directives, recommendations.
- Useful for orienting or preparing audience if distributed before the meeting.
- Good policy to supply paper copies of visuals used during presentation.
- The use of color and pictorial graphs is effective for nontechnical presentations.

Reference Sources:

Luzzadder, Warren J. Basic Graphics for Design Analysis, Communication and Computer, 2nd ed., Prentice-Hall, Englewood Cliffs, NJ, 1968.

Includes computer-aided design, automated drafting of engineering components and systems, and an introduction to design, sketching, and creative thinking.

Basic Photography for the Graphic Arts, 1975, expanded edition (No. Q-1). Eastman Kodak Co., 343 State Street, Rochester, NY 14650.

How to make line and half-tone negatives, contacts and duplicates, screened paper prints, and offset lithographic plates for photomechanical reproduction. Includes a glossary of terms.

Croy, Peter. Graphic Design and Reproduction Techniques, Hastings House Publishers, New York, 1968.

A comprehensive text and reference source on all stages of the transformation of design to printed page, along with a range of graphic materials, mediums, and printing methods.

Verry, H. R. Document Copying and Reproduction Processes; Morgan and Morgan, Hastings, NY, 1958.

Methods, equipment, practical survey. Carbon, offset, direct positive, Verifax, Thermofax, Kalfax, Xerography, Electrofax, Hectograph, stencil, etc.

B.1.4 Posters and Flip Charts

Description:

Any flat display material produced in format large enough for clear audience viewing in the presentation room. Could involve enlarged versions of most of the formats described under Handout/Briefing Report in Section B.1.3.

Production:

Wide variety of techniques, depending on content. May involve any or all of the following: illustrating, photographing, coloring, shading, mounting, laminating, and lettering.

Delivery Requirements:

Bulletin boards (although may be taped to a wall if necessary), or flip chart, easel or stand.

Cost:

Minimal (a few dollars for supplies) to perhaps $25 for preparation by a professional artist.

Advantages:

- o More conducive to evoking audience participatory interaction than slides.
- o More accessible to speaker as lecture aid than slides.
- o Does not require room to be darkened.
- o If visually attractive, can enhance interest.
- o No delivery equipment necessary.

Limitations:

- o Clumsy handling will disrupt lecture.
- o If inadequate size, it will detract from the presentation.
- o Not effective for presenting complex data.

Recommendations and Special Considerations:

- o Should be simple, with brief text, and attractive.
- o Single concept most effective.
- o If several posters prepared, should be carefully organized before lecture to avoid confusion during the presentation, or use flip chart.
- o Unless it is of continuing usefulness, cover the poster after showing it, to avoid distracting audience attention.
- o Useful in supplementing oral presentation with photographs or drawings, outlining the presentation or for emphasis.

Reference Sources:

Boughner, Howard. Posters. Pitman Publishing Corp., New York, 1962.

A booklet for the amateur poster maker. Covers planning, lettering, color, etc. Several pages are devoted to commercial posters.

Horn, George F. Posters: Designing, Making, Reproduction. Davis Publications, Worcester, Mass., 1966.

Provides all the elements for successful poster-making.

B.2 Category B: Audio

B.2.1 Audiotape

Description:

Sound track can be recorded on reel-to-reel tape or on cassette. Can be:

(a) simple recording,

(b) voice-over narration with background music or sound effects,

(c) an edited tape (splicing sections together), or

(d) mixed tape, using an electronic mixer and additional sound equipment.

Production:

At its simplest, narration can be recorded on a small tape recorder with a microphone in a quiet (preferably soundproofed) room. More advanced production techniques could use an audiomixer (to mix sound from several sources); equalizers and filters to change frequency emphasis; compressors and expanders which control sound level and act as limiters for extreme volume; a stereo record player as a source for prerecorded music.

Delivery Requirements:

Cassette or reel-to-reel playback machine. May be tied into visual equipment (slide projector, motion picture) for automated cued control by a program synchronizer.

Cost:

Inexpensive to produce. Small, reasonably quality cassette machine from $50 (accessories available include pause control, counter, remote control microphone). Good reel-to-reel machine about $370. Mixer can be bought for $50.

Advantages:

- Tape is reusable.
- Useful for recording interviews with experts for presenting scientific opinion at meetings and hearings.

- Recorded noise levels sampled in different areas and specific noise sources can be presented to illustrate technical concepts (i.e., single event, background noise, intrusive noise).

Limitations:

- Some risk of losing audience attention if not well done, because of lack of personal contact with speaker (nonverbal cues are lost and no interaction possible).
- Sound quality easily suffers when recordings are made in less than optimal surroundings or with poor quality equipment.

Recommendations and Special Considerations:

- Should most often be used in conjunction with a visual presentation.
- There must be close coordination with visuals in production of the audiotape.
- Reel-to-reel provides greater flexibility in editing; cassette is more portable.
- Commercial records and tapes are covered by copyright: Consult a music store for proper procedure if you wish to include such sources.
- Noise effects should not be at levels to produce discomfort.

Reference Sources:

Better Communications Through Tape. Magnetic Products Division, 3M Company, St. Paul, Minn. 1968.

A 30-page guidebook for more effective use of tape recorders.

B.3 Category C: Motion Picture

B.3.1 Movie Film

Description:

Most basic is Super 8mm film; more advanced is 16mm film. Both provide moving image projected on screen.

Production:

Super 8mm or 16mm camera and film; fairly elaborate production facilities for editing and quality production needed - may be available for use at local universities.

Delivery Requirements:

- o Projector (either Super 8mm or 16mm, whichever is used).
- o Screen (size dependent on size of delivery room).
- o Darkened room necessary (unless rear projection screen used).

Cost:

Super 8mm film: relatively inexpensive.

- o Super 8mm camera from $50; film cartridge approximately $6 (including processing for 2-1/2 minutes of color film). Additional equipment for editing available. Projector from $200, silent; $350 with sound.

16mm film: relatively costly.

- o 16mm camera from $700, but can often be rented from educational supply houses, universities, or libraries for a reasonable daily rate. Three minutes of color film (including processing) is approximately $25. Projector, silent, $725; with sound, from $850. A 10-minute professionally-made film may cost over $10,000.
- o Screen from $20 (40 x 40 in). Higher quality screen will provide sharper, brighter image.

Advantages:

Allows audience to see and hear recorded experiences. Best presents action, motion, and ongoing processes. Compels attention. Heightens feeling of reality compared to other presentation methods and therefore may be more effective in evoking cooperation of viewer.

Limitations:

- o Requires darkened room for showing.
- o Film is subject to wear from repeated showings and age.

- Film cannot be reused (only reshown), unlike magnetic audio and videotape.
- Not always possible to freeze action, or to replay film in parts, to highlight any aspect.
- No interaction between speaker and audience; should only be used to supplement the presentation.
- Showing requires some effort in terms of threading, rewinding, providing equipment; and short films may not be regarded as being worth the effort.
- Long film risks loss of audience attention after showing.

Recommendations and Special Considerations:

- Super 8 cameras may be available from individuals who have them for home use; relatively inexpensive; camera and projector are lightweight and portable; easy to load and operate; available with sound track recording ability (though sound quality is not high). 16mm film is higher quality, but expensive and time-consuming to produce.
- Probably most effective if used with sound.
- Use freeze-frames and close-ups to call attention to information; animation to simplify.
- Useful where movement is important (e.g., to present examples of noise sources such as traffic); sample interview (staged) might be filmed.
- Single concept film is most effective.
- Educational background on noise and attitudinal surveys could be presented in a short movie.
- Production of photographs from the film, to be included in handouts, are good for providing continuity.
- Effective existing films on community noise can be rented from the Environmental Protection Agency.

Reference Sources:

Movies With a Purpose. A pamphlet available free (single copy) from Eastman Kodak Co., 343 State Street, Rochester, NY 14560.

An excellent 18-page pamphlet which explains how to draw a basic storyboard, and how to film the basic, single concept film.

Mikolas, Mark and Hoos, Gunter. The Handbook of Super 8 Production. New York: Media Horizons Press, 1976.

Probably the most complete book on film ever written. Encyclopedic in nature. Explains everything anyone would ever need to know about Super 8 film production. How to buy a camera, how to shoot film, how to edit film, how to "talk to the lab," even how to shoot aerial photography.

Lipton, Lenny. Independent Filmmaking. San Francisco: Straight Arrow Books, 1972.

Probably the most complete and easy-to-ready book on 16mm filmmaking ever written. It explains how to buy a 16mm camera, how to edit film and how to talk to the lab when having film processed. It also includes information on reading light meters, types of lenses available for cameras, tripods, filming, filmstocks, etc.

U. S. Environmental Protection Agency, Office of Noise Abatement and Control, Consumer Affairs Office (AW-471), Washington, D. C. 20460.

Offers a wide variety of films concerning community noise problems and solutions. Films are available for rental, purchase, or free preview.

B.3.2 Videotape

Description:

Audiovisual tape which is displayed on a television monitor. Available in reel-to-reel, cassette, or cartridge format, black-and-white or color.

Production:

Taping is fairly simple with a videotape camera and recorder. If well-equipped production facilities available, highly professional effects can be achieved by editing and special effects (e.g., "dissolve" methods, superimpositions of words over picture, computer animation). A second recorder is required for editing. May be available for use at local universities or public broadcasting corporations.

Delivery Requirements:

Videotape player and monitor.

Cost:

If facilities are available, relatively inexpensive; if not, relatively expensive.

- Production: Simple black-and-white videotape recorder with TV camera from $1700; Color: $7000. Tape about $20 per hour reel. A complete but basic production system is approximately $3000 to $4000.
- Delivery: Videotape player black-and-white from $700; color from $1100; monitor from $185 black-and-white, $525 color.

Advantages:

- Similar to movie film, but easier and less disruptive delivery. Video and audio levels are adjusted automatically.
- Tape can be reused.
- Taping is relatively simple; does not require professional assistance.
- Tapes are compact, easily mailed.
- Battery-operated recording capability makes it useful for remote site, on-location taping.
- Videotape suffers much less wear with repeated showings than film.
- Special effects can be more easily and inexpensively produced than with film (e.g., "dissolve" methods or superimposition of words over a picture).
- "Dubbing" for multiple copies is cheaper than for film.
- Films can be transferred to videotape for distribution and vice versa.
- Highly familiar medium to all audiences, and therefore little danger of distraction because of novelty of medium itself.
- Room need not be darkened.

Limitations:

- Restricted to use with relatively small audience because of size of playback monitor (or television screen).
- Equipment is expensive.

- o Does not provide interaction between instructor and audience.
- o Videotape is a relatively new medium and equipment has not been standardized (e.g., machines may record on 1/2-inch, 1-inch, or 2-inch tape, and are not compatible with different machines).
- o Videotape recorders and cameras are susceptible to electronic problems and require careful maintenance.

Recommendations and Special Considerations:

- o Many of the same characteristics and special applications as movie film.
- o Suggest taping of interviews for dramatic presentation of attitudinal data, and on-site taping of environments where noise measurements made.
- o Could provide copies of tape for further distribution and use.

Reference Sources:

Mattingly, Grayson and Welby Smith. Introducing the Single-Camera VTR System: (A Layman's Guide to Videotape Recording). New York: Charles Scribner's Sons. 1973.

An excellent reference for those who know absolutely nothing about television and want to do videotaping with a portable system. Explains how to operate a camera, how to check for problems, how to dub audio onto videotape, what to touch and what not to touch on the equipment, what to leave to the engineers, etc. Includes basic videotape exercises on role-playing, etc., to help a videotape user learn to use the medium effectively.

APPENDIX C

Technical Summary of the Allentown Attitudinal Survey

The results of the Community Noise Assessment attitudinal survey are summarized in this appendix. The information obtained from the survey includes the way residents evaluate their area, the extent to which they see noise as a problem, the personal impact noise has on them, the extent to which residents support a noise control program and the factors which affect their attitudes toward noise. These attitudes, and an evaluation of the accuracy of the sample interviewed, are presented and discussed below.

C.1 Accuracy of the Sample

To assess the accuracy of the sample, the sample characteristics are compared to the known population of Allentown taken from the 1970 census. If the estimate from the sample is discrepant with the known census results, it can be due to two things: either the sample is biased, or the population has changed. Both of these are liable to be true because it has been 7 years since the last census, and Allentown appears to have undergone a change. By comparing the census data with the sample data, both the accuracy of the sample and the demographic trends occurring in Allentown can be estimated. The comparisons described below show the consistency between the census and the sample to be extremely close. On most indices, the accuracy is within 3 percent or less. From this it can be concluded that with the exception of sex distribution, and possibly by occupation, the sample very accurately represents the population.

C.1.1 Age Distribution

The percentage of the total population under age 18 is within 1 percent of the 1970 results. There is a difference, however, for those between 18 and 65, and for those over 65.

Age	1970 Census	Sample
Under 18	27.7%	28.6%
18 - 65	58.6%	54.2%
65+	13.7%	17.1%

It appears that these are correct estimates and that there has been a change in the Allentown age distribution. Younger and middle-age persons have been moving out to the suburbs, thereby changing the adult age distribution. This is consistent with known population shifts from the central areas. Since the population under age 18 is almost identical in the comparison, this suggests that fertility levels are the same.

C.1.2 Sex Distribution

There is a bias here in the sample. The correct sex distribution for Allentown is 55.1 percent females and 44.9 percent males; the sample produced 61.0 percent females and 39.0 percent males. Females have been over-sampled and caution should be taken for any characteristics which correlated with sex (very few).

C.1.3 Percentage Black

The census indicates that 1.8 percent of the population is black, and the sample indicates approximately the same, 1.9 percent.

C.1.4 Education

The census gives faulty results, for it lists 46.3 percent of the population have completed high school (without defining what is meant). The sample shows 66.8 percent have completed high school. The discrepancy may be due to an irregular definition in the census, for the sample results are more consistent with tendencies in other cities in the U.S. If the median education levels of the population is compared, there is more agreement: the census median is 11.5 years and the sample median is 11.9 years.

C.1.5 Housing

Four comparisons were made:

a. Ownership status - The census indicated 62.4 percent of the population had owner-occupied homes, and the sample indicated 63.7 percent had owner-occupied homes.

b. Persons per unit - The census median was 2.4 persons per unit; the sample median was 2.3 persons per unit.

No. of Persons	Percent in Census	Percent in Sample
1	22	23.8
2	32	32.1
3	18	18.0
4	14	15.4
5	8	6.2
6+	7	4.4

c. Average household size - According to the census the average household size is 2.78. The sample indicates the average size to be 2.67.

d. Total Number of Households - Total Population - In 1970, there were 37,870 households listed. In 1977-78, the sample indicates that there are 38,118 households. This was calculated by multiplying the Estimated MOS (41,888) times the contact ratio - 91 percent (637 households contacted/700 expected households). Thus, there has been a very slight increase in the number of households since 1970. There has also been a slight drop in the average size of households, so that the overall population of Allentown has dropped.

e. Units in Building Structure

Units	Percent in Census	Percent in Sample
1	66	69.7
2	9	8.3
3-4	10	7.9
5+	15	15.6

f. Years of Residence

Years	Percent in Census	Percent in Sample
Less than 3	26	26.0
3-5	15	17.8
6-10	15	14.6
11-20	21	16.7
21+	23	24.9

g. Employment Status

Two characteristics were assessed, employment status and occupational distribution.

Employment Status	Percent in Census	Percent in Sample
Labor Force Participation Rate (percent of population 18 and over who are either employed full or part-time, or looking for work)	59.5	61.2
Not in Labor Force	40.5	38.5
Unemployed (the percent of the labor force looking for work)	2.5	11.9

Although labor force statistics are often inaccurate, it appears that the sample estimate is a good index of the true extent of unemployment.

Occupational Category	Percent in Census	Percent in Sample
Professional, Technical	13.0	20.6
Managerial, Administrative	7.0	6.6
Sales	9.0	8.0
Clerical	18.0	14.8
Crafts, Foremen	14.0	11.9
Operatives	23.0	19.2
Transport	4.0	3.5
Laborers	4.0	3.1
Farm Workers	0.1	0
Service	7.0	11.1
Private Household	0.7	1.1

h. Income Distribution

It is very difficult to compare income levels due to inflation and changes in real income levels. In 1970, the average income was $10,988, and from the sample, the average income is $12,629. Results indicate there is more inequality of income in the sample than in the census. This could be due to an over sampling of poor people, or the migration of middle-aged wage earners to the suburbs and a proportional increase in older, retired persons with lower incomes. It appears that both factors are responsible, although the age shift appears more probable.

C.2 Evaluation of the City

C.2.1 Stability

Allentown appears to be a stable city in terms of residence. Fifty percent of the population have lived in their area longer than 7 years, and the average period of residence is 13.4 years in their area.

C.2.2 Age and Sex Characteristics

The sample indicates that the city is relatively an aged one. The population age 65 or over is 17.1 percent as compared to the U.S. national average of 9.9 percent age 65 or over.

C.2.3 Health Condition

Generally, the population perceive themselves as healthy. However, looking at the stepwise regressions it appears that older people and poorer people see themselves as less healthy. Because this is an "old" population, this dimension is important in assessing the population.

C.2.4 Ownership Status

Approximately 63 percent of residents are owner-occupiers. From the stepwise regression we can see that those who have lived longer in their area, those who have higher socio-economic status (education, income, prestige), those who are younger (middle-ages), and those who live in quieter noise zones are more likely to be owner-occupiers. In other words, permanency, income, and a particular stage in the life cycle are determinants of ownership. It also appears that owners choose quieter areas to live. One interpretation of this is that those less able to buy a house (the poor, the old, the transients) are thrown into the noisier areas.

C.2.5 Evaluation of the Area

The majority of residents evaluate their area very favorably. Only 4 percent evaluate their area as poor, while 75 evaluate it as good. When we examined the characteristics of their area that they liked, locational issues proved to be the most important, followed by environmental issues. The top five characteristics mentioned were: (1) general location (52 percent), (2) shopping (31 percent), (3) good neighbors (29 percent), (4) closeness to work (23 percent), and (5) quietness (21 percent). The quietness of an area is important to people in evaluating it well. Areas in order of preference of rating were:

Rank	Area (Area Number)
1	West (I)
2	South (IX)
3	Northwest (II)
4	Central West (VII)
5	Southeast (X)
6	Northeast (VI)
7	Central Southwest (VIII)
8	North Central (III)
9	Central Northeast (V)
10	Central (IV)

C.2.6 Evaluation of Public Services

Generally, the residents rated all public services as good; some could use some improvement, however. The services in order of rating were:

1. Fire Protection
2. Hospitals and Health
3. Garbage Collection
4. Schools
5. Police Protection
6. Public Transportation

7. Sewage and Drainage

8. Recreation Facilities

9. Pollution Control

10. Street Maintenance

Thus, recreation, pollution control and street maintenance were not evaluated as well as other services (although still fairly good). Areas were ranked for each of the 10 evaluated services and then "ranking of rankings" was made for each area. Some areas consistently get better services than others. The order of rankings were:

Rank	Area
1	South (ranked first - three times; second - five times)
2	West (ranked first - three times; second - three times)
3	Central West
4	Central
5	Northwest
6	North Central
7	Central Southwest
8	Southeast (tie)
9	Northeast (ranked last - three times; next to last - once)
10	Central Northeast (ranked last - five times; next to last - twice).

Thus, the Northeast (area VI) and the Central Northeast (area V) generally get poorer services (i.e., the residents rate their services as the worst).

C.2.7 Major Problems

Residents rated problems in two ways, by (a) rating the severity of eight listed problems, and (b) by providing three areas they considered problems.

a. Eight Problem Areas. Listed in order of "severity":

	Problem	Mean (On a Scale of 1 to 5)	Percent Whose Impact Was Moderate or Greater
a.	Traffic Congestion	2.35	45.7
b.	Noise	1.81	26.5
c.	Unclean Air	1.80	26.8
d.	Run-Down Areas	1.74	24.4
e.	Crime	1.64	22.3
f.	Unemployment	1.62	19.9
g.	Inadequate Low-Income Housing	1.46	15.9
h	Polluted Water	1.23	7.1

Thus, traffic congestion is the dominant problem. Several other problems follow - noise, unclean air, run-down areas, and crime with approximately 25 percent of the population impacted. Then comes a moderate set of problems - unemployment and inadequate low-income housing. Finally, a few people feel water pollution is a problem. Noise is one of several urban problems, but traffic congestion (which affects noise) impacts almost half the adult population.

b. Open-ended list of problems. The 10 most frequently mentioned problems and the percent of the population who mentioned them are:

Rank	Problem	Percent of Population
1	Parking	28
2	Traffic	26
3	Noise	19
4	Crime	10
5	Youth Problems	9
6	Run-Down Areas	8
7	Street Maintenance	8
8	Air Pollution	6
9	Recreation, Lack of	6
10	Litter	5

Again, traffic and parking are the most important problems. However, noise is the third most frequently mentioned problem. The percentage mentioning this, without prompting - 19 percent - is consistent with our observation that approximately 25 percent of the population are impacted by noise. After noise comes a number of other urban problems - crime and delinquency and environmental concerns.

C.2.8 Characteristics of a Good or Bad Area

Finally, the respondent's evaluation of the area was regressed against other characteristics. The best stepwise model produced four characteristics of a well-evaluated area. They are: (1) they lack urban problems, (2) they are quiet, (3) public services are good, and (4) the residents are wealthier. Thus, noise levels are an important dimension in the residents' perceptions of their area.

C.3 Extent of Noise as a Problem

C.3.1 Characteristics of Noise Zones

The majority of people live in the residential zone, with a smaller proportion living in minor roadway zones. Very few people live in the other zones. The longer an individual has lived in his/her area, the more likely they are to live in the quieter, residential zones. Generally, the wealthier the residents are, the more likely they are to live in the residential zone. Further, owners are more likely to be in the quieter, residential zones and renters are more likely to be in minor roadway zones. Thus, it appears that people in their housing choice try to avoid noisy areas. This can be seen by the relationship between the noise zone and the evaluation of the area. People who live in residential areas evaluate their area more favorably than those who live in the minor roadways or other noise zones.

C.3.2 Quietness or Noisiness of the Area

Generally, most residents perceive their area as quiet or very quiet. A little over a quarter of the population (28 percent) perceive their area as noisy or very noisy. Thus, again, about 25 percent or so are impacted by noise. There is a positive relationship between the quietness of the area and the extent to which they evaluate it positively.

C.3.3 Noise as a Problem

The residents were asked to what extent they felt noise was a problem. Approximately 25 percent perceived it as a severe problem, again showing the extent of the impact. The areas of the city which have a greater noise impact as perceived by the residents were examined. The order of severity is:

Rank	Area (Area Number)	Mean (on a scale of 1 to 5)
1	Central Northeast (V)	2.3
2	Cental (IV)	2.0
3	Central Southwest (VIII)	2.0
4	Northeast (VI)	2.0
5	North Central (III)	1.9
6	Central West (VII)	1.7
7	Southeast (X)	1.6
8	West (I)	1.6
9	Northwest (II)	1.4
10	South (IX)	1.3

C.3.4 Annoyance to Noise

Approximately 8 percent of the residents were greatly or highly annoyed by noise, and approximately 25 percent were moderately annoyed or more. Thus, the extent of the impact is about the same as with the other indices.

C.3.5 Types of Noise Sources Which Are Annoying

The noise sources were assessed in two ways: (a) the respondents were given a list of six general types of noise sources and asked to rate them, and (b) they were then asked which three noise sources annoyed them the most.

a. The ratings of the six general noise sources were as follows:

Rank	Source	Mean (on a scale of 1 to 5)	Percent Greatly Annoyed
1	Traffic	2.8	12
2	People Noise	2.5	11
3	Local Services	2.2	6
4	Construction Equipment	2.1	6
5	Garden Equipment	1.6	2
6	Internal House Noise	1.6	1

b. The 10 most frequently mentioned general noise sources were:

Rank	Source	Percent of Population Which Mentioned Source
1	People Noise	67
2	Auto Noise	55
3	Airplane Noise	16
4	Motorcycles	12
5	Emergency Vehicles	10
6	Trucks	8
6	Service Vehicles (tie)	8
8	Crowds	5
8	Household Equipment (tie)	5
10	Other Traffic	4

As indicated by these two tables, traffic and people are the dominant noise sources that impact people. All other noise sources have a small impact compared to these. Small impacts are produced by airplane noise, emergency vehicles (sirens) and service vehicles (garbage trucks). Traffic, of course, is made up of several sources - autos, trucks, and motorcycles - as is people noise - dogs, kids screaming, adults making noise, etc. In conclusion, it appears that approximately 25 percent of the population are impacted by noise and the greatest impact comes from traffic and people. Traffic is perceived as both an irritating noise source as well as the most important urban problem.

C.4 Personal Impact of Noise

C.4.1 Perceived Health Impact of Noise

Residents were asked to what extent noise had affected their physical and emotional health. Forty-one percent said that it had impacted their health and an additional 9 percent said that it may have impacted their health. Thus, approximately half the population perceived that noise affects their health. This is twice the impact that was shown from the other indices. However, the question may have led respondents. When the symptoms that had been produced by noise were examined, very few respondents indicated that it affected them.

The symptoms that respondents felt noise affected at least occasionally were: headaches (17 percent), tiredness (14 percent), nervousness (24 percent), irritability (34 percent), hearing difficulties (6 percent), and worsening of existing health problems (11 percent). Thus, taking a more specific symptom analysis, we can see that 25 percent or less show symptoms at least occasionally; irritability has a slightly bigger impact. However, these are perceptions of impact, rather than actual measurements, and perceptions are affected to a great extent by other attitudes. When this variable was regressed against others, it showed that while it was true that residents' general health condition bore a negative relationship with the perceived impact of noise; other variables showed a stronger effect. These were the extent to which they perceived other urban problems, their perception of the noise level in their area, their socio-economic status, their evaluation of their area, their age and the internal noise levels in their house. Thus, caution is urged in interpreting this question.

C.4.2 Activity Interference

The impact of noise on activities was assessed by asking residents how annoyed they were by noise during each activity. The activities most impacted were:

Rank	Activity	Mean (1 to 5 scale)	Percent Greatly Annoyed
1	Resting and Relaxing	2.4	8
2	Sleeping	2.2	8
3	Reading and Studying	2.2	6
4	Conversing, Listening	2.1	5
5	Housework	2.1	2

Thus, we can see that noise has some activity impact, though it only seriously affects less than 10 percent of the population.

C.4.3 Preventive Actions

The preventive actions residents had taken against noise were assessed.

Rank	Action	Frequency (Percent)
1	Did Nothing	51
2	Close Doors or Windows	41
3	Use Radio or TV	19
4	Go to Another Room	10
5	Use Soundproofing	10
6	Go Away from House	9
7	Change Sleeping Quarters	5
8	Other Actions	5
9	Earplugs	2

Thus, approximately half the population have not needed to take any preventive actions to reduce noise levels, but approximately half have had to do so. The frequency of these actions is not known, however. The most common action is to close the doors or windows. All other actions were carried out by less than 20 percent of the population, those who were the most impacted. These actions were: masking the sound - 19 percent, and going to another room, using soundproofing or leaving the house - around 10 percent. Only a small minority have had to change their sleeping quarters or use earplugs to sleep. Thus, we can conclude that approximately half of the population are exposed to noise to some extent and have to take preventive actions, but that less than 20 percent are severely impacted.

C.4.4 Public Actions

The results show that even fewer have ever taken public actions to reduce noise. This is expected as most people rarely do anything publicly. Actions which have been taken are:

Rank	Action	Frequency (Percent)
1	Complaining to Neighbor	18
2	Contacting Official	10
3	Signing a Petition	3
4	Other Actions	2
5	Worked on a Committee	1
6	Took Legal Action	1

What is interesting is the relatively high percentage who have taken any public action, considering that most people are passive. Almost one-fifth have had to talk to their neighbor about reducing noise and 10 percent have actually talked to an official. Thus, Allentown appears unique in that citizens will actually take actions if a problem affects them. Since we have estimated that around one-quarter are significantly impacted by noise, then over half of these people have taken some kind of public action.

C.5 Extent of Support for Program

C.5.1 Can Anything Be Done About Noise?

The respondents were asked to list three noise sources that had an impact on them. They were then asked whether anything could be done about these noises. Their attitude toward this is a good index of feelings of passivity in the face of environmental invasion. The major sources of noise and the attitudes about control of those mentioning them were:

Rank	Source	Number of Items Mentioned	Percent Indicating that Control Is Possible
1	Motorcycles	44	68
2	Service Vehicles	30	57
3	People	248	50
4	Autos	205	42
5	Jets	57	23
6	Emergency Vehicles	36	14

Thus, residents feel that motorcycle noise and service vehicle noise can be controlled. They are less sure that people noise can be controlled, but are more passive with respect to auto noise, jet noise, and emergency vehicle noise.

C.5.2 Who Is Responsible for Noise?

Respondents indicated who they felt should be responsible for the mentioned noise sources. The noise sources and responsible parties are listed below.

Rank	Source	Percent Mentioning Party as Responsible			
		Operator	Manufacturer	Local Gov't	Federal Gov't
1	People Noise	33	2	52	2
2	Autos	51	18	71	10
3	Jets	18	35	25	42
4	Motorcycles	73	32	70	2
5	Emergency Vehicles	17	3	78	3
6	Service Vehicles	33	20	57	13

It must be remembered that this table and the previous one summarize the attitudes of those people who mentioned these sources, not of the population as a whole. Those people mentioning sources, however, identified autos, motorcycles, and, to a lesser extent, service vehicles and people noise. Jet noise is seen as a Federal Government responsibility. It is clear that the majority of those mentioning any source see the local government as the most important regulating body over all sources.

C.5.3 Support for a Noise Control Program

Respondents were asked how much they would be willing to support a noise control program. Three questions were asked: (a) whether they would support a program, (b) how much in extra taxes they would be willing to pay, and (c) which actions they would support.

a. Support for Program: Fifty-four percent indicated that they would support a program. This is approximately twice the number of persons who were impacted by noise.

b. Extra Taxes: Again, 54 percent indicated that they would be willing to pay something in extra taxes for a noise control program, but 46 percent would not. For those willing to pay, the most typical amount was $1 per capita (which is approximately four times the present amount). Thus, residents either do not want to pay anything or else they are willing to pay quite a bit to control noise.

c. Types of Actions in Noise Control Program: The types of actions and the frequency with which they are supported are:

Rank	Action	Percent Supporting Action
1	Zoning and Planning	85
2	Fines	81
2	Public Information (tie)	81
4	Quieter Noise Source	78
5	Building Codes	73
6	Barriers	60
7	Curfews	50

Two observations from these results are: (1) the majority favor all supporting actions, and (2) the actions which are less popular are barriers and curfews.

These results give somewhat contradictory information. Results show that the majority of respondents are in favor of most actions but only a little more than half are willing to pay for and support a noise control program. Fifty percent support is probably a more realistic index of much support the city will find in the public for a program.

C.5.4 Support for Noise Control by Area

The frequency with which respondents favor a noise control program are:

Rank	Area (Area Number)	Percent Favoring Program
1	Central West (VII)	77
2	Central Northeast (V)	63
2	North Central (III) (tie)	63
4	Central (IV)	62
5	South (IX)	55
6	Northeast (VI)	53
7	Central Southwest (VIII)	47
7	West (I) (tie)	47
9	Northwest (II)	39
10	Southeast (X)	37

The most supporting areas are the central areas and the northeast. To some extent, these are the areas having poorer public services, but they are also the areas with the greatest noise impact. When support for a noise control program is compared with severity of noise as a problem, it is clear that there is a definite relationship. Residents who are impacted are more likely to support a program. It is also clear, however, from the stepwise regression, that their attitudes toward a noise control program are part of a broader perception of urban problems. Thus, noise is seen as part of a whole range of urban problems and depending on their political orientation and attitudes about attempts to handle these problems, they will or will not support a noise control program.

C.6 The Impact of Noise as a System

Finally, the questionnaire has been analyzed with a system analysis, using stepwise regression. These results indicate that there are four dimensions which seem to exlain residents' attitudes toward noise:

- their social and residential characteristics - where they live,
- their evaluation of the environment and their area,
- their perception of noise, and
- their orientation toward public and political action to solve urban problems.

APPENDIX D

Technical Summary of Allentown Acoustical Survey

A summary table of results from the Allentown Acoustical Survey is presented in Table D-1. For each noise zone, the number of measurement sites are indicated, and the numerically averaged noise level values from these spatially distributed sites, i.e., day-night average sound level (L_{dn})* and statistical levels (L_1, L_{10}, L_{99}),* are presented. The total number of noise sources identified in each noise zone are also listed, with the contribution (in terms of frequency of occurrence) of each individual noise source.

*See Appendix A, Glossary of Terms, for definition of terms.

Table D-1

Results of Allentown, Pennsylvania, QCP Acoustical Survey

Summary Table

Noise Zone	Noise Zone Spatial Average Level, dB										Source Identifications, % of Total																	
	No. Sites	7-Day $\bar{L}_{dn}$	σ	$\bar{L}_1$	$\bar{L}_{10}$	$\bar{L}_{90}$	$\bar{L}_{99}$	$\bar{L}_{10}-\bar{L}_{eq}$	5-Day $\bar{L}_{dn}$	W/E $\bar{L}_{dn}$	Total No. I.D.	E	P	J	H	R	T	A	B	M	S	V	C	Y	F	h	D	L
Residential (R)*	31	62	8.2	67	61	45	44	2.4	64	55	1436	.1	18.1	2.2	0	2.3	13.0	53.6	.4	0	.1	1.0	.8	0	1.8	.8	5.0	0
Major Roadway Zone B (A)	11	62	7.2	69	63	45	43	3.6	64	58	424	0	2.6	0	0	0	28.5	65.8	1.4	0	.7	0	0	0	0	0	.9	0
Highway (H)	8	66	5.1	72	67	52	49	3.4	68	68	425	0	.5	0	0	0	52.9	45.9	.5	0	.0	0	0	.2	0	0	0	0
Commercial/ Industrial (C/I)	41	69	6.7	76	69	51	48	2.9	70	65	3037	.1	1.7	.2	0	14.9	17.8	59.2	1.0	.1	.1	.8	.6	0	2.8	.1	.5	.1
Minor Roadway (M)	20	72	3.6	80	76	53	49	4.0	73	69	1847	0	4.4	.1	.1	0	15.1	78.2	.7	.1	.6	.3	0	0	.1	.3	0	0
Major Roadway Zone A (HA)	11	76	7.4	84	78	54	51	3.7	76	77	404	.3	2.3	.8	0	0	26.0	66.4	3.0	.2	0	0	0	0	0	0	.2	0
Railroad	2	72																										
Airport	0	65**																										

* Letters in parentheses correspond to noise zone symbols in data reduction printout.

$\bar{L}_{dn}$, $\bar{L}_1$, $\bar{L}_{90}$, etc.: Numerical average of values from spatially distributed sites throughout the noise zone.
σ: Standard deviation of L_{dn} values from sites throughout the noise zone.
** Value based on available airport noise contours.

E: Emergency Vehicle
P: Small Plane
J: Jet
H: Helicopter
R: Railroad
T: Truck
A: Auto
B: Bus
M: Motorcycle
S: Service Vehicle
V: Off Road Vehicle
C: Construction Equipment
Y: Yard Maintenance Equip.
F: Factory Equipment
h: Household Equipment
D: Dog
L: Loudspeaker

APPENDIX E

Technical Summary of the Allentown Strategy Analysis

The results of applying methods developed in the Community Noise Strategy Guidelines Manual to the City of Allentown, Pennsylvania are summarized in this discussion. In conjunction with EPA and Allentown, problem noise sources were identified on the basis of acoustical, attitudinal, and complaint information, and a list of countermeasures was derived which were felt to be the most promising and practical means of abating these sources. The costs incurred by society and the noise reductions achieved with each of the selected countermeasures were estimated from data supplied by Allentown, using methods described in the Strategy Guidelines Manual.

The noise optimization program, NOIZOP, was then used to find optimal degrees of societal expenditure on each of the selected countermeasures for various overall spending limits. In particular, optimal expenditure strategies were found which would provide the maximum reduction in impacts from noise (1) in the year 1980, and (2) in the year 1988, for a nominal expected city noise control budget, as suggested by Allentown Quiet Communities Program Staff. These results are presented and discussed in this report.

E.1 Abatement Measures Considered (Input)

The countermeasures which were analyzed in the computer optimization program are listed below. Although some of the measures appear to be repetitious, they are directed toward different noise sources. This is a more practical approach in determining cost effectiveness, as one measure may not be equally effective for all noise sources.

The countermeasures analyzed in the optimization program are:

1. Property Standard Applied to Noise from Garden Equipment and People

   This property standard would set noise emission limits at the property line of between 75 and 80 dB for one hour due to noise from garden equipment or activity by people (i.e., playing loud music, etc.).

2. Noise Ordinance Applied to Motorcycles

   A noise ordinance was considered which would consist of four parts:

(1) Enforcing the federal new vehicle standard on motorcycles (83 dB in 1978, 80 dB in 1980, all regulation limits are given maximum low speed passby levels measured at 15 m)

(2) Enforcing the Pennsylvania Department of Transportation (Penn DOT) low speed operational regulations on motorcycles (84 dB)

(3) Enforcing operational controls (reducing excess accelerations)

(4) Enforcing an equipment standard (e.g., "all motorcycles shall have proper mufflers")

3. Noise Ordinance Applied to Autos

A noise ordinance applied to autos was considered which would consist of three parts:

(1) Enforcing the Penn DOT low speed operational regulations on autos (84 dB)

(2) Enforcing operational controls (reducing excess accelerations)

(3) Enforcing an equipment standard (e.g., "all autos shall have proper mufflers")

4. Noise Ordinance Applied to Trucks

A noise ordinance applied to trucks was considered which would consist of four parts:

(1) Enforcing the federal new vehicle standard on trucks (83 dB in 1978, 80 dB in 1980)

(2) Enforcing the Penn DOT low speed operational regulations on trucks (88 dB)

(3) Enforcing operational controls (reducing excess accelerations)

(4) Enforcing an equipment standard (e.g., "all trucks shall have proper mufflers")

5. Noise Ordinance Applied to Buses

A noise ordinance applied to buses was considered which would consist of four parts:

(1) Enforcing the proposed federal new vehicle standard on buses (83 dB in 1979, 80 dB in 1983, and 77 dB in 1985)

(2) Enforcing the Penn DOT low speed operational regulations on buses (88 dB)

(3) Enforcing operational controls (reducing excess idling near residences)

(4) Enforcing an equipment standard (e.g., "all buses shall have proper mufflers")

6. Operational Controls Applied to Emergency Vehicles

This countermeasure would reduce the amount of time sirens are used by restricting their use to emergency situations.

7. New Vehicle Standard Applied to Garbage Trucks

This noise standard would enforce federal noise regulations on newly manufactured garbage trucks (78 dB in 1979, 75 dB in 1982)

8. Mode Transfer from Autos to Buses

This countermeasure would use education and advertisement media to get more commuters to use buses instead of autos.

9-13. Education and Complaint Mechanism Applied to (9) Autos and Motorcycles, (10) Trucks and Buses, (11) Garbage Trucks and Emergency Vehicles, (12) Garden Equipment and People, and (13) Pets

These countermeasures have to do with informing the public about the causes and effects of community noise and establishing a mechanism such as a noise "hot line" which the public can use to complain about noisy sources such as motorcycles, private parties, or industrial plants. Although these measures act as an adjunct to other countermeasures which may have a more direct noise reducing effect, they do have cost factors in and of themselves.

14. Stationary Source Controls Applied to Fairgrounds

This countermeasure would reduce noise emissions from equipment and loud music typically found at fairs.

15. Stationary Source Controls Applied to Music Clubs

This countermeasure would reduce the undesirable source of music clubs propagating into nearby residential areas by requiring owners to provide sound insulation treatment of the exterior walls of their clubs.

16. Building Insulation and Codes

Twenty areas ("cells") throughout the city were selected as potential candidates for building insulation treatment. The noise optimization program was then allowed to pick the cells which needed insulation.

In addition to inputs which defined the above potential countermeasures, an annual noise control budget of $123,000 for the City government of Allentown was selected. This number is based on the man-year estimates provided by the City shown in Table E-1.

Table E-1

Manpower Distribution Estimated by Allentown for Various Noise Control Activities, Man-Years

Noise Control Activity	Government Entity Performing Activity			
	QCP	Police	Information Services	Community Planners
Stationary Source Control	1/2	-	-	-
Motor Vehicle Noise Enforcement	1	2	-	-
Education and Complaint Activities	1	-	1/2	1/2
Bus Ridership Campaign	1/2	-	-	-
Building Insulation Program	1	-	-	-
Total = 7 man-years				

The total costs defined for each countermeasure include all costs incurred by society. To find the costs incurred by Allentown's City government alone, a "City Fraction" was estimated for each countermeasure. The city fraction is the portion of the total cost to society that the local government is responsible for. These city fractions are shown in Table E-2. Note that some of the countermeasures are expected to be paid for almost entirely by Allentown (such as the Bus Noise Ordinance), while others only involve relatively minor government expense (such as a building insulation program).

E.2 Discussion of Results (Output)

The degree to which each countermeasure should be implemented for the most cost effective noise control program is indicated in terms of the percent of the maximum allowable expenditure for each measure that NOIZOP chooses to spend. A maximum allowable expenditure was defined for each countermeasure and supplied as input information, based on practical, technical and economic grounds.

The optimum total (T) and city government (U) expenditures selected by NOIZOP for each countermeasure at the city budget level are shown in Figures E-1 and E-2 for the years 1980 and 1988, respectively. Very little difference is observed between expenditures optimized in 1980 versus expenditures optimized in 1988, since most countermeasures are expected to take effect immediately (1978) and remain unchanged thereafter. Note that the costs shown in these figures are "total discounted dollars," with an assumed discount rate of 10 percent. These costs indicate the total amount of money which is needed for each countermeasure, from now until infinity. To find the equivalent annual cost, divide these costs by 11. For example, when the optimization is made in 1980 (Figure E-1), the optimal annual expenditure on Countermeasure No. 2 is 50,000 - 11 = $4550. A discussion of present value analysis and discounted costs is provided in the Strategy Guidelines Manual.

As a supplementary submittal, two additional NOIZOP runs are provided. Figure E-3 shows the optimum expenditure strategy in 1980 if no building insulation program is allowed. The same input data and budget are used here as were used in Figure E-1. Finally, Figure E-4 shows the expenditure pattern at a somewhat reduced budget (an annual city budget of $82,000 instead of $123,000).

Table E-2

Effectiveness of Countermeasures in the Allentown Strategy Analysis

No.	Countermeasure	Noise Source Affected	City Fraction[2]	Cost/Effectiveness (Percent of Maximum Allowable Expenditure)	
				1980	1988
1	Property Standard	Garden Equipment, People	0.995	0	0
2	Noise Ordinance[1]	Motorcycles	0.25	51	51
3	Noise Ordinance[1]	Autos	0.84	100	100
4	Noise Ordinance[1]	Trucks	0.11	100	49
5	Noise Ordinance[1]	Buses	1.00	0	100
6	Operational Control	Emergency Vehicles	1.00	100	100
7	New Vehicle Standard	Garbage Trucks	0.09	0	100
8	Mode Transfer	Autos, Buses	1.00	100	100
9	Education and Complaint Mechanism	Autos, Motorcycles	1.00	100	100
10	Education and Complaint Mechanism	Trucks, Buses	1.00	0	0
11	Education and Complaint Mechanism	Garbage Trucks, Emergency Vehicles	1.00	100	100
12	Education and Complaint Mechanism	Garden Equipment, People	1.00	85	86
13	Education and Complaint Mechanism	Pets	0.48	100	100
14	Stationary Source Controls	Fairgrounds	0.54	0	0
15	Stationary Source Controls	Music Clubs	0.37	0	0
16	Building Insulation and Codes	All Sources	0.04	5	5

[1] Includes: New Vehicle Standard (except for Autos), Operational Standard, Operational Controls, and Equipment Standard.

[2] Fraction of countermeasure costs incurred by the City of Allentown.

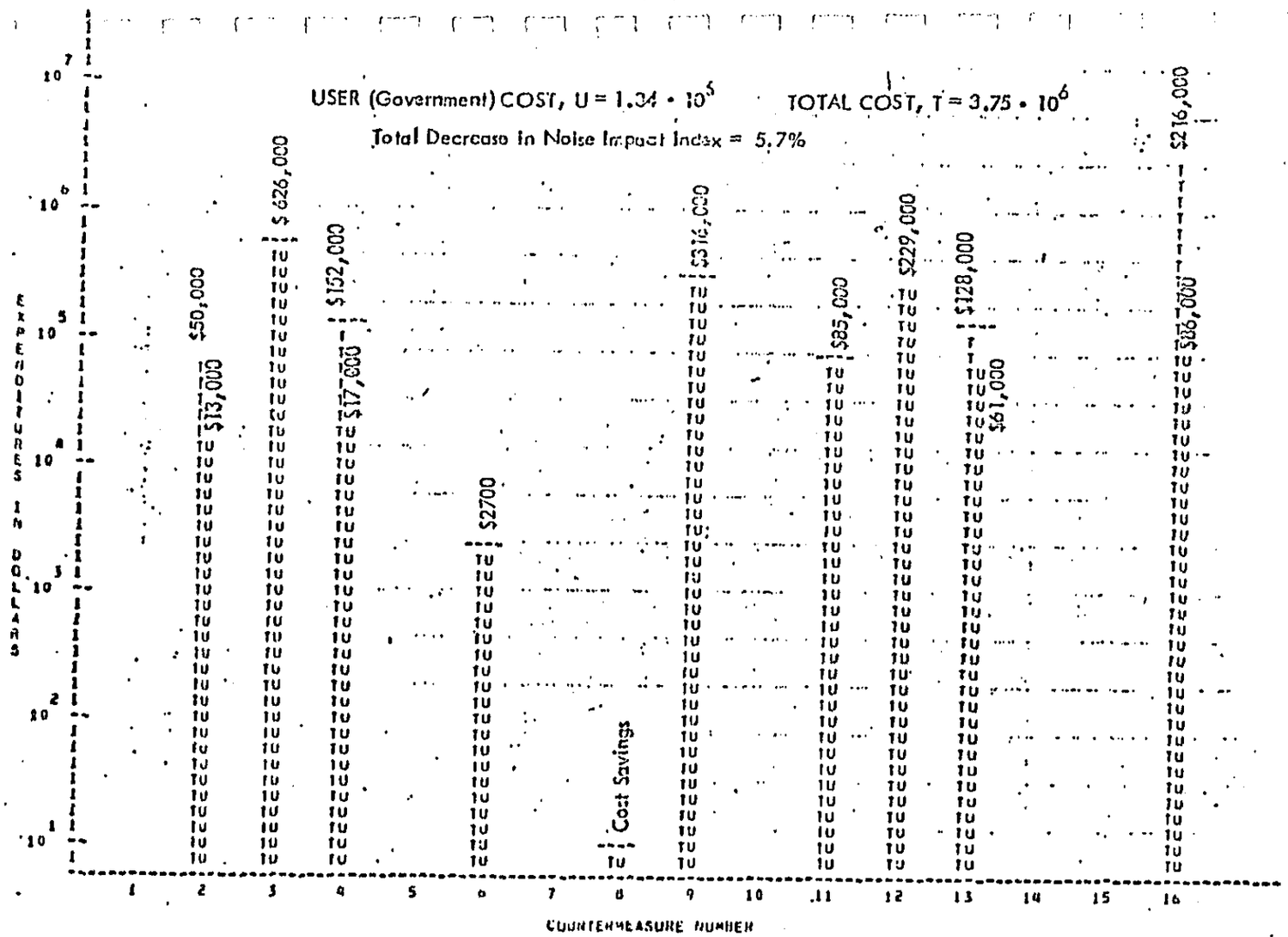


Figure E-1. Expenditures Optimized in 1980

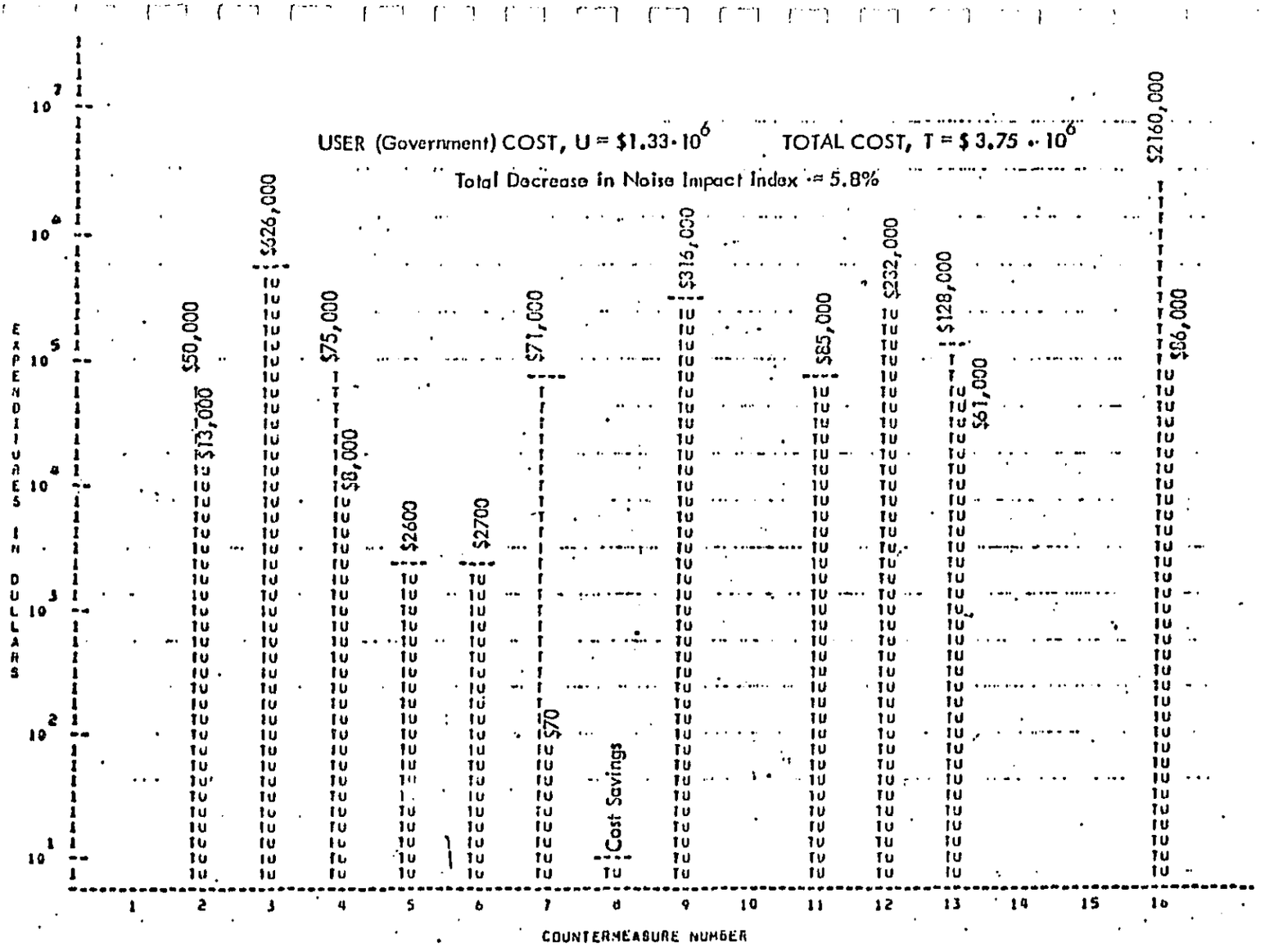


Figure E-2. Expenditures Optimized in 1980

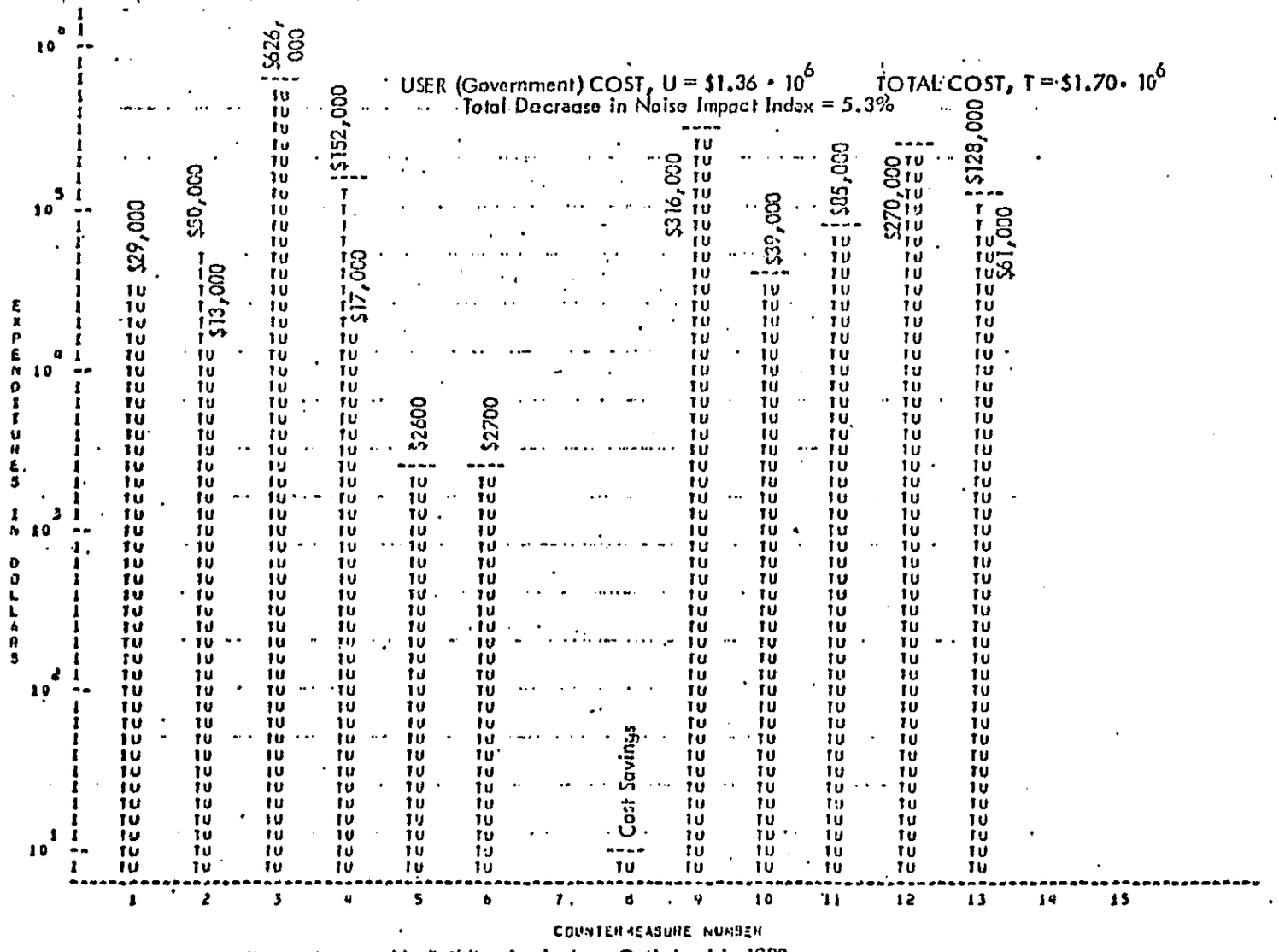


Figure E-3. No Building Insulation, Optimized in 1980

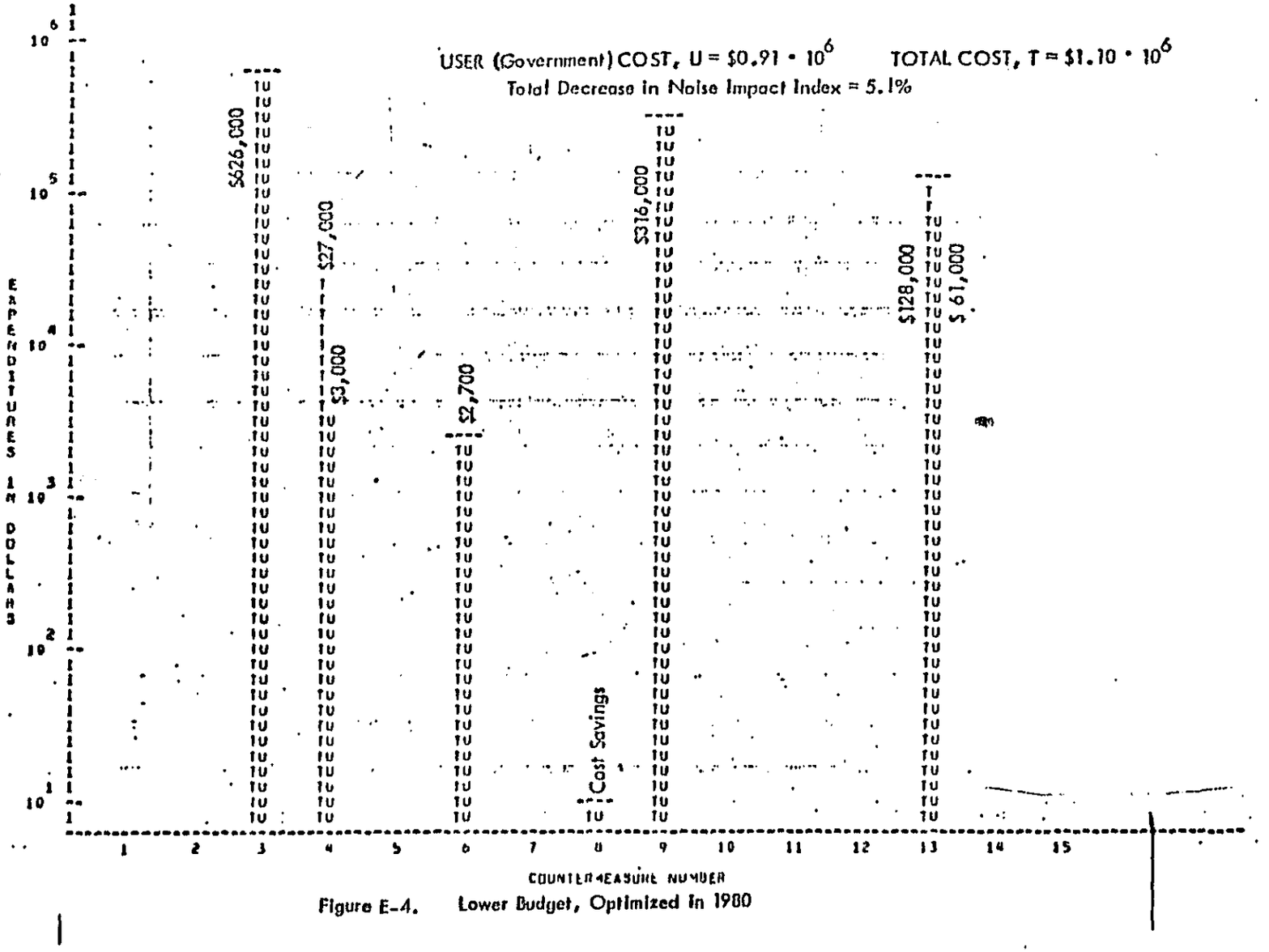


Figure E-4. Lower Budget, Optimized in 1980

This budget seems to be a more desirable one for the countermeasures under consideration, since much less reduction in noise impacts can be achieved per dollar above this point. These results, and the implications of the cost-effective percentages for each countermeasure implemented are discussed below.

Recommended Countermeasures

1. Property Standard Applied to Garden Equipment and People

   - NOIZOP did not choose to implement this countermeasure in either 1980 or 1988. This is probably due to the fact that noise levels from garden equipment and people were fairly low compared to other noise sources, due to their intermittent and transitory nature. If the building insulation countermeasure is eliminated from consideration, some money is spent on this measure (Figure E-3), but only a relatively small amount ($2640 per year).
   - Implication - A property line standard against garden equipment and people noise is not cost effective.

2. Noise Ordinance Applied to Motorcycles

   - This countermeasure is relatively cost-effective at low expenditure levels, but decreases in comparison with other measures as expenditures increase.
   - Implications - A motorcycle noise ordinance is warranted and will be effective even if relatively mild restrictions are enforced. This is because a small percent of the motorcycles produce noise levels which are much higher than the average motorcycle levels. As a result, even a simple equipment standard requiring "proper mufflers" should have immediate benefit, as long as it is adequately enforced.

3. Noise Ordinance Applied to Autos

   - The maximum allowable expenditure was reached, indicating that automobile noise reduction should be a primary target for the City of Allentown. The maximum expenditure corresponds to an operational regulation level of 74 dB, which is 10 dB lower (more strict) than the present Pennsylvania DOT noise regulation.

- Implications - Allentown may wish to establish standards for automobiles that are more strict than existing state standards. These standards should be directed first at autos which have modified, improper, or inadequate exhaust systems. A fairly strict equipment standard which specifies allowable exhaust modifications and minimum insertion loss values for replacement parts may be very effective in this regard. To abate the impacts of the general automobile population, alternate strategies must be used, some of which lie outside the municipal government's domain. These countermeasures might include traffic controls on minor residential streets, rerouting certain major boulevards to less populous areas, and barriers located in strategic positions.

4. Noise Ordinance Applied to Trucks

   - Maximum expenditure limits were reached in the 1980 run, but other countermeasures were found to be somewhat more cost effective in 1988.
   - Implications - A truck noise ordinance, paralleling Federal and State standards, is worthwhile at the present time, but may be deemphasized in the future.

5. Noise Ordinance Applied to Buses

   - While no expenditures were made for the 1980 case, the maximum expenditure limit was reached in 1988 since more new buses are expected to be operating in the fleet by that time. This ordinance will make sure these new buses meet the stricter Federal limits.
   - Implications - Allentown should consider enforcing Federal bus noise regulations as they become more strict in the future. (Note: Federal bus noise regulations are still in the proposal stage.)

6. Operational Controls Applied to Emergency Vehicles

   - This countermeasure received maximum allotment in both analysis years, corresponding to a reduction of 20 percent of the time sirens normally are operating.

- Implications - An emergency vehicle operational control should be implemented which would reduce unnecessary siren use as much as possible.

7. New Vehicle Standard Applied to Garbage Trucks

   - Similar to Countermeasure No. 5 above.
   - Implications - Same as No. 5 above.

8. Mode Transfer from Autos to Buses

   - It was found that the cost to society is less if commuters use buses rather than autos; therefore this countermeasure has a "negative cost."
   - Implications - Commuters should be urged to ride buses through educational campaigns and increased bus service. A doubling of the bus fleet still saves society money, according to this limited analysis.

9,11,13. Education and Complaint Mechanism Applied to (9) Autos and Motorcycles, (11) Garbage Trucks and Emergency Vehicles, and (13) Pets

   - The results for each of these countermeasures were the same, namely, the maximum allowable expenditure was reached.
   - Implications - Education and complaint programs should be geared to the above five sources of noise. Increased manpower assignments may be warranted in this area, compared with the nominal values suggested by Table E-1 above. As with Countermeasures Nos. 2 and 3 above, for automobiles and motorcycles, the most effective results can be achieved if attention is paid primarily to those vehicles which have modified or inadequate exhaust systems.

10. Education and Complaint Mechanism Applied to Trucks and Buses

   - No expenditures were made on this countermeasure. This is probably due to the fact that in Allentown, the major truck routes are well defined; therefore trucks and buses do not affect people as much near their homes, where people are more likely

to complain, as they do when people are in transit. Similarly, educational programs directed at bus and truck operators are expected to change their operational habits to a lesser degree, and therefore will reduce noise levels to a lesser degree, than programs directed to more alterable causes of noise such as accelerating or modified autos and motorcycles, unnecessary sirens, or barking dogs.

- o Implications - Little effort should be expended on this countermeasure other than to support, in a general way, existing State and Federal truck and bus noise regulations.

12. Education and Complaint Mechanism Applied to Garden Equipment and People

- o Changes resulting from this countermeasure typically cost less money than changes caused by Countermeasure No. 1, which deals with the same noise sources but may require equipment substitution to meet the regulation. In contrast, education and complaints act to achieve nearly the same ends without large expenditures.
- o Implications - To reduce noise from garden equipment and people in the most effective way (1) people should be educated as to the effect of their (and their equipment's) noise on others, and (2) a means of complaining about annoying neighborhood noises should be established. To assist officials in enforcing the reduction of these "annoying noises," as a practical matter, a property standard such as Countermeasure No. 1 may be needed, but the property standard should not be implemented in isolation.

14,15 Stationary Source Controls Applied to Fairgrounds and Music Clubs

- o No expenditures were made on these countermeasures due to their transitory and isolated nature. That is, in comparison with more continuous noise sources such as autos, their average sound levels (L_{eq}) were low. (Note, however, that noise levels for these two sources of noise were estimated without the aid of noise measurements from the acoustical survey.)
- o Implications - No substantial noise control activity seems warranted for these two noise sources.

16. Building Insulation and Building Codes

- Only a small portion (5 percent) of the total possible expenditure on this countermeasure was made, since only 5 of 20 possible cells received insulation and the cells which were picked have small floor areas. However, the effort required to insulate these cells amounts to almost 60 percent of the total cost to society at the budget level considered. At lower overall budget levels, such as the more desirable budget used to generate Figure E-4, no expenditure on building insulation is made by the computer program.
- Implications - A building insulation program should be initiated only if (1) the public is willing to help pay for improvements to their own homes (note that as shown in Table E-2, the city government is expected to incur only about 4 percent of the total cost of this countermeasure), and (2) a high degree of expenditure on noise control is desired and possible. If a building insulation program is desired, the noise optimizations for 1980 and 1988 indicate that the following areas deserve initial attention:
  1. Residences near Hanover Street (cells B1 and B3)
  2. Residences along garbage truck routes - Bayard Street and Roth Avenue (cells R5 and R7)

Reduction of Noise Impacts Due to Expenditures

The Noise Impact Index (NII) is a measure of the impact of noise on a community. A threshold of impact (NII = 0) is defined for each land use type for both day and night noise levels, and a 100 percent impact (NII = 1.0) is defined to be 20 dB above these threshold values.

The relationship between cost expenditure and percent reduction of the noise impact index for the 1980 Allentown analysis indicates that after a certain point the cost of additional benefits is much higher than before. This point corresponds to a total discounted cost to society of about 1.1 million dollars,

equivalent to an expenditure of about $100,000 annually. The associated discounted cost to the City of Allentown (from now to infinity) would be about 0.9 million dollars, or about $82,000 annually. This represents about a one-third reduction of the present anticipated Allentown annual budget, indicating that in the future, a somewhat reduced budget for noise control could be acceptable from the cost effectiveness standpoint.