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NOISE RESEARCH AND CONTROL ACTIVITIES IN THE FEDERAL GOVERNMENT: A REVIEW AND ASSESSMENT

October 26, 1973

U.S. ENVIRONMENTAL PROTECTION AGENCY
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NOISE RESEARCH AND CONTROL ACTIVITIES IN THE FEDERAL GOVERNMENT: A REVIEW AND ASSESSMENT

October 26, 1973

Prepared For:

U.S. Environmental Protection Agency
Office of Noise Abatement and Control

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PREFACE

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General Electric wishes to acknowledge the assistance and guidance provided by Mr. Charles Smith and Mr. Eugene Burcher, both of the EPA Office of Noise Abatement and Control.

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SECTION 1

INTRODUCTION

This report covers a study performed by the General Electric Company for the Office of Noise Abatement and Control (ONAC) of the Environmental Protection Agency. The purpose of the study was to describe and analyze the various activities of the Federal Government involving noise research and noise abatement and control. In addition, the study addressed the information and information-handling requirements of ONAC associated with its mission to coordinate all Federal noise activities.

The Noise Control Act of 1972 (PL 92-574) requires EPA to coordinate the noise programs of all Federal agencies and to periodically publish a report describing and assessing the Federal Government's progress in its efforts to control noise. This report by General Electric is--except for the section containing recommendations to EPA--intended to serve as the first of the periodic reports required by the Noise Control Act.

The basic information utilized for the study was submitted to EPA by the various agencies in a format following guidelines provided by EPA. The only additional information collected in the course of the study was that which was required for clarification of the basic information which had been submitted to EPA.

Period Covered by the Report

The report includes information pertaining to Federal noise activities in recent years and also some information regarding planned activities. However, the most definitive and complete information available covers FY 73 and, therefore, the report should be regarded as an FY 73 report.

Major Characteristics of the Report

There are several items which deserve mention in order to ensure that the report is interpreted as intended--in effect, to clarify what it does and what it does not say, and its limitations.

First, the report covers the status of noise programs in FY 73. In general, it does not provide a view of the future other than what might be inferred from the present state-of-affairs. The reason for this shortcoming is a general lack of program planning information for noise activities.

Second, the report provides a two-dimensional view of noise activities. It describes and summarizes the activities on an agency basis. It also describes and summarizes activities grouped according to the type of noise pollution problem involved, cutting across agency lines. Thus, for example, the report describes the various noise-related activities within DOT and, on the other hand, the report describes all the work related to aircraft noise in DOT and elsewhere.

Third, an exact cost accounting of expenditures for noise activities has not been done. Many activities involve noise considerations only peripherally and not as a program type of task. That is, noise-related elements of such programs are generally not separately budgeted tasks. This appears to be the case in a significant amount of aircraft-related research conducted by NASA, and also with other kinds of transportation systems work. Another element of uncertainty arises from the fact that the data was submitted to EPA in mid-FY 73 and, therefore, FY 73 funding reported was planned funding, not actual. The lack of precise accounting does not invalidate the findings of this report, since they deal with the Government's overall efforts to control noise.

Organization of the Material

Section 2 is a summary of the entire report. Section 3, 4, and 5 deal with research and technology pertaining to aircraft noise, surface transportation noise, and non-transportation noise. These pollution problems are being worked on by more than one agency and the material is presented accordingly. Section 6 deals with noise abatement activities. These tend to be ad hoc types of projects to reduce the noise emmissions from specific sources located at Federal installations. Section 6 is presented on an agency-by-agency basis. Section 7 summarizes EPA's activities and examines its role as coordinator of Federal noise programs. Section 8 contains recommendations to EPA regarding their information requirements stemming from their mission to coordinate Federal noise programs.

Appendix A reports the results of an opinion survey conducted for the purpose of judging a desirable distribution of resources among the various aspects of the general noise pollution problem. Appendix B provides basic reference information pertaining to the noise activities of each Federal agency. It includes data on organization, personnel, program objectives, and budgets.

SECTION 2
SUMMARY

The overall picture of the Federal Government's efforts in noise related work is summarized in the following three tables. The first (Table 2-1) summarizes FY73 expenditures* rank-ordered by agency. A total of $74.4 million have been identified,** based on data submitted to EPA from other agencies. NASA, DOT, and DOD account for 93% of the total, with NASA alone accounting for over 60%.

Table 2-2 provides a different view of the total effort, in terms of major categories of activity. Research and technology accounts for 86% of the total, while the remainder is distributed between noise abatement programs and the administrative activities of EPA. The table shows that aircraft research and technology dominates the picture, accounting for 91% of all research and technology and more than 78% of the total $74.4 million. Aircraft related work also accounts for about 87% of the total if one adds to the amount for aircraft research and technology the $5.9 million of aircraft related noise abatement programs, shown as part of the $7.9 million for "Noise Abatement Programs."

The perspectives provided by the first two tables are combined in Table 2-3 in order to show how the major categories of work are distributed among the agencies.

The remainder of this section is structured to provide for the discussion of several general points, and is followed by a summary of each of the major areas of activity.

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*Estimated FY73 expenditures submitted to EPA in mid fiscal 73.

**The costs of hearing conservation programs are not included. They were generally not separable from the costs of total health services programs.

TABLE 2-1

SUMMARY OF FY73 EXPENDITURES BY FEDERAL AGENCY

AGENCY	FY73 FUNDING (Dollars in Thousands)	PERCENT OF TOTAL (rounded)
NASA	44,929	60.4
DOT	16,778	22.6
DOD	7,505	10.1
EPA	2,300	3.1
DOL	700	.9
DOC/NBS	607**	.8
HEW	510	.7
NSF	271	.4
HUD	259	.3
DOI	180	.2
USDA	164	.2
Postal Service	183	.2
TVA	4	0
TOTAL	74,390*	99.9

*Does not include cost of hearing conservation programs.
**Does not include $478 thousand in funds transferred from other agencies; such amount is included in the amounts shown from other agencies.

TABLE 2-2

SUMMARY OF FY73 EXPENDITURES BY CATEGORY OF ACTIVITY

CATEGORY OF ACTIVITY	FY73 FUNDING ($ Thousands)	PERCENT OF TOTAL
Research and Technology		
o Noise Associated with Aircraft	58,454	78.6
o Noise Associated with Surface Transportation	3,299	4.4
o Noise Other than Transportation	2,420	3.2
SUBTOTAL	(64,173)	(86.3)
Noise Abatement Programs	7,917	10.6
Administration (EPA)	2,300	3.1
TOTAL	74,390*	99.9

*Does not include cost of hearing conservation programs.

TABLE 2-3

SUMMARY OF FY73 EXPENDITURES BY FEDERAL AGENCY
AND CATEGORY OF ACTIVITY

(Dollars in Thousands)

CATEGORY OF ACTIVITY	FEDERAL AGENCY													
	NASA	DOT	DOD	NSF	DOC Bu Stds	HEW	DOI	USDA	HUD	EPA	TVA	Postal Service	DOL	Totals
Research and Technology														
• Noise Associated with Aircraft	44,390	13,021	1,043											58,454
• Noise Associated with Surface Transportation		2,852	360	87										3,299
• Noise Other than Transportation Related		460	164	184	607*	432	180	164	229					2,240
(Research and Technology Total)	(44,390)	(16,333)	(1,567)	(271)	(607)	(432)	(180)	(164)	(229)					(64,173)
Noise Abatement Programs	539	445	5,938			78			30		4	183	700	7,917**
Administration (EPA)										2,300				2,300
TOTALS	44,929	16,778	7,505	271	607*	510	180	164	259	2,300	4	183	700	74,390**

*Does not include $478 thousand in funds transferred from other agencies; such amount is included in the amounts shown from other agencies.

**Does not include cost of hearing conservation programs.

GENERAL COMMENTS

On The Total Distribution of Effort

Aircraft related activities would appear to be receiving a disproportional share of attention, in terms of the seriousness of aircraft noise relative to other aspects of noise pollution. This is indicated by the following facts:

- Work related to highway noise accounts for slightly more than 3% of the total budget. That is, expenditures for activities related to aircraft noise are about 30 times larger than expenditures for the reduction of noise from trucks, buses, and autos.
- About 0.6% of the total effort is directed to the study of the health effects of noise on man.
- About 0.6% of the total expenditures is directed to the quieting of noise from construction and industry.

A recent survey* lends support to the view that the actual effort is not in balance with the relative needs. The membership of several noise related professional societies was polled regarding their opinions on how the total budget for noise work ought to be allocated. They were asked to consider, in making their (subjective) responses (1) the relative seriousness of each of several aspects of the general noise pollution problem, and (2) the tractability of the problem. Some highlights of this survey, summarized in Table 2-4 are:

- Aircraft noise and highway noise were given equal weight by the respondents – both received an average of approximately 13% of the total budget.
- Industrial sources of noise would on the average receive 27.9% of the budget, contrasted with an actual 0.6%.

* Described in Appendix A.

TABLE 2-4

COMPARISON OF SURVEY RESULTS TO ACTUAL EXPENDITURES

	Percent of Budget Actual	Percent of Budget Survey Average
Transportation Sources of Noise		
• Aircraft	86.6	13.2
• Highway	3.4	12.8
• Rail Systems	0.9	6.6
• Recreational Vehicles	0.7	3.7
Total Transportation	(91.6)	(36.3)
Industrial Sources of Noise	0.6	27.9
Home Equipment Sources of Noise	0	14.8
Effects of Noise and Related Issues		
Effects on Man	0.6	10.5
Other*	7.2	10.4
Total Effects of Noise and Related	(7.8)	(20.9)

*Details provided in Appendix A.

- The study of the effects of noise on man would on the average , receive from the respondents 10.5% of the total budget, contrasted with an actual 0.6%.

EPA is presently sponsoring several studies to attempt to quantify the subjective ranking of "seriousness" of various noise sources involved in this survey. The results will hopefully shed further light on the question.

On the Need for Coordination

No attempt was made in the course of preparing this report to ascertain the degree of coordination actually being accomplished by the various agencies of the Government. However, an effort was made to identify areas of activity involving numerous projects of similar technical scope, thereby providing a basis for further inquiry regarding coordination. An examination of project information provided to EPA produced the following observations (refer to Section 3 for details):

- There were, in FY73, approximately fifty-five projects – sponsored by five components of NASA, three DOT components, and the USAF – which had related workscope, all having to do with the generation of noise from the exhaust flow of jet engines. These projects accounted for about $4 million.
- There were sixteen projects relating to the noise from lift fans, by-pass fans, and engine compressors, sponsored by two NASA components, two of DOT, and the USAF.
- Eleven projects relate to the noise of rotating blades, three in DOD, seven in NASA, and one in DOT.
- There are numerous activities in DOT, HEW, HUD, and USDA involving community noise survey work.

On the Lack of Visibility

In general, there is a lack of program planning information. Without such data EPA cannot establish a coherent view of the numerous activities involved and, therefore, cannot effectively coordinate such efforts. The current efforts of the Joint DOT/NASA Office of Noise Abatement* should alleviate the problem insofar as aircraft noise work is involved. There are, however, other important areas of activity where apparently no comprehensive planning for noise work is underway.

EPA will, in order to proceed with its coordination mandate, need to establish more effective communications with all Federal noise activities. Where necessary, EPA will need to work with appropriate personnel in other agencies in order to develop the needed information. It is recognized that in some cases it may not be reasonable to expect noise program plans to exist. This is the case in those areas of activity which have a primary focus other than noise reduction per se. For example, in the development of an advanced bus by DOT/UMTA there is no budgeted task for noise aspects of the program, even though specifications exist for noise levels associated with the new bus. EPA's progress in coordination has been limited so far due to the necessity of applying most of its resources to the development of standards and regulations and related matters as mandated by the Noise Control Act. See Section 7, "EPA Activities," for more information on EPA.

On Cost Accounting

An exact cost accounting for noise expenditures has not been done in this report. Moreover, in many areas of activity it may not be possible to do so. As indicated above, some programs are not structured to allow costs to be

*The Joint DOT/NASA Office of Noise Abatement has recently completed a draft of a long-range plan for aviation noise research, which was not available at the time this report was prepared.

accumulated for the noise aspects of the program. Contacts with other agency personnel during this study emphasized this limitation of the data. On the other hand, exact cost accounting probably is not essential for EPA to accomplish its mission of understanding and influencing the overall direction of noise research and control efforts by the Federal Government. However, it is important for EPA to understand more about the accuracy of the data which it is dependent upon, and this will therefore require more attention in the future.

On Hearing Conservation Programs

Data presently available to EPA is not adequate to draw any firm conclusions about the effectiveness of hearing conservation programs operated at Federal installations. In the future EPA will design a questionnaire specifically intended to elicit the appropriate information.* Additionally, on-site visits and coordination with DOL and HEW will augment the questionnaire data. Section 6, "Noise Abatement and Hearing Conservation Programs" provides additional information, including some tentative observations based on available data.

AIRCRAFT NOISE

Distribution of Effort

By far the most intensive area of involvement by the Federal government in research and technology was related to aircraft noise. In FY73, work in this area comprised $58.4 million, or over 90% of all the Federal effort as measured by levels of expenditure on all aspects of noise pollution. The distribution of these funds for aircraft related work has been estimated for different classes of aircraft since this is one of the most obvious perspectives by which aircraft noise problems are debated and by which funding decisions are made. In addition, the distribution has been estimated by organizational units so that those agencies responsible for attacking the problem can be identified with the funds that were expended.

*EPA's first questionnaire, utilized for this report, was primarily intended to obtain programmatic data on research and abatement activities, and was not well-suited for hearing conservation information. (See Figure B-1, Appendix B)

Figure 2-1 displays the distribution of funds for five classes of aircraft. It is seen that work related to noise from Conventional Take Off and Landing Aircraft (CTOL) accounted for $33.5 million, or 57% of the total for all agencies. The three other classes of aircraft account for $6.1 million, or about 10% of the total Federal effort. Supporting research and technology that cannot be reasonably assigned to one of the four current classes amounted to $18.9 million, or 32% of the total.

Three major Federal agencies were responsible for the FY73 work – NASA, DOT and DOD. The expenditures by NASA were 76% of the total funds of all three agencies combined. Table 2-5 shows the expenditures by each agency. Of the $44.4 million funded by NASA, the Lewis Research Center was responsible for $27.3 million. Within DOT, the FAA Aircraft and Noise Abatement Division was responsible for the major portion of effort, amounting to $10.5 million.

TABLE 2-5

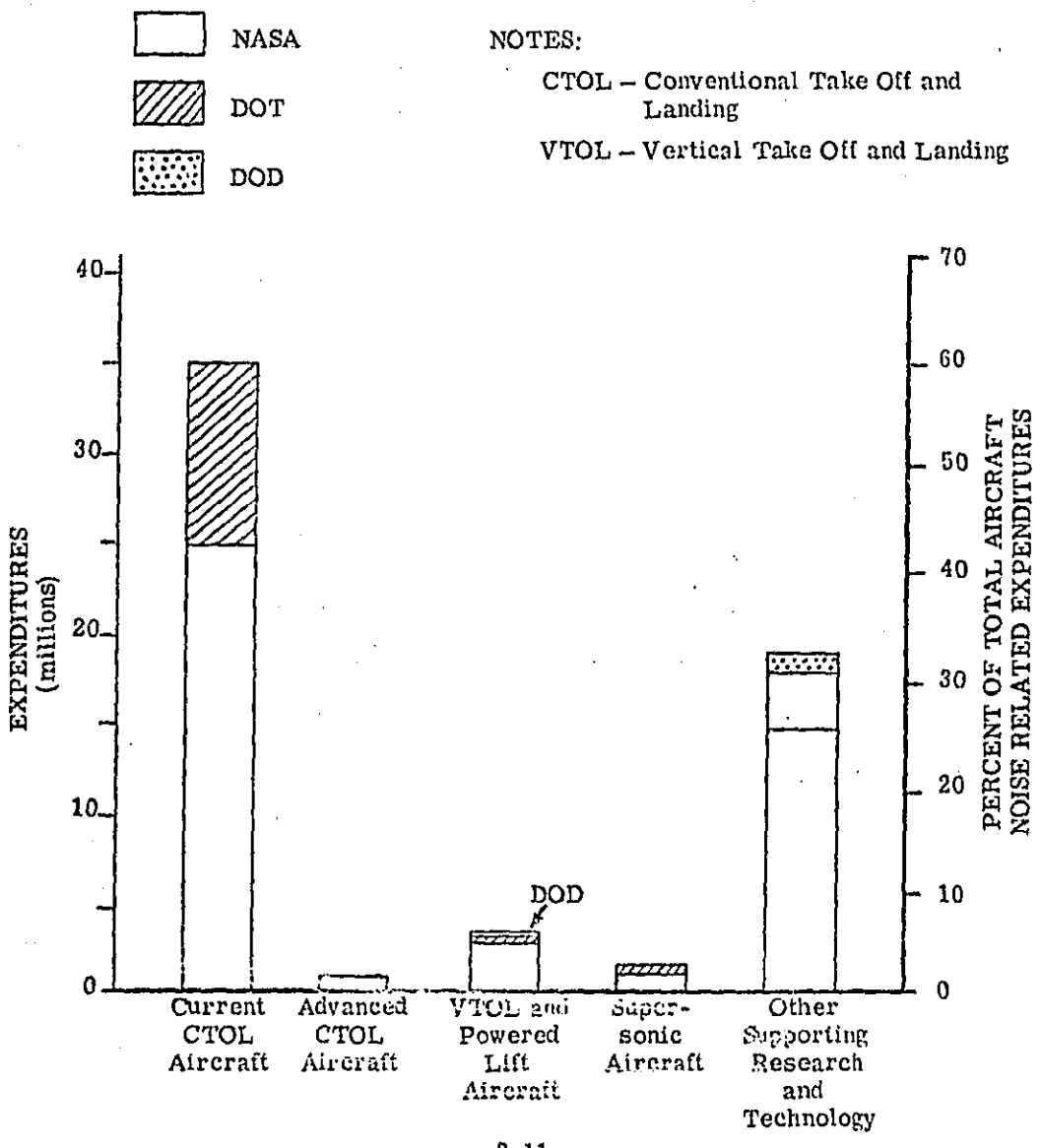
DISTRIBUTION OF FY73 FUNDS BY AGENCY
FOR AIRCRAFT NOISE RESEARCH AND TECHNOLOGY

AGENCY	FY73 FUNDING (in millions)	PERCENT OF ALL AIRCRAFT-RELATED EXPENDITURES (rounded)
NASA	$44.4	75.9%
DOT	$13.0	22.3%
DOD	$ 1.0	1.8%

The research and technology efforts of the various agencies were identified in a survey conducted by the EPA in mid-year of FY73. Individual project efforts of each agency were described in 256 individual project records which provided the primary basis for this report and, of these, 148 identified some

FIGURE 2-1

DISTRIBUTION OF FY73 FUNDS BY AIRCRAFT CLASS AND AGENCY FOR NOISE RESEARCH AND TECHNOLOGY



funding in FY73. NASA reported 96 funded projects concentrated at the Langley (46 projects), Lewis (26 projects) and Ames (20 projects) Research Centers. The DOT identified 37 funded projects in FY73, of which 19 were sponsored by the FAA Aircraft and Noise Abatement Division. The DOD sponsored 15 projects,mostly by the Air Force.

The range of expenditures for the 148 projects varied considerably from one or two thousand dollars to over twenty million. By far the largest funded effort in FY73 was the NASA Refan Program at $21 million. This work is aimed at engine-fan modifications to the JT3D and JT8D engines which provide propulsion for the DC-8, DC-9, 707, and 727 commercial aircraft. A complimentary effort on the Acoustic Nacelle Program was the second largest project, funded for $9.18 million by DOT. Together these two programs for retrofitting the earlier commercial jet aircraft account for 52% of all FY73 funding for aircraft noise research and technology.

Four other programs account for an additional 13% of all FY73 funding. These programs are: (1) the noise research work related to the development of an engine for powered lift, short haul aircraft with acceptable performance and economic characteristics, (2) development of acceptable flight operations procedures for use by commercial carriers amounted to $2.61 million. (The operations consist primarily of a two-segment landing approach for current CTOL aircraft. A steeper angle of approach prior to the final landing phase reduces the ground area exposed to sound levels of specified intensity.), (3) noise research related to the development of a supersonic aircraft engine, and (4) the Quite Engine Program aimed at providing suitable power plants for CTOL aircraft of advanced designs. The six major programs account for 65% of all FY73 funding and are described in Table 2-6.

TABLE 2-6

SIX LARGEST PROGRAMS ON AIRCRAFT RELATED
NOISE RESEARCH AND TECHNOLOGY IN FY73

PROGRAM NAME	AGENCY	FY73 FUNDING ($ in millions)	PERCENT OF ALL AIRCRAFT RELATED WORK (rounded)
Retrofit			
Refan Program	NASA	$21.0	35.9%
Acoustic Nacelle Program	DOT	$ 9.18	15.7%
Short Haul Aircraft Engine Development	NASA & DOT	$ 3.10	5.3%
Operational Procedures for Noise Reduction	NASA	$ 2.61	4.5%
Supersonic Aircraft Engine Development	NASA	$ 1.06	1.8%
Quiet Engine Program	NASA	$ 0.95	1.6%

Additional Findings

An analysis was made to further describe and characterize the technical work in those research efforts aimed at advancing the state-of-the-art in noise research, and to determine the possible need for coordination. Only those activities judged to be distinctly research in nature ("basic" research) were included in the analysis. The results were summarized and an analysis was made in terms of the basic elements of the noise problem: (1) noise source, (2) transmission path, and (3) receiver which is concerned with noise impacts. Research on the generation of jet noise was found to be the most intensive area of work and 55 projects were identified in this one category. These projects amounted to $3.5 million carried out by five organizational components in NASA, three in DOT and one in DOD for 28% of the total basic research effort. In the aggregate, research on all noise sources was 60% of this effort while research on noise transmission path and receiver were 27% and 13% respectively, in FY73.

Approximately $12.5 million was associated with basic research in the FY73 funding. This is about 21% of the total expenditures for aircraft noise research and technology. Table 2-7 displays the distribution of funds among the three major areas of investigation and the components within each.

In addition to the one area of jet noise generation where 55 projects had similar technical work scopes, other research areas also revealed a multiplicity of projects. Obviously there is a need for coordination in light of the number of individual projects and agencies involved. However, the information available was not adequate to determine whether effective coordination existed.

SURFACE TRANSPORTATION NOISE

The Department of Transportation accounts for nearly all of the work related to surface transportation, more than 86% of the $3.3 million total in FY73. DOD accounts for most of the remaining effort (11% of the total), and

TABLE 2-7

FUNDING IN FY73 FOR AIRCRAFT NOISE RESEARCH*

($ in Thousands)

	FUNDING IN FY73
NOISE SOURCES	$ 7,492
– Jet Noise Generation	3,471
– Lift Flow Noise	2,369
– Sonic Boom Generation	272
– Other	1,380
TRANSMISSION PATH	$ 3,306
– Two-Segment Approach	2,772
– Sonic Boom	320
– Sound Attenuation	214
RECEIVER	$ 1,649
– Basic Effects on Man, Wildlife and Structures	478
– Noise Exposure	1,171
TOTAL	$12,447

*Only those having a distinct research orientation are included.

NSF is involved lightly. Table 2-8 shows the summary of FY73 funding by agency. Viewing the effort from the standpoint of the kind of work involved, highway noise is the largest area of activity, accounting for 70% of the total FY73 funds. As seen from Table 2-9, truck noise work alone accounted for more than 50% of the total. The second largest activity was for highway design, 14.3% of the total. The table also identifies the agencies primarily associated with each category of work.

The work related to truck noise was sponsored by the DOT Office of the Secretary. It included projects concerning the reduction of tire noise, engine intake and exhaust quieting, accessories, fan noise, and demonstration of a new quiet truck. The rest of the DOT work is split primarily between highway design efforts ($472 thousand) and rail technology work ($505 thousand). There also are noise related aspects of a DOT/UMTA $23.9 million new bus program. However, the program is not structured in a manner that lends itself to separating out the funds associated with noise and, therefore, no estimate has been provided.

The DOD work is of course conducted for military purposes. It could, however, have applications to civil systems. In particular, the Army's efforts for the quieting of combat vehicles could have civilian application. The Navy's work covers the quieting of shipboard machinery and small boats and could similarly have nonmilitary benefits.

Additional details on surface transportation related activities are provided in Section 4, "Research and Technology: Noise Associated With Surface Transportation."

TABLE 2-8

SUMMARY BY AGENCY OF RESEARCH AND TECHNOLOGY
RELATED TO SURFACE TRANSPORTATION NOISE

AGENCY/COMPONENT		FY73 FUNDING ($ in Thousands)	PERCENT OF TOTAL
DOT		2,852	86.4
• Office of Secretary	1,875		(56.8)
• UMTA	505*		(15.3)
• Federal Highway Admin.	472		(14.3)
DOD		360	11.0
• Army	56		(1.7)
• Navy	304		(9.3)
NSF		87	2.6
	TOTAL	3,299	100.0

*Includes only rail technology funds. No estimate obtained for noise related portions of UMTA's advanced bus program.

TABLE 2-9

SUMMARY BY CATEGORY OF ACTIVITY OF RESEARCH AND TECHNOLOGY
RELATED TO SURFACE TRANSPORTATION NOISE

CATEGORY OF ACTIVITY	FY73 FUNDING ($ in Thousands)		PERCENT OF TOTAL
Highway Noise		2,309	70.0
• Trucks (DOT)	1,750		(53.1)
• Buses (DOT)	*		—
• Highway Design (DOT)	472		(14.3)
• All Other (NSF)	87		(2.6)
Rail Systems (UMTA)		505	15.3
Water Systems (Navy)		304	9.2
Other Related R&T (DOT and Army)		181	5.5
	TOTAL	3,299	100.0

*No estimate obtained for noise related portions of UMTA's advanced bus program.

RESEARCH AND TECHNOLOGY NOT RELATED TO TRANSPORTATION NOISE

In addition to the activities identified above specifically related to transportation noise there are a variety of other areas of activity. In FY73 there were about 40 projects in this category in 8 major agencies of the Government, totaling $2.3 million. Table 2-10 shows the distribution of this work among the various agencies. No single agency dominates this area. The largest, however, is the National Bureau of Standards, accounting for about 26% of the total. (The National Bureau of Standards was funded for nearly another $500 thousand for support to other agencies. These additional funds are reflected in the total expenditures reported by the various sponsoring agencies and are not separately identified here.)

The projects comprising this category span a broad range of noise problems and can be classified for purposes of presentation in various ways. One such classification is that utilized in Table 2-11, which groups the projects into the following categories: (1) industrial and construction sources, (2) information services, (3) methods and equipment for the measurement of noise, (4) surveys and receiver effects, and (5) propagation and attenuation.

The largest of these categories is that pertaining to noise surveys and receiver effects, accounting for almost 40% of the total. This is divided roughly evenly between (1) community survey work, sponsored by DOT and to a lesser extent HUD, and (2) receiver effects. Most of the receiver effects work is sponsored by HEW ($432 thousand, or about 19% of the total) and deals with the human effects – auditory and other physiologic systems – of noise. The Department of Agriculture conducts a rather small effort ($22 thousand) directed to the effects of noise on animals.

The second largest category is that dealing with noise measurement technology and is conducted almost exclusively by the National Bureau of Standards. In addition to the amount shown, funds transferred to NBS by other agencies augment this amount to bring the total slightly over $1 million.

TABLE 2-10

SUMMARY BY AGENCY OF RESEARCH AND TECHNOLOGY
NOT RELATED TO TRANSPORTATION NOISE

AGENCY	THOUSANDS ($)	TOTAL (%)
DOC/National Bureau of Standards	607	26.2
DOT	460	19.7
HEW	432	18.6
NSF	184	7.9
DOI	180	7.8
DOD	164	7.1
USDA	164	7.1
HUD	229	5.6
	TOTAL 2,420	100.0

TABLE 2-11

SUMMARY BY CATEGORY OF ACTIVITY OF RESEARCH AND TECHNOLOGY
NOT RELATED TO TRANSPORTATION NOISE

CATEGORY OF ACTIVITY		FY73 FUNDING ($ in Thousands)	PERCENT OF TOTAL
Industrial and Construction Noise		270	11.6
◦ Mining (DOI)	130		
◦ Highway Construction and Road Maintenance Equip. (DOT)	28		
◦ Agricultural Machinery (USDA)	45		
◦ Industrial Machinery Processes (NSF)	17		
Information Services (DOT, HUD)		46	2.0
Noise Measurement Technology (Various)		686	29.6
Noise Surveys and Receiver Effects (Various)		857	36.9
Propagation and Attenuation (Various)		461	19.9
TOTAL		2,320	100.0

The work on propagation and attenuation (about 20% of the total) is spread among DOT, Department of Agriculture, and the NSF and deals, respectively, with (1) sound absorbtion characteristics of various materials, (2) attenuation of sound by trees and vegetation, and (3) the transmission of sound in buildings.

Several projects pertain to various industrial and construction sources of noise, primarily within the mining industry, and account for only $270 thousand or 11.6% of the total.

The smallest category pertains to the development of information systems – data banks and data handling systems – for transportation noise, and accounts for $46 thousand or 2% of the total.

Additional details are provided in Section 5, "Other Research and Technology."

NOISE ABATEMENT ACTIVITIES

Noise abatement activities* accounted for $7.9 million** in FY73. Approximately 75% of this amount was spent by DOD for the acquisition of equipment and construction of facilities for the quieting of jet engine ground runup noise at military installations. The remaining funds were expended for a variety of projects including (1) $700 thousand by DOL for OSHA activities, (2) $539 thousand for construction of a sound absorbing structure around a wind tunnel at NASA Ames, (3) DOT Federal Highway Administration activities

* The term "abatement" is used here synonamously with "control," and refers to the reduction of noise emissions from specified sources, either for the purpose of reducing worker exposure or the community noise impact from Federal installations.

**These funds do not include the cost of hearing conservation activities, which were generally not separable from the cost of total health services programs.

($262 thousand), and (4) relocation of fog signal equipment and emission controls, by the Coast Guard ($183 thousand). Note that DOL/OSHA and DOT/FHWA activities have to do with administration of noise abatement activities, rather than the reduction of noise generated by their own operations.

Table 2-12 summarizes these activities. Additional details are provided in Section 6, "Noise Abatement and Hearing Conservation Programs."

TABLE 2-12

SUMMARY OF NOISE ABATEMENT PROGRAMS

AGENCY	FY73 FUNDING ($ in Thousands)	PERCENT OF TOTAL (rounded)
DOD	$5,938	75
DOL	700	9
NASA	539	7
DOT	445	6
Postal Service	183	2
HEW	78	1
HUD	30	–
TVA	4	–
TOTAL	$7,917	100

SECTION 3

RESEARCH AND TECHNOLOGY: NOISE ASSOCIATED WITH AIRCRAFT

Noise problems related to aircraft and aviation systems was the predominant area of investigation in terms of FY 73 funds compared to all other areas of noise research. In this section the agencies within the Federal Government responsible for aircraft-related noise research are identified and the nature of their work is described. This is followed by a discussion which summarizes the expenditure of funds among major classes of aircraft systems, and also the distribution of expenditures among the various Federal agencies. The concluding part of this section presents a more detailed analysis of selected activities in FY 73 which were distinctly oriented to research.

DESCRIPTION OF RESEARCH WORK IN THE FEDERAL AGENCIES

Aircraft related noise research activities were carried on by three major Federal agencies in FY73: NASA, DOT, and DOD. (In addition, the NSF was involved to a minor degree in the transfer of about $25 thousand of FY73 funds to NASA.) Within the three major agencies, specific research projects were the assigned responsibility of numerous component offices and laboratories.* In the following discussion, the organizational components are first identified. Each agency's overall research activities are then described without detailing work carried out in component laboratories or offices.

*Organizational responsibility does not connote whether the research is carried out inhouse or by contract, although this information is readily available from raw data acquired in EPA's survey.

National Aeronautics and Space Administration

Within NASA six components identified research activities in response to the EPA survey. These are:

- Ames Research Center
- Flight Research Center
- Langley Research Center
- Jet Propulsion Laboratory
- Lewis Research Center
- Marshall Space Flight Center

NASA's aviation noise research activities are aimed at understanding all aspects of the aircraft noise problem. The ultimate objective is to provide technology for the design of components and systems which generate the least possible noise and to develop operational techniques so that any noise generated is within acceptable limits of environmental impact. Research at NASA is divided into three broad categories which are (1) source and propagation noise, (2) receiver noise research, and (3) sonic boom research.

Source and Propagation Noise Research. This work is concerned with understanding the phenomena by which propulsion system and airframe noise is generated and propagated toward the receiver and with the development of technology and operational procedures for noise reduction. Propulsion system noise associated with subsonic aircraft systems includes analytical work, ground test, and flight test of several classes of engines. Fan, jet, and other system components (such as combustor and turbine) which generate noise are studied. Suppression of engine noise by means of acoustic linear materials and choked inlets is investigated and, in addition, the NASA Program investigated modifications to the JT3D and JT8D engines. These engines are in use on the narrow-body commercial aircraft (707, 727, 737, DC-8, and DC-9) introduced in the late 1950's. Objectives of this program are to demonstrate through use of retrofit kits, the predicted noise reduction while retaining engine reliability, maintainability, performance, and safety.

NASA also studied the total engine as a noise source wherein all components and their noise contributions are accounted for (e.g., if a higher by-pass ratio is used to reduce core noise, the turbines may be subjected to higher loadings thereby increasing turbine noise). The complex interactions among the various components must be analyzed in the engine design phase in order to determine trade-off between propulsion system performance, noise levels, and costs. NASA is also involved in the Quiet Engine Program which was initiated almost six years ago. The objectives of this program are to develop engine noise reduction technology, demonstrate by engine tests the results of such advancements, and assess the economic impacts associated with the noise reduction.

Airframe noise--generated in flight from sources other than the engine, auxiliary power units, and machine accessories--is another area of research in NASA. An extrapolation of results to date suggests that airframe noise may become the dominant source of noise during approach and landing phases for large aircraft if further significant reductions in engine noise can be obtained.

Operational procedures provide another avenue for noise reduction in both the landing-approach and takeoff-climbout phases of flight operation. NASA is cooperating with FAA and the airlines in developing and evaluating these procedures and the associated airborne and ground equipments. The operational procedures being evaluated include a two-segment landing approach, and curved and decelerating landing procedures, all of which result in a reduction of the area on the ground exposed to higher noise levels when compared with current practices. Research and development work covered a special purpose glide-slope computer, a two-segment avionics system using three-dimensional area navigation with vertical guidance, and a microwave landing system. The impacts of new operational procedures on the air traffic control system were

also being examined. Take-off and climbout noise reduction has also been studied; a main finding is that optimum conditions for noise alleviation depend on aircraft characteristics (particularly, type of engine) and operating characteristics, all of which will probably be different for each new aircraft.

Powered lift aircraft have been receiving increasing attention as a means for reducing congestion around major cities. These aircraft which accomplish short take-off and landing distances will probably be operational from existing airports as well as new short runway facilities within, or very close to, cities. The cost and complexities of the lift and propulsion systems will probably limit their use to short haul applications. NASA's research activities on powered lift aircraft were concentrated on three principal aircraft designs, i.e., the augmentor wing, the externally-blown flap with engines located under the wing, and the externally blown flap with engines over the wing. Each of these designs generates noise from the ducting and gas ejection systems associated with the powered lift as well as from the basic power plant installation. Because these aircraft will provide service out of heavily congested areas, the noise specifications imposed may be very severe; therefore, noise research and advanced technological developments are required.

The Quiet Clean Short-Haul Experimental Engine (QCSEE) is a major element in NASA's powered lift program. The major objective is to develop and demonstrate the technology and economic viability of a commercial powered lift short-haul aircraft. NASA's work includes system studies of the overall short-haul transport operations as well as analytical and hardware development/test work on the lift and propulsion components.

NASA investigated rotor noise associated with helicopters since this may be the dominant noise component with either turbine or reciprocating engine configurations. Work was aimed at the theoretical concept of fluctuating air loads over the defined range of operating conditions and the identification of practical means of rotor noise reduction such as the injection of gases at the rotor tip. For general aviation aircraft, NASA investigated methods for minimizing propeller and gear box noise in addition to gas turbine and internal combustion engine quieting. NASA studies indicate that propellers currently used on general aviation aircraft are not generally well matched to the engine and airframe. Thus, an optimized propeller may provide substantial noise improvement with a minimal effect on aircraft performance.

Supersonic aircraft noise is another area of NASA research. Work continued on advanced propulsion systems wherein variable cycle engines, core noise, noise suppression devices, and their effects on inflight performance were being determined. Sonic boom phenomena were researched from several aspects. Aircraft maneuvers and atmospheric conditions all are major factors and were under study to determine the boom intensity and path. Sonic boom overpressures as a function of aircraft altitude have been determined for a number of vehicles including a supersonic transport, fighter, bomber, and a hypersonic transport. Current and planned research is aimed at an improved understanding of nominal boom intensity and prediction of over-pressure enhancement (or focusing) due to accelerated flight and atmospheric inhomogeneities. Reducing boom intensity by configuration shaping is also under continuing study.

Receiver noise research (i.e. the characterization of noise impacts) in NASA was conducted to provide a data base that can be used to establish aircraft noise levels and operating practices acceptable to airport communities. The research utilized psychoacoustic laboratory studies and opinion surveys.

The work involved development of methods for describing human and community reactions to noise--including sonic boom--and also development of standardized methods for evaluating composite effects of aircraft noise considering type of aircraft, frequency, and duration of community exposure. This work will provide a foundation for establishing aircraft noise specifications, aircraft certification, land-use planning near airports, and airport traffic monitoring/control activities.

NASA is involved with other agencies in addition to carrying out its own research work. NASA and DOT have been concerned about the many factors affecting the growth of civil aviation. These two agencies conducted a study* over a two-year period, 1969-1970, which resulted in the DOT/NASA Joint Office of Noise Abatement (research activities sponsored by this Office are described later under DOT). The Joint Office is currently developing a five-year plan in Transportation Noise Research and Development.

Department of Transportation

Within this agency, five component offices identified research activities related to aircraft noise in response to the EPA survey. These components are:

- Office of the Secretary, Office of Noise Abatement
- FAA, Quiet Short-Haul Air Transportation Office
- FAA, Office of Environmental Quality
- FAA, SST Office
- FAA, Aircraft and Noise Abatement Division

Research was carried out in DOT on aircraft noise generation mechanisms to develop useful analytical tools and a unified theory of jet

*Civil Aeronautics Research and Development Policy Study (also known as the CARD Study).

noise to guide the development of new techniques for suppression. Studies of combustion noise and jet nozzle configurations were also in progress, as well as the development of engineering guidelines for noise abatement relevant to supersonic jets.

DOT develops airport noise reduction forecasts, recognizing costs associated with modifying aviation systems and land usage. Various options are evaluated considering noise source reduction, operational procedures, and land-use. VTOL and STOL aircraft systems are being researched to determine trade-offs in aircraft design and operations with operating costs and with the sound levels propagated into urban environment.

Feasibility of retrofitting 707, 727, DC-8, and DC-9 aircraft engines was investigated by DOT. The research was directed toward acoustical treatments, designed to meet specified noise reduction goals as well as airworthiness certification criteria. Research on ways to control core engine noise involved development of theoretical and experimental data that will assist in the design of future technology aircraft conforming to lower noise levels than are now required by FAR-36.*

DOT carries out work to determine the significant aircraft operational procedures and atmospheric parameters that influence noise exposure on the ground and to develop improved evaluation and prediction techniques. Factors required to control noise once it is propagated are being determined; this requires an understanding of the significant spectral, temporal, and spatial variables which influence human response to noise. Better measures for noise exposure work and guidelines for the control of undesirable effects on residential areas are under study for both conventional and V/STOL aircraft.

*Federal Aviation Regulation, Part 36, requires all new aircraft to meet specified noise regulations.

Sonic boom research in DOT seeks to establish a better understanding of fundamental factors in generation and propagation in order to design future supersonic vehicles and to minimize boom effects on the earth's surface. New concepts and theories for vehicle design and operation were studied with provision for utilizing wind tunnels, simulators or other laboratory equipment as well as flight demonstrations. Atmospheric factors that influence sonic boom were researched under varying conditions of temperature, density, turbulence, and humidity. DOT provided support to the Department of the Interior and FAA to determine sonic boom impacts on marine biota and wildlife. Other work was aimed at more accurate assessments of sonic boom on man and his environment including structures and wildlife. Effects of sonic boom rise-time and overpressure on sleep disturbance were studied to acquire the information necessary for the establishment of aircraft design and certification criteria.

Congressional action placed the responsibility and authority for control and abatement of aircraft noise and sonic boom upon the Administrator of the FAA. That authority is limited to control of the noise source--the airframe/engine and to noise transmission. However, DOT's work is also concerned with the environmental effects since the agency must identify research needs for supporting regulatory action, assess economic impact of regulatory action, and develop recommended regulatory action for the Administrator's consideration. In FY 73, testing of the two-segment approach under operational conditions, development of noise exposure forecasts, measurement and evaluation of aircraft noise, evaluation of economic impacts of sound reduction aircraft modifications, and the analysis of feasible approaches to the Fleet Noise Reduction Program were addressed.

DOT is providing government-industry leadership in the development of a quiet short-haul air transportation system. The Quiet Short-Haul Noise

Program is intended to ensure the development of aircraft and engines that are designed to FAR standards which are technically achievable and economically sound. Subsequent flight operations will be required to minimize noise in the vicinity of the airports. Research activities included VTOL and STOL noise prediction and reduction, analysis of community acceptance, and economic benefits of the short-haul service locations.

DOT has sponsored technology development for a supersonic transport engine. That work, funded from appropriations prior to FY 73 but still in progress, includes investigations of the acoustic technology required to meet expected noise regulations and standards. Basic data on jet and turbomachinery noise has been acquired that will be adaptable to a range of possible advanced aircraft/engine systems.

The Joint DOT/NASA Office of Noise Abatement is responsible for developing an integrated long-range DOT/NASA aircraft noise abatement research and development plan. The effort involves program managers from both agencies. Work on that plan was initiated in the spring of 1973, aimed at providing the technology for the design and development of quiet air transportation systems. The plan will include schedules and funding for accomplishing work related to the following subjects.

1. Community Assessments to achieve noise levels at or beyond airport boundaries which are compatible with ambient, or background levels for specified land uses.
2. Regulatory Planning and Support to provide the technology to FAA and EPA who are responsible for regulatory action.
3. Existing Conventional Take-Off and Landing (CTOL) aircraft to assure the technology necessary for all aircraft to comply with FAR 36. For near-future aircraft, in addition to those with

expected life of 10 years or more to provide technology necessary to comply with standards approximating FAR 36 minus 10-dB.

4. Advanced Subsonic CTOL Aircraft to provide noise reduction technology so that observed noise levels in the vicinity of airports are compatible with ambient noise levels for specified land uses.

5. Short-Haul Aircraft and Powered Lift (approximately the same goal as stated above for Advanced Subsonic CTOL Aircraft).

6. Advanced Supersonic Aircraft (approximately the same goal as stated above for Advanced Subsonic CTOL Aircraft).

7. General Aviation (similar to the goal stated for Advanced Subsonic CTOL Aircraft but with lower noise levels corresponding to smaller gross weights).

8. Basic Noise Research to provide basic information that will help in achieving lowest possible noise levels.

9. Aircraft System Noise Analysis to develop analytic techniques and carry out accurate analyses which relate costs and performance changes to noise exposure for various aircraft configurations.

At the present time the Joint DOT/NASA Office has prepared a long-range plan which is being reviewed by management in both of these agencies.

Department of Defense

Within this agency, the Air Force, Navy, and Army identified research activities related to aircraft noise in response to the EPA survey. The component organizations which are involved are:

- Air Force
  - Aero-Propulsion Laboratory
  - Flight Dynamics Laboratory
  - Office of Scientific Research
  - Aerospace Medical Research Laboratory
- Naval Air Systems Command
- Army
  - AMC Air Mobility R&D Laboratory
  - ECOM Night Vision Laboratory
  - AMC Materials and Mechanics Research Center
  - OCRD Research Office

Air Force sponsored research included the development of the technology base needed to reduce the propulsion system noise and assess the associated performance and weight penalties. This work covered noise reduction by means of engine design changes which affect generation and also by means of noise attenuation and suppression. Computerized processes are being developed to improve the capabilities to predict uninstalled and installed engine noise and to evaluate the trade-offs between engine noise and system performance. Combustion system instabilities (which can cause noise and flutter in skin structure, turbine, and compressor blades) require basic research on the mechanisms and processes by which the noise is generated and transmitted. In addition, theoretical and experimental research was carried on to determine interactions between fan noise and compressor blade airflows and to determine how high-intensity jet noise is propagated.

The Air Force work also covered materials research and methods for testing the structural integrity of aircraft configurations. Boron epoxy materials may provide high-strength, high-damping characteristics, at reduced weight for skin structures. Design requirements for a future acoustic test facility (involving high-intensity sound simulation) and testing techniques were under development. Other research on testing methods was sponsored so that better estimates of structural life and integrity can be made for environmental conditions of high-noise intensity and high temperature. Various quiet propulsion system designs (some involving novel ways for ejecting propulsion system gases) were studied to determine the noise reduction that may be possible, particularly for special purpose reconnaissance/surveillance aircraft. Turboprop, turbofan, and turbojet engines were included in these investigations of quiet systems. Research on nonpropulsion airframe noise was also addressed in order to reduce detectability of military aircraft. Other ongoing Air Force efforts concerned propeller noise generation mechanisms, new procedures for assessing community response to noise and land use compatability, and study of reentry vehicle noise/vibration/buffeting/fatigue phenomena.

The Navy's research activities included development of a portable noise suppressor, adaptable to existing portable turbojet engine test stands. In addition, jet exhaust control--including noise considerations for VTOL and STOL airfields in Marine Corps expeditionary operations--was under investigation by the Navy.

Army research work was directed toward helicopter noise. The range of aural detectability was analyzed to determine realistic criteria for five classes of helicopters in order to assure high survivability and tactical advantage. Lightweight structural materials with desirable acoustic properties were under development for use in future helicopter vehicles.

Noise research on the phenomenon of rotor-blade slap as well as broadbased noise studies associated with helicopters was also part of the Army's research activities.

DISTRIBUTION OF RESEARCH AND TECHNOLOGY EFFORTS

Aircraft noise projects identified by each Federal agency were analyzed and classified according to specific attributes which describe the project from several viewpoints. These are:

- Primary technical focus or orientation (e.g., noise source, transmission path, receiver effects)
- Relationship of activity to major programs (e.g., part of the Refan Program, the Quiet-Engine Program)
- Class of aircraft potentially affected by the research (e.g., CTOL aircraft, powered lift aircraft)
- Disciplines and technique utilized (e.g., physical sciences, social/behavioral sciences, flight test, anechoic chamber)
- Dates of initiation and completion of work
- Funding estimates

These characteristics were than expanded so that more detailed descriptions of research work could be made. For example, noise source as a primary technical orientation was expanded to identify research on engine nacelles, ducts, inlets, engine core, jet exhaust, propeller, airframe, etc. Similarly, CTOL as a class of aircraft, was expanded to distinguish between current and advanced aircraft systems that may be improved by the research work.

Each of the aircraft noise research projects* identified in response to the EPA survey was classified by the above listed attributes. This allows the development of many different aggregations or "cuts" of the research information, e.g., aggregating projects which may differ in primary technical or organizational sponsorship, but which relate to a common aircraft noise problem. It also allows classification and aggregation of research work in accordance with several other formulations used by key Federal agencies involved with aircraft noise.**

One primary classification structure was selected for aggregating research information. The structure was developed to be responsive to the way in which aircraft noise issues are debated and funding decisions are made. The classification relates research activities to four major classes of aircraft which are:

A. Current CTOL Aircraft
B. Advanced Subsonic CTOL Aircraft
C. VTOL and Powered Lift Aircraft
D. Supersonic Aircraft

In addition, a fifth category (E) was defined to encompass other supporting research and technology which cannot reasonably be identified with one of the four aircraft classes.

It should be noted that the aircraft classes do not differentiate between military and civil aviation. Research results obtained by DOD efforts on military systems should result in technological advancements which are transferred to all aircraft transportation systems if it is assumed that effective coordination is provided in the Federal government.

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* There were 236 projects identified; however, 88 of these showed no FY 73 funding estimates.

** See References 1 through 5.

Table 3-1 displays the distribution of FY 73 funds for noise research and technology by the three major Federal agencies. Of the estimated $58.4 million, 76% was funded by NASA, 22% by DOT, and 2% by DOD. The NASA Refan Program funded at $21 million accounts for 36% of all the FY 73 expenditures. This program together with DOT's Acoustic Nacelle Program ($9.2 million) accounts for 52% of all funds. These two major programs are complimentary efforts aimed at noise reduction of the JT3D and JT8D engines. The assignment of research and technology to specific classes of aircraft was based on the analysis of individual project descriptions acquired in the EPA survey.

Several qualifications are necessary in interpreting the information in Table 3-1. The estimates are primarily based on project level data provided in the EPA survey for which FY 73 funding was indicated. Some projects identified only prior year funding and/or anticipated expenditures in FY 74 and beyond (but not FY 73 funding); these have not been included in Table 3-1. It should also be noted that funding estimates for individual projects were made midway in FY 73 and therefore subject to modifications before year end.

An analysis of individual projects identified by NASA was able to account for approximately 75% (i.e. $32.6 million) of the $44.4 million estimated by NASA as the total agency-wide noise research and technology effort. (The individual projects were those having an exclusive or dominant orientation to aircraft noise.) The remaining 25% ($11.8 million) is associated with other aerodynamic projects in which some noise research was involved, but as an unidentifiable component of the research work; and support costs which were not always included with project estimates. The $11.8 million is included under the category of Other Supporting Research and Technology.

TABLE 3-1

DISTRIBUTION OF FY73 EXPENDITURES
BY AIRCRAFT CLASS AND AGENCY
FOR NOISE RESEARCH AND TECHNOLOGY

(Dollars in Thousands)

	NASA	DOT	DOD	Total	Percent of Total (rounded)
A. Current CTOL Aircraft	$24,275	$ 9,176	$ –	$33,451	57.2%
B. Advanced Subsonic CTOL Aircraft	945	–	–	945	1.6%
C. VTOL and Powered Lift Aircraft	3,156	209	56	3,421	5.9%
D. Supersonic Aircraft	1,460	281	–	1,741	3.0%
E. Other Supporting Research and Technology	14,554	3,355	987	18,896	32.3%
TOTAL	$44,390	$13,021	$1,043	$58,454	
PERCENT OF TOTAL	75.9%	22.3%	1.8%		100.0%

NOTE:

Funds shown are estimates submitted to EPA in mid FY73.

The following discussion covers each of the four aircraft classes and other supporting research and technology. Tables 3-2 through 3-5 summarize the FY 73 funding by each agency for each of the four classes of aircraft and the other supporting research and technology. The accompanying text elaborates on the tabular data and highlights the funding shown.

Current CTOL Aircraft (Table 3-2)

Research directed at noise reduction for this class of aircraft was estimated at $33.5 million or 57% of the total aircraft noise effort. Of this amount $24.3 million was NASA funding. Development of operational procedures--primarily consisting of flight tests and associated equipments for the two-segment landing approach--was the primary focus of nine of the projects (carried out by NASA at the Ames Research Center) involving $2.6 million in FY 73.

Noise reduction for the JT3D and JT8D engines involved four projects amounting to $30.2 million allocated to the Refan Program ($21.0 million) carried by NASA's Lewis Research Center, and to the Acoustic Nacelle Program ($9.18 million) carried out by the Aircraft and Noise Division of the FAA.

Three other projects were identified with Current CTOL Aircraft for power plant noise reduction on engines other than the JT3D and JT8D. That work was carried out by NASA at the Lewis Research Center.

Advanced Subsonic CTOL Aircraft*

Research on noise reduction was estimated at $945 thousand or about 2% of the total effort in FY 73. All of this work was carried out in two projects by NASA at the Lewis Research Center on the Quiet Engine Program.

*No table is presented for this one program.

TABLE 3-2

DISTRIBUTION OF FY73 FUNDS FOR
CURRENT CTOL AIRCRAFT NOISE RESEARCH AND TECHNOLOGY

(Dollars in Thousands)

Component Area of Research	NASA	DOT	Total	Percent of all Aircraft Noise Research
Development of Operational Procedures (e.g., two-segment landing approach)	$ 2,607	–	$ 2,607	4.5%
Aircraft Retrofit Programs	21,000	$9,176	30,176	51.6%
– Acoustic Nacelle Program	–	9,176	9,176	15.7%
– Refan Program	21,000	–	21,000	35.9%
Other Research and Technology	668	–	668	1.1%
TOTAL	$24,275	$9,176	$33,451	57.2%

NOTE:

Funds shown are estimates submitted to EPA in mid FY73.

VTOL and Powered Lift Aircraft (Table 3-3)

Research to reduce noise associated with this class of aircraft was $3.42 million or 6% of the total FY 73 effort of which $3.16 million was NASA funding. Noise research related to short-haul aircraft engine development totaled $3.10 million, comprised of twelve projects in NASA (totaling $2.90 million), and two projects in DOT. The NASA work was carried out by the Ames, Langley, and Lewis Research Centers, and the DOT effort by the Aircraft and Noise Abatement Division of FAA.

Related system studies for short-haul aviation systems totaled $69 thousand of which one project of $60 thousand was funded by the NASA, Langley Research Center, and one project of $9 thousand by DOT, Quiet Short-Haul Transportation System Office.

Other research related to VTOL and Powered Lift Aircraft totaled $252 thousand. Of this, $196 thousand was NASA work on noise sources (engines and airframe) at Langley and Lewis Research Centers on six different projects. DOD Air Force research was $31 thousand on one project. In addition, one other project in the Navy accounted for $25 thousand on noise transmission path.

Supersonic Aircraft (Table 3-4)

Research related to this class of aircraft noise was $1.74 million or about 3% of the total FY 73 funds. NASA was responsible for $1.46 million and the FAA's Aircraft and Noise Abatement Division for $281 thousand. Engine noise research was $1.06 million which was funded in three projects at NASA's Lewis and Ames research centers. (It should be noted that funding prior to FY 73 by the FAA Supersonic Transport Office amounted to approximately $17 million for engine developments of which about $6.3 million could reasonably be allocated to noise reduction technology.

TABLE 3-3

DISTRIBUTION OF FY73 FUNDING FOR
VTOL AND POWERED LIFT AIRCRAFT
NOISE RESEARCH AND TECHNOLOGY

(Dollars in Thousands)

Component Area of Research	NASA	DOT	DOD	Total	Percent of All Aircraft Noise Research (rounded)
Short Haul Aircraft Engine Development	$2,900	$200	–	$3,100	5.3%
Short Haul Transportation System Studies	60	9	–	69	0.1%
Other Related Research and Technology	196	–	$56	252	0.4%
TOTAL	$3,156	$209	$56	$3,421	5.9%

NOTE:

Funds shown are estimates submitted to EPA in mid FY73.

TABLE 3-4

DISTRIBUTION OF FY73 FUNDS FOR
SUPERSONIC AIRCRAFT NOISE RESEARCH AND TECHNOLOGY

(Dollars in Thousands)

Component Area of Research	NASA	DOT	Total	Percent of All Aircraft Noise Research (rounded)
Engine Development	$1,060	–	$1,060	1.8%
Sonic Boom	400	$272	672	1.1%
– Generation	334	–	334	0.6%
– Path	66	192	258	0.4%
– Receiver	–	80	80	0.1%
Other Research and Technology	–	9	9	*
TOTAL	$1,460	$281	$1,741	3.0%

NOTE:

Funds shown are estimates submitted to EPA in mid FY73.

*Less than 1/10 percent.

While no additional funding was provided in FY 73, contracted work was still in progress.)

Research on sonic boom noise generation, propagation, and receiver effects amounted to $672 thousand, of which twelve NASA projects at Ames and Langley research centers accounted for $400 thousand. Eight projects in DOT, Aircraft and Noise Abatement Division of FAA amounted to $272 thousand.

Other supersonic aircraft noise activities (i.e., not specifically related to engine noise or sonic boom) amounted to $9 thousand on three projects in DOT, Aircraft and Noise Abatement Division. This work concerned the analysis of meteorological data and noise attenuation of foliage and ground cover.

Other Supporting Research and Technology (Table 3-5)

Research in this category amounted to $18.9 million in FY 73 which is 32% of the total aircraft noise research.* The NASA portion was $14.8 million while DOT and DOD were responsible for $3.35 and $0.997 million respectively. Forty-seven projects in NASA were carried on in five different centers; twenty projects in DOT were the responsibility of three offices. In DOD, all three military services were involved with fourteen projects.

*EPA's activities in FY 73 addressed the development of noise standards, guidelines and regulations, including recommendations pertaining to the abatement and control of aircraft and airport noise as well as other noise sources. All of EPA's activities which expended $2.38 million in FY 73 are reported in Section 7.

TABLE 3-5

DISTRIBUTION OF FY73 FUNDS FOR
OTHER SUPPORTING RESEARCH AND TECHNOLOGY

(Dollars in Thousands)

Component Area of Research	NASA	DOT	DOD	Total	Percent of All Aircraft Noise Research (rounded)
Noise Sources	$2,500	$2,018	$720	$5,238	9.0%
Transmission Path	–	225	120	345	0.6%
Receiver Effects	246	1,007	27	1,280	2.2%
Non-Allocable Research and Technology	11,808	105	420	12,033	21.6%
TOTAL	$14,554	$3,355	$987	$18,896	32.3%

NOTE:

Funds shown are estimates submitted to EPA in mid FY73.

Noise Sources. Funding in FY 73 totaled $5.24 million. Forty-two NASA projects, funded in FY 73, were related to noise sources. NASA's work involved several centers as follows: Ames (4 projects), Flight Research Center (1 project), Lewis (12 projects), Jet Propulsion Lab (3 projects), and Langley (22 projects). The coverage of this NASA basic research is briefly summarized.

- Ames
  Investigation of air-speed effects on noise, measurement techniques including wind tunnel testing, study of various flow-fields and noise generated in turbulent flow, propagation around obstacles, and aircraft surfaces.
- Flight Research Center
  Flight and ground tests to determine noise generated by various aircraft and effects of shielding and atmospheric conditions.
- Lewis
  Turbulence measurement in jet impingement flow, aerodynamic noise, propagation of noise through nacelles, acoustics of hot by-pass flow, suppressors for quiet engines, simulation of duct burning, and acoustic phenomenon.
- Jet Propulsion Lab
  Investigation of frequency spectrum and instrumentation related to jet flows core engine noise.
- Langley
  Investigations of jet noise, shielding by gases and baffles, noise measurement techniques-equipments and instrumentation, nozzle designs, inlet and duct acoustics, noise cancellation by artificial sources, analytic models of engine noise, and acoustically treated surfaces.

Eight projects were identified in DOT, carried out in the Office of the Secretary, Office of Noise Abatement and the Aircraft and Noise Division of FAA, and covered the following topics:

- Office of the Secretary, Office of Noise Abatement
  Investigation of single jet to guide the development of a unified theory of jet noise and methods of suppression, techniques, and analytical tools for analysis of jet flow and shock phenomena, temperature-pressure effects on combustion noise.

- FAA, Aircraft and Noise Division
  Investigation of core engine noise generation, prediction, and suppression, acoustic and aerodynamic performance of nozzle designs for subsonic turbofan and turbojet aircraft.

Ten projects on noise sources in DOD were all carried out by the Air Force and addressed the following subjects:

- Air Force
  Development of computerized aids for noise/performance trade-off studies, technology base for small turbine engine noise reduction and suppression, theory of fan noise generation and transonic compressor blade flow, microjet and other novel propulsion techniques for quiet reconnaissance/surveillance aircraft, structural materials with improved sonic fatigue characteristics.

Transmission Path. Funding in FY 73 totaled $345 thousand. DOT reported two projects sponsored by the Office of Environmental Quality and one Navy project was identified. This work included:

- FAA, Office of Environmental Quality
  Testing of operational flight procedures including installation of ground equipments, computerized analysis of runway system to minimize noise.

- Navy
  Development of portable suppression equipment for jet engine stands.

Receiver Related. Funding in FY 73 was $1.28 million. NASA sponsored five projects at the Langley Research Center while DOT reported eight projects and DOD reported one project. These activities included:

- NASA, Langley
  Investigation of human response to noise including effects on sleep and on basic hearing mechanisms of the inner ear.
- DOT, Office of the Secretary, Office Noise Abatement
  Analysis of noise forecasts, courses of action and costs for reducing noise near airports, determination of noise floor for developing regulations based on aerodynamic noise.
- FAA, Aircraft and Noise Abatement Division
  Development of methods for monitoring noise at several locations and production of advisory services to other airport authorities.
- FAA, Office of Environmental Quality
  Evaluation of noise generated by general aviation aircraft and comparison of operational and data reduction methods for certification, development of computer system for mapping noise exposure, support to FAA for sound measurement and tests.
- DOD, Army
  Investigation of noise detection range of helicopters.
- DOD, Air Force
  Development of updated land use planning methods to reduce noise from military aircraft.

Nonallocable Research and Technology. The total agency-wide expenditures for NASA were estimated at $44.4 million. As discussed earlier, about 75% or $32.6 million can be accounted for in the project level data submitted to EPA. Therefore, $11.8 million were NASA funds for noise research and technology, unidentifiable with any particular class of aircraft or any of the other research topics identified in Table 3-5.

In addition to the $11.8 million, there were three specific projects classified as unallocable. One Air Force project (concerned with determining design requirements for an environmental-acoustic test facility primarily for sonic fatigue testing), and two DOT projects (Office of Environmental Quality). The DOT work produced a training film for pilots, airtraffic controllers, etc. to minimize noise of aircraft operations and compared operational methods for evaluating noise from general aviation aircraft with data reduction methods.

Summary by Agency. The aircraft-related noise research funded in FY 73 carried on by the three major agencies was made up of 148 projects amounting to $46.6 million. The organizational locations of these efforts are shown in Table 3-6. In addition, the table shows the aggregate amount of funds for each agency.

For purposes of comparison, Table 3-6 also shows the funds for the period preceding FY 73. It should be noted the data for the prior years are based solely on the information submitted at the mid-point of FY73. Not all project records submitted at that time identified funding for the years prior to FY 73. Furthermore, no estimate can be made of projects that had been funded prior to FY 73 and closed out at the time of the survey by EPA. Based on the project information where the earlier years funding was provided, the total that can be accounted for was $53.7 million, distributed among 147 projects. As shown in the table, three additional organizations (Marshall Space Flight Center, HUD and the DOT Supersonic Transport Office) identified

TABLE 3-6

SUMMARY OF AIRCRAFT NOISE RESEARCH AND TECHNOLOGY
BY FEDERAL AGENCY COMPONENTS

(Dollars in Thousands)

		FUNDING	
		PRIOR TO FY73	FY73
NASA	(96)	$34,704	$44,390
– Ames	(20)	3,468	3,563
– Flight Research Center	(1)	—	100
– Langley	(46)	2,961	1,389
– Jet Propulsion Lab	(3)	600	215
– Lewis	(26)	27,425	27,315
– Marshall	(0)	—	—
– Unallocable NASA Expenditures	(--)	*	11,808
DOT	(37)	$16,391	$13,021
– Office of Secretary, Office of Noise Abatement	(5)	515	1,801
– FAA, Aircraft and Noise Division	(19)	9,004	10,500
– FAA, Office of Environmental Quality	(8)	612	711
– FAA, Quiet Short Haul Air Transportation Office	(1)	—	9
– FAA, Supersonic Transport Office	(0)	6,260	—
DOD	(15)	$ 2,514	$ 1,043
– Air Force	(11)	2,320	836
– Navy	(2)	—	145
– Army	(3)	194	62
HUD	(0)	98	—
TOTAL, ALL AGENCIES	(148)	$53,707	$58,454

NOTE: Entries in parenthesis indicate number of projects with funding in FY73 as reported in EPA survey.
* Unallocable NASA expenditures in years prior to FY73 not identified in survey.

some efforts in the years prior to FY 73; however, these offices did not identify funded work for FY 73.

ANALYSIS OF SELECTED RESEARCH ACTIVITIES

The purpose of the analysis was (1) to describe and characterize the nature of the technical work in those research efforts aimed at advancing the state-of-the-art in noise research, and (2) to determine the possible need for coordination. This requires detailed examination of the technical work scopes at the project level. The analysis is presented in terms of basic elements of the noise problem, i.e., source, transmission path, and receiver. Only those activities which are distinctly research in nature have been included in this analysis. Those which have already reached the stage of engineering development, prototype fabrication, and associated testing have not been included.

The Source

For the aircraft-related projects, noise sources include (1) jet noise, (2) fan and compressor noise, (3) noise of rotating blades, (4) acoustically treated nacelles, ducts, and inlets, (5) lift-flow noise, and (6) sonic boom.

Jet Noise Generation. The overlapping nature of research conducted by various agencies and related to different programs is perhaps best illustrated by a close examination of the wide variety of projects which included within their scope research on the mechanism of jet noise generation. Table 3-7 lists a total of 55 projects in this one category of noise research. (In this analysis, all projects identified in the survey were included regardless of whether there are estimates of funds for FY 74 – this is in contrast to the preceding discussion which focused on projects funded in FY 73.) These projects were sponsored by five organizational components in NASA, three in DOT, and one in DOD. Thirty-six of these projects were of a basic research nature and apparently not related to any major designated program.

The columns in Table 3-7 identify fourteen technical descriptors which were formulated to provide a basis for comparing the work scopes of the 55 projects. Column 1 is a count of the number of projects identified with each organizational unit that were oriented to jet noise. Columns 2 and 3 identify two major elements of research related to the noise source. Columns 4 and 5 identify two major elements related to noise progagation. The remaining ten columns further characterize the work according to ten other technical aspects. Cells which are noted with "X" indicate that the column descriptor was judged to be relevant to the individual project identified with a specific organizational unit. For example, the table shows that there were four projects conducted at NASA Ames, the first of which had all of the characteristics indicated by columns 2, 3, 4, and 9.

Thirty projects in Table 3-7 appear to have a primary concern with the reduction of jet noise at the source. (This estimate is obtained by counting projects marked with "X" in column 2 or 3.) The reduction is accomplished by optimizing nozzle designs--considering the basic parameters of temperature gas density, etc. --and/or by the injection of secondary flow to modify shear in the jet stream. As identified in columns 4 and 5, eight of the projects (including one also identified in column 3) addressed basic questions such as localization of acoustic sources within the jet stream and how the far-field acoustic noise is related to near-field pressures and turbulance. From the information submitted in the EPA survey, it is difficult to make accurate estimates of expenditures on research for jet noise generation. All of the projects identified as relevant to engine noise research were scrutinized and those judged to be solely concerned or closely related to jet noise generation were estimated to account to $3.47 million in FY 73. The corresponding estimate for the years prior to FY 73 is $4.42 million. This latter estimate is probably very conservative; the available information typically goes back two-to-five years for those projects where

TABLE 3-7

PROJECTS RELATED TO JET NOISE GENERATION

			Major Source Elements		Major Propagation Elements		Other Technical Aspects									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	FEDERAL AGENCY	Project Count	Project Count	Basic Parameters, Nozzle Design, Temperature, Density	Aspects of Secondary Flow and/or Mixing – Shear Effects	Source Localization in Jet Stream	Near Field Versus Far Field	Supersonic Nozzle Flow	Correlations With Theory	Empirical Noise Prediction Procedures	Model Jets	Full Scale Engines	Special Instrumentation for Jet Noise Investigations	Effects of Nearby Surfaces	Effects of Core Flow, Combustion and Swirl on Jet Noise	Flight and/or Wind Tunnel Tests of Nozzle Configuration	Special Concepts
NASA	Ames Research Center	1	x	x		x					x						
		2	x		x			x				x				x	
		3		x	x							x					
		4			x			x				x			x		
	Jet Propulsion Laboratory	1	x					x					x				
		2											x				
		3													x		
		4													x		
	Langley Research Center	1					x		x								
		2				x	x		x								
		3							x		x						x
		4											x				
		5											x				
		6						x			x			x			
		7					x										
		8				x	x	x			x		x				
		9					x										
		10			x				x								
		11				x	x		x								
		12							x					x			
	Lewis Research Center	1	x	x					x					x			
		2	x	x					x								
		3	x	x													
		4	x	x				x	x								
		5	x	x													
		6	x								x		x				
		7	x	x							x	x					
		8		x										x	x		
		9	x													x	
		10		x					x								
		11	x						x								
		12							x		x		x				
		13	x									x					
		14	x									x					
	Marshall Space Flight Center	1				x			x		x		x				
DOT	FAA-Aircraft and Noise Abatement Division, Noise Abatement Branch	1	x						x								
		2													x		
	FAA-Office of SST	1	x	x				x			x						
		2	x	x				x			x	x				x	
		3	x					x			x	x				x	
		4	x					x	x		x						
	Office of the Secretary, Office of Noise Abatement	1									x		x				
		2	x					x									
		3	x					x			x						
		4						x	x		x						
		5													x		
DOD	U.S. Air Force	1	x					x	x				x				
		2	x					x	x								
		3								x							
		4	x							x							
		5	x														
		6								x							
		7								x							
		8								x							

funding prior to FY 73 was reported, while research of this general nature has been in progress for at least two decades. It should not be inferred that the indicated magnitude of expenditures was unnecessary or undesirable. Jet noise is a major component of aircraft noise. It also constitutes a complex physical problem with many unanswered questions regarding the basic phenomena involved. Progress, therefore, is expensive.

In this area of research with at least 55 projects having similar technical scope, there is an obvious need for coordination among the several agencies involved.* The information available is not adequate to determine whether effective coordination existed. Some coordination takes place at the agency level and most of these projects now fall within the scope of the Joint DOT/NASA Office. However, not only are many Federal agencies involved but also many research contractors. At the contractor level some coordination also takes place by means of publications and symposia; although, this tends to be a slow process, and competitive interests sometimes act to inhibit the communication of technical findings.

Fan and Compressor Noise. Noise research concerning lift fans, by-pass fans, and aircraft compressors constitutes another major technical scope of work. Sixteen projects were identified in this field. They were sponsored by two components of NASA, two of DOT, and the Air Force. Most of these are relatable to one of five efforts, i.e., (1) Quiet Engine Program, (2) the Quiet Clean Short-Haul Engine Program, (3) Supersonic Transport, (4) DOD aural detectability work, and (5) DOD power-plant work.

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*In addition to the 55 projects discussed above, at least three other Air Force projects dealt with jet noise generation. These involved the use of microjet power plants in the aircraft wing; also five projects at the Marshall Space Flight Center were concerned with the mechanisms of rocket noise generation. The degree of coordination among these eight and the other 55 projects is unknown.

It would be possible to form a tabulation similar to Table 3-7 for these sixteen projects. However, the data currently available from the survey is not adequate for this purpose. In general, these projects have some technical elements in common. Many involve blade design, blade loading, Inlet Guide Vanes (IGV)-rotostator interactions, transonic flow, duct geometry, etc. (Absorbent duct treatments are considered elsewhere.) With regard to funding, the available project data identify a total of only $375 thousand for FY 73. However, funding in prior years is estimated at $2.05 million, plus a part of the multi-million dollar contracts in DOT on the supersonic transport.

As in the case of the jet noise projects, the status of coordination at either the agency level or the contractor level is not clear and may be an appropriate subject to explore.

Noise of Rotating Blades. A third class of noise research was that concerned with rotating blades, typical of propeller aircraft and helicopters. (In spite of the difference in tip speed and blade design there are basic similarities in the mechanism of noise generation for propeller and helicopter rotors.) Eleven projects have been identified in this group. These included seven at NASA's Langley Research Center, one in DOT, and three in the Department of Defense.

Funds identified with these projects total $305 thousand for FY 73 and $254 thousand for previous years. However, $150 thousand of the FY 73 funding is for a DOT, V/STOL project which also covered other technical aspects. The technical coordination between these NASA DOT projects and the three DOD projects is not known.

Acoustically Treated Nacelles, Ducts, and Inlets. A fourth important class of noise research is concerned with the design of acoustic treatments,

used to reduce the radiation of fan noise. This is usually accomplished by treating inlet ducts or by forming part of the engine nacelle from materials with desirable acoustical properties. Such treatments may also be employed to reduce lift-flow noise for V/STOL aircraft. Studies relative to the effect of choked inlets and inlet flow often are part of such projects and therefore are included in this class of research.

The technical scope of these projects emphasizes these general aspects (1) basic design of acoustic treatments such as optimization of acoustic materials and their placement, (2) theoretical studies relative to acoustic propagation within ducts--including effects of flow and acoustic radiation from the ends of the ducts, and (3) full-scale engine and/or flight tests with appropriate economic analysis. Actually, more than 90% of the funds identified with acoustic treatment were related to the latter aspect.

In all, twenty-four projects were identified within this field, all but two being within NASA and DOT. Ten were sponsored by Lewis Research Center, nine by Langley Research Center, and three by DOT/FAA. The Air Force and Army each have one project of this type. The Army project may have possible commercial application since it has been investigating a special type of acoustic lining material. The three FAA projects are all related to the full scale testing mentioned above. Most of the theoretical work is being done by Langley, although Lewis also has several projects involving theoretical studies.

Altogether about $10 million was spent in FY 73 and $11 million in previous years for acoustical treatment research work. However, if only those projects where the major emphasis was on theory and materials are included, these estimates become about $700 thousand and $1.50 million respectively.

Lift Flow Noise. A total of eleven projects dealt with the noise attributable to blown flaps for STOL aircraft in connection with the short-haul aircraft and engine QCSEE program. All are with NASA; one at Ames Research Center, and five each at the Lewis and Langley research centers.

The FY 73 funding was $2.37 million of which $2.00 million was for one project at Lewis Research Center. Funding for previous years totaled $1.34 million, again mostly for a single project at Lewis.

Sonic Boom. The phenomenon of sonic boom is partially a source related problem (in that aircraft design can effect the generation) and partially a propagation problem. Eleven projects--nine at NASA Langley, one at NASA Ames, and one with DOT/FAA--were concerned with the source aspect of sonic boom research. Three of these Langley projects and the FAA project considered both sources and path aspects in some detail. The source related projects were concerned with how the boom is generated. Theoretical and experimental studies were in progress in this field. In addition to wing-body geometrical configurations, unusual approaches were considered, such as the concept of altering the flow-field of an aircraft by burning fuel in "thermal fins" to produce pressure signatures with a finite rise time. Increasing rise time can minimize both damage and annoyance of sonic booms.

Lacking further detail, it was assumed that half of the expenditures on the three projects concerned with both source and path were devoted towards the source aspect. Funding for FY 73 was about $272 thousand compared to $573 thousand in previous years. The total source related funding was $10.1 million in FY 73 and $8.05 million for previous years.

Sound Transmission Path

As noted above, many sonic boom projects include propagation path in their scope-of-work. (There are other projects concerned with the path such as the two-segment approach.)

Sonic Boom. Including the three projects previously mentioned, there were fourteen projects related to sonic boom transmission path. Five of these were at NASA Langley, one at NASA Ames, one at NASA Marshall Space Flight Center, and seven with DOT/FAA. Most of this work was concerned with the propagation of the sonic boom shock wave through the atmosphere and included considerations of aircraft operation and atmospheric properties. However, four of the DOT projects and the one NASA Ames project were primarily concerned with the development of sound recorders and related instrumentation.

Again, if only half of the funding for the three projects concerned with both source and path aspects is included, the FY 73 estimated funding for propagation path research was $320 thousand. Funding for prior years totaled $220 thousand.

Two-Segment Approach. The use of a two-segment glide slope for landing approach is currently receiving much attention. Such a procedure will minimize noise received on the ground by reducing the size of the NEF contours. Twelve projects were in this class, ten of them at NASA Ames and the other two within different branches of DOT/FAA. These projects included (1) the design and development of guidance equipment to allow the pilot to safely fly the desired approach, (2) the evaluation of these equipments by means of flight tests, and (3) application studies relative to specific fleets of aircraft and airline operations. In FY 73, $2.77 million was funded for such efforts, compared with $222 thousand in previous years.

Sound Attenuation. Other research projects related to sound transmission were concerned with some form of sound attenuation. In all, there were eleven such projects; six were within two branches of DOT/FAA, three within the Air Force, and two within the Navy.

Eight of these projects--all of the DOT projects and two Air Force projects--were concerned with obtaining a better understanding of natural attenuation such as attenuation by the atmosphere and by means of ground foliage. Funding for this effort was $69 thousand in FY 73 and $87 thousand in previous years.

Three of the projects were concerned with devising special sound attenuation devices. One Air Force project studied the mechanism of sound attenuation in a mixture of air and a cloud of liquid droplets. Results indicate that a reasonable quantity of water sprayed into the fan intake can appreciably attenuate sound. This is considered to be a potentially practicable technique for both take-off and landing operations, and there may be commercial applications as well as military. One Navy project was for the design and construction of an improved ground runup silencer, while the other Navy project was to develop a grid structure for V/STOL jet blast. A total of $145 thousand was expended relative to such silencing aspects in FY 73 and $55 thousand in previous years.

The total funding relative to sound attenuation was $214 thousand in FY 73 and $142 thousand in prior years. The total funding for transmission path related research was $3.31 million for FY 73 and $584 thousand for previous years. This total includes path-related work discussed under Sonic Boom, the Two-Segment Approach as well as under Sound Attenuation.

The Receiver

For purposes of this analysis, noise research oriented towards the effects on the receiver may logically be divided into two categories: (1) the basic effects of noise, and (2) matters related to noise exposure. Each of these may be divided into appropriate subcategories as described below.

Basic Effects of Noise. The basic effects of noise include effects on man, wildlife, and structures. For purposes of this assessment, the effects on man are further divided relative to (1) hearing loss, (2) general annoyance and speech interference, (3) sleep, and (4) military aspects.

In all, twenty projects fall into the noise effects category. NASA Langley identified two medical projects relative to hearing loss. FY 73 funding was only $21 thousand for one of these projects, the other being unfunded. Funding for previous years totaled $425 thousand.

In the second subcategory, NASA Langley had four projects and DOT/FAA identified two projects relative to annoyance and speech interference. These include both laboratory studies and community surveys. FY 73 funding was $295 thousand on four of these six projects, and prior funding was $682 thousand.

NASA Langley had three projects relative to effects on sleep, and DOT/FAA one. Funding in FY 73 was $105 thousand with $286 thousand in previous years.

With regard to military aspects, the Army identified one project with $27 thousand in FY 73 and $53 thousand in previous years.

Thus, in all, there were thirteen projects relative to the basic effects of noise on man, with $148 thousand in FY 73 and $1.45 million in previous years. All but one of these fall within the joint DOT/NASA effort.

TABLE 3-8

FUNDING IN FY73 FOR AIRCRAFT NOISE RESEARCH*

(Dollars in Thousands)

			Funding in FY73
SOURCE			$ 7,492
Jet Noise Generation			3,471
Fan and Compressor Noise			375
Noise of Rotating Blades			305
Acoustically Treated Nacelles, Ducts and Inlets			700
Lift Flow Noise			2,369
Sonic Boom			272
PATH			$ 3,306
Sonic Boom			320
Two-Segment Approach			2,772
Sound Attenuation			214
Natural Attenuation		69	
Silencing		145	
RECEIVER			$ 1,049
Basic Efforts			478
On Man		448	
Hearing Loss	21		
Annoyance and Speech Interference	295		
Sleep Loss	105		
Military Aspects	27		
On Wildlife		30	
On Structures		--	
Noise Exposure			1,171
Noise Exposure Forecasts	1110		
Noise Evaluation Criteria	--		
Noise Certification	61		
TOTAL			$12,447

*Only those projects are included having a distinct research orientation.

REFERENCES

1. "Aircraft Noise Reduction Technology," NASA Technical Memorandum, Lewis Research Center, NASA-TMX-68241, March 1973.

2. Civil Aviation Research and Development Policy (CARD) Implementation Plan, Joint DOT/NASA publication, March 1973.

3. NASA response to "EPA Survey," March 1973.

4. Fourth Federal Aircraft Noise Abatement Program FY 72-73, U.S. Department of Transportation, January 1973.

5. Unpublished working papers of the Joint DOT/NASA Office of Noise Abatement, September 1973.

SECTION 4

RESEARCH AND TECHNOLOGY: NOISE ASSOCIATED WITH SURFACE TRANSPORTATION

Research and the development of noise technology related to surface transportation is sponsored by several agencies of the Federal Government, but primarily within the DOT. Two other agencies – DOD and NSF – are involved to a lesser degree. Of the total FY73 funding, amounting to approximately $3.3 million, DOT accounted for about 86% ($2.85 million) with DOD and NSF accounting respectively for about 11% and 3%. Table 4-1 summarizes the FY73 funding and also indicates the broad nature of the activities in each of the agencies.

Available data indicates that a similar distribution of effort existed in prior years. A total of $1.42 million has been identified for surface transportation research and technology in years prior to FY73. Of the total amount, DOT accounted for about 81% and DOD for the remainder.

An expanded view of the information in Table 4-1 is provided in Tables 4-2 and 4-3. In Table 4-2 the individual components within each agency are identified, along with a description of their activities and their funding. The largest single activity was the DOT Office of Noise Abatement within the Office of the Secretary, accounting for $1.875 million in FY73. Of this amount, $1.75 million was identified with truck noise and the remaining $125 thousand was required for the development of information services. Rail programs were the next largest activity, at $505 thousand. This work is being conducted inhouse at the Transportation Systems Center. Expenditures for the reduction of bus noise are not known. The $23.9 million "Transbus" development program includes requirements for low noise levels. However, the funding for noise related aspects of the program have not been separately identified. Federal

TABLE 4-1

SUMMARY OF FY 73 RESEARCH AND TECHNOLOGY RELATED TO SURFACE TRANSPORTATION NOISE BY AGENCY AND AREA OF ACTIVITY

Agency/ Component	Areas of Activity	FY 73 Funding[1] ($ in Thousands)
DOT	Truck, bus, and rail system quieting; highway planning and design	2852
DOD	Quieting of Navy ships and Army vehicles	360
NSF	Basic research on tire noise	87
	Total	3299

[1]Funds shown are estimates submitted to EPA in mid FY 73.

Table 4-2 (Cont'd.)

RESEARCH AND TECHNOLOGY RELATED TO
SURFACE TRANSPORTATION NOISE

Agency/Component	Summary of Activities Related to Surface Transportation Noise	Funding[1] ($ in Thousands) FY 73	Other Years
• National Hwy. Traffic Safety Administration	Studies to measure the effects of noise upon driver performance.	None in 73	153 prior to 73
• U.S. Coast Guard	Elimination of risk of hearing loss on ships and boats. Elimination of annoyance from watercraft and from aids to navigation.	None in 73	274 prior to 73
	DOT Subtotal	(2852)	
ept. of Defense			
• Army	Development of novel exhaust silencing device for military vehicles; study and reduction of noise sources in combat vehicles.	56	50 prior to 73
• Navy	Reduction of shipboard machinery and other operating noises; quieting of small boats, analysis of acoustical signature data.	304	214 prior to 73
	DOD Subtotal	(360)	
ıtional Science Foundation	Basic research grant to Stanford University for the study of the mechanics of tire noise, with applications to tire design.	87	
	GRAND TOTAL	3299	

unds shown are estimates submitted to EPA in mid FY 73.

TABLE 4-3

SUMMARY OF FY 73 RESEARCH AND TECHNOLOGY RELATED TO SURFACE TRANSPORTATION NOISE BY CATEGORY OF NOISE SOURCE

Category of Surface Transportation Noise		FY 73 Funding[1] ($ in Thousands)
HIGHWAY NOISE		2309
• Trucks	1750	
• Buses	(Unknown)[2]	
• Highway Design	472	
• All Other	87	
RAILWAY SYSTEMS		505
WATER TRANSPORTATION SYSTEMS		304
OTHER RELATED RESEARCH AND TECHNOLOGY		181
	Total	3299

[1] Funds shown are estimates submitted to EPA in mid FY 73.

[2] Bus quieting technology is restricted to the "Transbus" development program, for which noise portion is not separable from the total $23.9 million effort.

highway noise reduction criteria, standards, and regulations.

- Experimental and analytical investigation of how noise is generated by truck tires at high speeds.
- Demonstration of specific noise reductions of diesel tractor trucks; identification of sources of noise (other than tire noise) under various operating conditions and the development, demonstration, and evaluation of means of reducing these noises to the lowest practicable level.
- Study of the parameters affecting intake and exhaust noise emissions from diesel bus and truck engines and the development of silencer specifications for each engine type currently in use. This report will be intended for use by trucking firms in new purchase and retrofit considerations.

Bus Noise

Efforts to reduce bus noise in FY73 were apparently confined to the "Transbus" development program. Although this program – sponsored by DOT/UMTA – includes specifications for low interior and exterior noise levels for the new prototype bus, separate tasks and associated funding have not been specifically identified for the noise aspects of the overall effort. Presumably, bus noise also will be reduced by some of the truck noise work described above. Prior year's work in this area included a 1972 study on the development of methods for quieting buses of the current fleet ($20 thousand), and the development in 1971 of noise specifications for the new Transbus ($30-$40 thousand).

Highway Design

The DOT Federal Highway Administration (FHWA) sponsors (under its Office of Research) research leading to noise abatement through highway design and use. The FHWA's Office of Environmental Policy directs its efforts to

achieve highway noise abatement via the development of standards, procedures, and technical information and also provides training to State and FHWA highway planning and design personnel. Research in FY73, accounting for $210 thousand, included the following areas:

- Development of methods for evaluation, prediction, and control of traffic noise near highways; determination of effects of highway design factors and terrain variables; development of criteria for desirable separations between highways and receivers of noise.
- Measurement of noise reduction effectiveness of various roadway treatments.
- Determination of relationship of highway design and noise factors, leading to improved design criteria.
- Acquisition of data from specified noise sensitive areas; development of noise abatement alternatives.
- Evaluation of sound attenuation characterisitics of various acoustical barrier configurations. Prior year expenditures for research in this area amount to $344 thousand.

The Office of Environmental Policy budgeted $262 thousand in FY73 to cover both inhouse and contracted activities in the following areas:

- Review of environmental impact statements.
- Technical assistance to State and FHWA personnel on noise prediction and analysis.
- Evaluation of State compliance with noise standards on highway projects.
- Development of policy covering noise aspects of highway projects.
- Training to FHWA and State personnel on noise aspects of highway development.

- Coordination with other agencies on traffic noise.

Other

The only other highway related work identified was for the study of the mechanics of tire noise, conducted by a Stanford University investigator and funded by the NSF for $87 thousand.

RAIL SYSTEMS NOISE

All reported rail systems work was sponsored by UMTA. FY73 funding amounted to $505 thousand for a single program – the Rail Supporting Technology Program – being conducted by the Transportation Systems Center. This program will extend from FY73-76; FY74 funding for the program is projected to be $560 thousand. The major elements of the program are:

- Assessment of noise and vibration associated with present rapid transit systems, including a pilot study based on the city of Boston; assessment of currently available abatement options; definition of abatement requirements.
- Determination of noise and vibration reduction potential of available components and technology; establishment of investment and operating costs, and compatibility with current operational procedures. Design and demonstrate in-service improved guideway segments of rapid transit lines.
- Assessment of new technology and development of predictive methods for noise and vibration control. Analysis of wheel/rail interface and track/elevated-structure interface. Development of prototype components, testing and evaluation using advanced technology components. In-service testing of promising prototypes.
- Documentation, in handbook format, of the results of the program for use by engineers engaged in the design and review of noise and vibration control in rapid transit rail systems.

WATER TRANSPORTATION SYSTEMS

In FY73 only the Navy reported any activity in this area, which amounted to $304 thousand. This includes measurements of ship-generated noise, development of methods for analysis and prediction of noise, and reduction of shipboard machinery noise. Other projects include: (1) the study of the effects of noise upon crew effectiveness and safety, leading to the development of specifications for allowable levels of noise in working and living spaces, and (2) reduction of noise generated by small boats via installation of acoustical treatments. These same activities accounted for about $214 thousand in recent years.

The U. S. Coast Guard also has been involved in the quieting of noise from small boats and fog signals. Although no FY73 funding was reported, approximately $275 thousand was identified in prior years. More specifically, the Coast Guard projects included:

- Surveys of power-boat equipment and evaluation of noise associated with operation of outboard motor boats and power boats; determination of extent to which such operations constitute hearing hazards to boating public and annoyance to shore areas.
- Abatement of fog signal annoyance to shore areas.

OTHER RELATED RESEARCH AND TECHNOLOGY

There were a few other surface transportation activities that do not conveniently fit in any of the above categories. The Army reported two projects totaling $56 thousand in 1973 directed at the quieting of combat vehicles. One dealt with the development of a novel exhaust silencing device. The other was a study of the various sources of noise from combat vehicles and of means for reducing or eliminating them, including consideration of costs and benefits associated with the various alternatives identified.

There also was a project sponsored by the DOT Office of the Secretary to provide for a variety of information services pertaining to transportation noise. This has been a fairly extensive effort, initiated in 1970 and continuing into 1973. It accounted for $450 thousand, of which approximately $125 thousand was expended in FY73. There were several interrelated aspects to the project:

- Definition of requirements for storage and retrieval of information regarding surface transportation noise.
- Development of specialized files pertaining to noise research information; technical information reference service.
- Advisory services regarding the need for research and development activities leading to abatement of transportation noises.

SECTION 5
OTHER RESEARCH AND TECHNOLOGY

The majority of all noise research and technology activities of the Federal Government are related to aircraft and surface transportation, as discussed in Sections 3 and 4. There is, however, a significant amount of activity in areas not specifically related to transportation. In FY 73 there were about 40 projects identified in this category in eight major agencies of the Government, accounting for $2.3 million. These projects span a broad range of noise problems and can be classified for purposes of discussion in a variety of ways. One such classification is that utilized in Table 5-1, which groups the projects into the following categories: (1) research and technology related to industrial and construction sources of noise, (2) information services, (3) development of methods and equipment for the measurement of noise, (4) noise surveys and receiver effects, and (5) research on propagation and attenuation.

Table 5-2, derived from Table 5-1, provides a closer look at the relative levels of activity within each agency. The table rank-orders the agencies by funding level and shows the percent of the total contributed by each. The remainder of this section provides additional detail on the five categories of activity identified in Table 5-1.

RESEARCH AND TECHNOLOGY RELATED TO INDUSTRIAL AND CONSTRUCTION SOURCES OF NOISE

Projects in this category accounted for $270 thousand in FY 73. The areas of activity include (1) the mining industry, (2) highway construction and maintenance equipment, (3) agricultural machinery, and (4) industrial machining processes. Table 5-3 shows the relationship between these areas of research and the agencies involved. Activities associated with the mining industry are seen to account for two-thirds of the total funding.

TABLE 5-1

SUMMARY OF OTHER RESEARCH AND TECHNOLOGY[1]
FY 73 FUNDING

Categories of Other Research and Technology Activity	Agency ($ in Thousands)											
	DOT			HEW	HUD	USDA	DOC	NSF	DOD		DOI	TOTAL
	Ofc. Secy. Ofc. Noise Abate.	Fed Hwy Admin	DOT Total				NBS		Army	DOD Total	Bu. Mines	
Research and technology related to industrial and construction sources of noise		28	28			45		17			180	270
Information services	25		25		21							46
Noise measurement--development of methods and equipment					79		607*					686
Noise surveys and research on effects	374		374	432	29	22						857
Research on propagation and attenuation	33		33			97		167	164	164		461
Totals	432	28	460	432	129	164	607	184	164	164	180	2320

[1]Not directly related to noise of transportation systems.

*These funds do not include support from other agencies. Refer to the text for explanation.

TABLE 5-2

SUMMARY OF FY 73 FUNDING BY AGENCY

Agency	Thousands ($)	Total (%)
DOC/NBS	607	26.2
DOT	460	19.7
HEW	432	18.6
NSF	184	7.9
DOI	180	7.8
DOD	164	7.1
USDA	164	7.1
HUD	129	5.6
Total	2320	100.0

TABLE 5-3

RESEARCH AND TECHNOLOGY ACTIVITIES RELATED TO CONSTRUCTION AND INDUSTRIAL SOURCES OF NOISE

Area of Activity	Agency	FY 73 Funding ($ in Thousands)
Mining Industry	DOI/Bu. Mines	180
Highway Construction and Road Maintenance Equipment	DOT/FHWA	28
Agricultural Machinery	USDA	45
Industrial Machining Processes	NSF	17
	Total	270

Mining Industry

The Bureau of Mines, Department of Interior, is involved in the development and implementation of noise control technology to promote the health and safety of personnel involved in the mining industry, and the minimization of community annoyance from mining activities. As indicated by Table 5-1, these activities accounted for $180 thousand in FY 73, all for inhouse work. The work is organized into three areas (1) Underground Mines, (2) Surface Mines, and (3) Experimental.

- Underground Mines. Projects in this category include:
  - Noise exposure surveys, to determine the prevalence of hearing loss among coal miners and to improve exposure standards
  - Evaluation of newly developed mufflers for pneumatic drills
  - Evaluation of noise output of various commercially available dust scrubbers
  - Noise measurement and evaluation of underground personnel carrier
  - Evaluation of effectiveness of emergency sirens
  - Measurement of noise output from diesel powered equipment.
- Surface Mines. Projects in this category include:
  - Noise surveys on large diesel-powered dozers, for the purpose of reducing noise exposure of operators via engine muffling and acoustical treatment of operator's cab
  - Noise surveys at coal cleaning plants, leading to noise control measures

- Experimental. Projects include:
  - Evaluation of personal noise dosimeters
  - Evaluation of efficiency of various ear protectors
  - Prediction of noise levels of machinery when operated in mining environment (underground)
  - Sound-power measurements of machinery
  - Study of wind-induced error in noise measurements taken in the field
  - Cataloging of mine inspector reports on noise exposure in various mining situations
  - Vibration measurement of mining equipment
  - Automation of coal mine noise data files

INFORMATION SERVICES

The DOT Office of the Secretary, HUD, and EPA reported a joint effort to publish a new journal on noise control engineering. Scheduled funding was: DOT, $25 thousand; HUD, $15 thousand; and EPA, $25 thousand. Since the project was subsequently terminated, the cited funds have not been expended.

The only other project effort or work in this category was a HUD project to produce a handbook containing comprehensive information about environmental noise in the community and significant planning measures to ensure that noise considerations are addressed in urban planning. The handbook is intended for use by HUD program managers, planners, and municipal offices. Funding was reported as $6 thousand in FY 73 while prior year funding amounted to $43 thousand in FY 72.

NOISE MEASUREMENT--DEVELOPMENT OF METHODS AND EQUIPMENT

All work identified in this category is being performed by the National Bureau of Standards. NBS reported an inhouse budget of $607 thousand for these activities in FY 73. In addition, support from other agencies totaled $478 thousand. Of this amount, $79 thousand was from HUD, shown in Table 5-1, and $100 thousand from DOT, reported in Section 4 under "Truck Noise." From the available information, the remaining $299 thousand is not readily identified by sponsoring agency and amount. Some agencies have identified funds transferred to the Bureau of Standards. In other cases such funds have not been explicitly identified, but are known to be included in the total funding provided by those agencies.

The Bureau of Standards possesses an extensive sound laboratory to support its research in acoustics and vibration. Two of the main features are an anechoic chamber and a reverberation chamber. The anechoic chamber provides approximately 16,000 cubic feet of working space in an environment which is at least 99% sound absorbent in the audiofrequency range above 40 hertz. The reverberation chamber provides about 15,000 cubic feet of space whose walls are about 95% sound reflecting over most of the audio frequency range. There are several smaller chambers in the laboratory which are used for microphone calibration, hearing and testing, research on audimotery, and psychoacoustical research. The facility also contains dedicated computer support and a broad variety of acoustical measurement instrumentation such as microphones, amplifiers, filters, oscillators, etc. NBS also has two mobile laboratories which are utilized for field measurements and research.

Project activities in the Bureau of Standards are numerous and broad in scope. The following is a summary of project areas by sponsoring agency.

- NBS (inhouse support)
  - Improvement of microphone calibration techniques

- Improvement of calibration techniques for vibration transducers
- Evaluation of NBS anechoic chamber as a measurement instrument
- Evaluation of NBS reverberation chamber as a measurement instrument
- Development of audiometric standards
- Basic research on psychoacoustics, especially loudness, noisiness, and aversiveness of sounds
- Investigation of sound transmission loss of exterior walls, doors, and windows
- Preparation of design guide for protecting building occupants from noise of exterior origin
- Investigation of limitations of standard procedures for field measurement of airborne sound transmissions loss in buildings
- Development of improved procedures for the measurement of sound power in reverberation chambers

• EPA

- Assistance with preparation of the Report to the President and Congress on Noise
- Evaluation of commercial noise exposure meters and preparation of performance specifications and prototype instrumentation for a noise exposure meter tailored to EPA requirements
- Preparation of a white paper on measurement standards

- DOT
  - Measurement and analysis of truck and auto tire noise
  - Measurement of in-cab and exterior noise due to over-the-road trucks
  - Evaluation of environmental noise monitoring system
  - Study of the audibility of fog horns and the possibility of achieving less annoying fog horns for U.S. Coast Guard
- HEW
  - Evaluation of sound level meters for the National Institute for Occupational Safety and Health (NIOSH) and general consultation
  - Testing of toys judged to be potentially hazardous to children's hearing for the Food and Drug Administration (FDA)
- HUD
  - Evaluation of plans and specifications in the Operation Breakthrough program to identify acoustic problem areas; field testing of acoustical performance of housing systems
  - Development of performance specifications and prototype instrumentation for an urban noise exposure measurement system for use in enforcing HUD noise policy
- DOJ
  - Development for LEAA of interim procurement standards for hearing protectors used by law enforcement agencies
  - Production of interim procurement standard for sirens for emergency vehicles
- VA
  - Testing of hearing aids

Estimated future funding for noise research is $1417 thousand in FY 74 (including $510 thousand from other agencies), and $2.23 million in FY 75 (including $510 thousand from other agencies). Anticipated research activities for FY 1974 and 1975 are given below.

- FY 1974
  - Extension of standards for calibrations of microphones to low frequencies (< 0.1 Hz) and to high-frequencies (≈100 kHz)
  - Evaluation and improvements in standard sound sources
  - Development of systems for direct measurements of diffusiveness of sound field in reverberation rooms
  - Development of standard methods and the basis for inter-comparisons of results for small sources using reverberation rooms
  - Conducting of analytical and experimental investigations on standard sources and methods for establishing ratings of impact noise transmission in buildings
  - Investigation of noise attenuation properties of exterior shells of buildings
  - Studies of procedures for temporal and spatial samplings of community noise
  - Preparation of design guide for protection against environmental noise
  - Evaluation of methods for scaling and modeling vibration isolation systems for noise control

- FY 1975
  - Development of standards for calibrations of microphones used for measurements of high-intensity sound fields
  - Evaluation of methods for determining diffusiveness of sound fields in reverberation rooms by direct measurement systems and absolute methods
  - Investigation of methods for sound power output measurement in situ
  - Examination of causes of discrepancies among loudness, annoyance, and noisiness calculating algorithms
  - Development of methods for measurement of random incidence sound absorption
  - Investigation of influence of connotation on response of humans to environmental noise
  - Study of models and field measurements for predicting effectiveness of barriers and site topography for attenuating noise

NOISE SURVEYS AND RESEARCH ON EFFECTS

This category has two components: (1) community noise surveys and related work, and (2) health effects on human and animals. Other work involving surveys and receiver effects was included in the sections of this report dealing with transportation sources of noise (Sections 3 and 4). Survey work is also included as part of some of the noise abatement and hearing conservation programs, but is not regarded as research oriented and therefore is addressed elsewhere (Section 6). This section includes only those survey and health effects projects which are research oriented (i.e., aimed at advancing the state-of-the-art), and which are not exclusively or specifically related to transportation. Of the total $857 thousand funds for this category

in FY 73, $403 thousand are identified with survey-related activities and the remaining $454 thousand for health effects, mostly human effects.

Noise Surveys

DOT sponsored most of this work through its Office of the Secretary, Office of Noise Abatement. The DOT projects included:

- Development of descriptors of ambient environmental noise, to be utilized in monitoring community noise, creation of a national baseline data bank of noise levels to which the public is currently exposed; identification, measurement, and analysis of noise from specific sources and their respective contributions to the ambient level.
- Community annoyance survey of the area around JFK airport, due to all sources of noise. Study of the relationship between annoyance responses and changes in transportation near JFK over a three-year period.
- Economic effects of noise pollution. Development of conceptual and theoretical framework for the analysis of the costs of noise to society; predictions of effects that will be observable for use in formulation of policy.

HUD sponsored one small ($29 thousand) project in FY 73 to evaluate (1) the acoustical environment of a proposed housing site, and (2) the acoustical environment within residential structures proposed for the site.

Health Effects

The primary efforts are directed to understanding the effects of noise on man and sponsored by HEW. A smaller effort in the Department of Agriculture is devoted to the study of the effects of noise on animals (about $22 thousand in FY 73). The HEW work is conducted by two components--

the National Institute for Occupational Safety and Health (NIOSH) and the National Institute of Environmental Health Services (NIEHS). In FY 73 their combined funding for noise research was $432 thousand--$187 thousand for NIOSH and $245 thousand for NIEHS. The NIOSH work emphasizes the identification of hazards associated with occupational exposure to noise and the development of criteria for standards, whereas the NIEHS efforts are directed more at the biochemical and physiologic level of investigation.

NIOSH Activities. Much of the recent NOSH activity has been consumed in the preparation of a criteria document, "Criteria for a Recommended Standard. . . Occupational Exposure to Noise." This document includes a recommendation that the existing 90-dBa standard be revised downward to 85-dBA if technologically and economically practicable. NIOSH also conducted studies of noise exposure and hearing loss among selected occupational groups, including:

- Hearing tests on individuals exposed to farm tractor noise
- On-site visits to inspect hearing conservation programs in industry. Information gathered includes procedures for audiometric testing, training of personnel, procedures for dispensing and regulating the use of personal protective equipment, successess and failures of engineering control methods, and overall costs of the programs.
- A study of the hearing of young adults exposed to potentially hazardous noise
- A study of audiograms of textile workers
- Testing of noise exposure integrating instruments
- Hazardous effects of exposure to impulsive noise

- Study of hearing loss among underground coal miners, as a function of noise exposure levels, for the purpose of improving noise exposure limits, and for establishing guidelines for hearing conservation programs in the coal industry. A joint study with the Bureau of Mines has been underway since 1972; noise exposure data combined with an extensive hearing testing program and relevant background data on the miners will provide the basis for analysis of cause-effect relationship of noise and hearing loss.

Projected budgets for these NIOSH noise research activities are $320 thousand in FY 74 and $280 thousand in FY 75. Expenditures in FY 72 amounted to $244 thousand for contracts and grants and approximately $190 thousand for inhouse work, or an estimated total of $434 thousand.

NIEHS Activities. The NIEHS work divides into two-broad areas: (1) study at the biochemical level of the auditory system effects of noise and noise in combination with drugs; and (2) investigation of nonauditory physiologic effects of noise and noise-drug interactions in animals. Included in the latter category are effects on the cardiovascular system, the central nervous system, and the endocrine systems. It is necessary to understand such nonauditory effects in order to establish community noise standards, necessarily lower than those required to prevent auditory damage.

It is planned that by 1975-1977 this line of research will enable the identification of those drugs and chemicals which synergistically interact with noise to produce undesirable effects. The NIEHS activities in FY 73 were budgeted at $245 thousand for inhouse and contracted work. Projected budgets are $220 thousand in FY 74; $240 thousand in FY 75. No prior year expenditures were reported.

RESEARCH ON PROPAGATION AND ATTENUATION

Most of the work pertaining to the propagation and attenuation of sound is directly associated with transportation noise--predominately aircraft noise, but also surface transportation noise--and therefore has been covered in Sections 3 and 4. This section contains a description of the work in propagation and attenuation not specifically related to transportation. Only four projects were identified in this category, accounting for a total of $461 thousand in FY 73. The subject matter covered by these projects varied widely: (1) attenuation of noise by trees and vegetation ($97 thousand in FY 73), (2) sound absorption characteristics of various materials ($33 thousand in FY 73), (3) transmission of sound in buildings ($167 thousand in FY 73), and (4) prediction of sound levels generated by Army activities ($164 thousand in FY 73).

Attenuation of Noise by Trees and Vegetation

This work is being sponsored by two components of the Department of Agriculture, the U.S. Forest Service, and the Cooperative State Research Service. No details were available except that the work is being done inhouse and that it deals with the use of trees and vegetation for the scattering of sound energy.

Sound Absorption Characteristics of Materials

DOT sponsored this work to determine the sound absorption characteristics of various materials which appear promising as absorbers of low-frequency noise. A large number of absorbers will be examined which are combinations of porous materials, screens, perforated plates, and the like.

Transmission of Sound in Buildings

This project, funded by the NSF, explored the distribution of sound within buildings. Structures studied included those with potential applications in new forms of modular housing and those used as enclosures for machines

and other sources of industrial noise. Sound transmission along corridors was also investigated with application to the study of sound transmission in city streets.

Prediction of Noise Associated with Army Activities

This activity is conducted by the U.S. Army's Construction Engineering Research Laboratory. It is a program projected through FY 75 to develop methods for predicting the noise associated with various Army activities, including (1) blast noise, (2) helicopter noise, and (3) construction and industrial noise. The overall objectives of the program are to ensure that noise pollution does not adversely affect human health and welfare in or around Army facilities. Thus, the development of predictive methods will enable undersirable noise exposures to be avoided through the application of appropriate controls.

In FY 73, a model was completed for the prediction of blast noise. Instruments for the measurement and spectral analysis of noise were procured. In FY 74 the work will be continued and noise prediction contours will be developed for aircraft noise, blast noise, and vehicle noise. Work will also begin on the prediction of noise from construction sites and will continue into FY 75.

Other research originally planned for FY 74-75 as part of this program may be deferred or terminated due to a lack of funds. This work would include (1) the relationship of noise to human activities at military installations, under varying acoustical conditions, and (2) the development of acoustical criteria for the design of family housing, barracks, hospitals, offices, and shops. Funding for FY 73 was $164 thousand; FY 74 is projected at $400 thousand, and $450 thousand for FY 75.

SECTION 6

NOISE ABATEMENT AND HEARING CONSERVATION PROGRAMS

The term "abatement" is used synonymously with "control" to refer generally to the reduction of noise emissions from specific sources, primarily within the context of reduction of community noise (over-the-fence noise) impact from Federal installations. It does not refer to research and development leading to abatement which was the subject matter of Sections 3, 4, and 5 in this report.

The second term, "hearing conservation," includes those activities directly concerned with the prevention of hearing loss among personnel--government and contractors--whose duties expose them to potentially harmful levels of noise. Such programs normally include all or some of the following activities:

- Noise surveys
- Reduction of noise at the source
- Reduction of exposure via reduction of engineering solutions or management actions
- Periodic hearing testing (audiometry)
- Training programs
- Use of hearing protection devices

Excluded from this category are those activities involving basic research on the effects of noise on the auditory system.

Noise abatement and hearing conservation programs are most naturally discussed one agency at a time, since these programs are tailored to meet the

peculiar needs of individual organizations. Therefore, the latter parts of this section describe the programs in each agency. This is preceded by a summary of the reported noise abatement programs and a general discussion of hearing conservation programs.

SUMMARY OF NOISE ABATEMENT PROGRAMS

Table 6-1 provides a brief description of the noise abatement activities in each agency and the associated FY 73 funding. The total for all agencies is $7,917,300, with DOD accounting for $5,930,000, approximately 75% of the total. Most of the DOD expenditures were for the procurement of equipment and associated construction for quieting jet engine maintenance, and runup noise. Although not shown in the table, it is significant to note that the Navy has planned expenditures of $105 million during the next five years for such programs. None of the remaining identified activities exceeded $500,000, except for the administrative and compliance functions of OSHA.

HEARING CONSERVATION PROGRAMS

A number of general remarks can be made with reference to the hearing conservation programs. These deal with (1) the information required for EPA to make a critical assessment of such programs, and (2) observations based on the data obtained from the EPA survey.

Information Requirements

The information collected by EPA for this report was not sufficient to allow an indepth assessment of hearing conservation programs to be made. The guidelines provided by EPA to the Federal agencies (shown as Figure B-1, Appendix B) for submitting data pertaining to noise research and control activities did not explicitly identify hearing conservation. Therefore, some agencies provided no information on hearing conservation even though it is known that extensive programs exist in these agencies (e.g., Army and Air Force). Most agencies did, however, provide some information regarding hearing conservation,

TABLE 6-1

SUMMARY OF FEDERAL AGENCY NOISE ABATEMENT[1] PROGRAMS FOR FY 1973

Agency	Program Areas	FY 73 Funding
Department of Defense		
• Army	Office of Surgeon General provides variety of services throughout Army--acoustical engineering, community noise assessment, etc. Current projects include community impact of blast noise, helicopter noise, and computer equipment noise.	$144,000
• Navy	Large program to reduce the noise associated with jet engines at air stations and maintenance centers. ($1.785 million) Also numerous community noise studies around air stations ($290 thousand).	$2,075,000
• Air Force	Acquisition of equipment and construction of facility for quieting jet engine runup noise ($3.7 million) miscellaneous studies related specific noise sources ($19 thousand).	$3,719,000

[1] These are programs directed at the abatement of community noise and include only those with responsible FY 73 funding. Hearing conservation programs are not included. Such activities are generally not separable as budget items, comprising only a part of more comprehensive health service programs.

TABLE 6-1 (Cont'd.)

SUMMARY OF FEDERAL AGENCY NOISE ABATEMENT[1] PROGRAMS FOR FY 1973

Agency	Program Areas	FY 73 Funding
DEPARTMENT OF HEALTH, EDUCATION AND WELFARE		
• Social Security Administration	Corrective measures for controlling identified industrial noise problem areas. Only one funded program reported.	$ 78,000
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	Development and enforcement of HUD program standards which contain noise abatement policies.	$ 30,000
DEPARTMENT OF LABOR		
• OSHA	Development of standards and regulations, conduct of compliance inspections and investigations and investigations and approval of State plans.	$700,000
DEPARTMENT OF TRANSPORTATION		
• USCG	Control and relocation of fog signalling equipment.	$183,500
• Federal Highway Admin.	Preparation of standards and guidelines, technical assistance and training programs for highway design and planning activities.	$262,000

[1] These are programs directed at the abatement of community noise and include only those with responsible FY 73 funding. Hearing conservation programs are not included. Such activities are generally not separable as budget items, comprising only a part of more comprehensive health service programs.

TABLE 6-1 (Cont'd.)

SUMMARY OF FEDERAL AGENCY NOISE ABATEMENT[1] PROGRAMS FOR FY 1973

Agency	Program Areas	FY 73 Funding
NASA		
o Ames Research Center	One major project for construction of sound absorbing structure around wind tunnel.	$493,000
o Marshall Space Flight Center	Test firing of large rocket engines constitutes a community annoyance problem. Efforts directed to ensure testing done under favorable atmosphere conditions and time of day.	$ 46,000
TVA	Investigation and investigation of problems related to thermal electra generating plants, power transmission systems, and general construction operations.	$ 3,800
U.S. POSTAL SERVICE	System and equipment modifications necessary to meet noise standards.	$183,000
	TOTAL	$7,917,300

[1]These are programs directed at the abatement of community noise and include only those with responsible FY 73 funding. Hearing conservation programs are not included. Such activities are generally not separable as budget items, comprising only a part of more comprehensive health service programs.

including it as part of their "control" activities. The information was, however, highly variable with respect to type of information and level of detail. This deficiency was an oversight due to EPA's primary interest in collecting information on major noise programs. Thus, the survey was designed to primarily collect this type of information.

In the future, EPA will utilize a more appropriate questionnaire to obtain information on hearing conservation programs. The details of such questionnaires have not yet been fully defined, but it will include the following kinds of data:

- Identification of noise sources constituting potential hazards, measured levels of noise, and nature of the associated human exposure.
- Engineering controls utilized at the source
- Attentuation devices in place
- Administrative controls in use
- Hearing protection devices utilized
- Enforcement procedures for adherence to hearing conservation programs
- Prevention program; training and education, audiometry--details of audiometry, including interpretation, and filing of audiograms, equipment utilized, and qualifications of personnel.

Measures of effectiveness will be provided by the above indicated data. In addition, data will be solicited on the incidence of hearing loss cases associated with specific activities and, in particular, any data that might reveal change in the incidence of hearing disabilities and hence, indicate increases in effectiveness. The questionnaire will be developed with the assistance of

experts and in cooperation with other appropriate Federal agencies in order to ensure that the desired information be obtained. Additionally, it is planned that a number of on-site visits will be made in order to further understand the problems inherent in assessing such programs.

General Observations

Due to the above indicated limitations of the available data, only tentative observations are of a general nature and others pertain to specific agencies and activities.

- In general, the costs of hearing conservation activities are not available due to the fact that these programs are included as part of overall health services programs. Rough estimates of personnel costs were provided by agencies in a few cases as proportional amounts of the total health services effort.
- Many health services programs are provided by contractors. Experience in industry indicates that such services are obtained more efficiently when conducted by inhouse personnel, especially when the number of personnel to be serviced becomes relatively large.
- Based on the available data (and emphasizing the incomplete nature of this data), there would appear to be a general lack of comprehensive standards and guidelines for operating hearing conservation programs. Practices appear to be highly variable from one facility to another. This seems most evident in regard to: (1) the interpretation of audiograms, (2) the conducting of surveys, (3) maximum exposure levels without hearing protection, (4) training and education programs, (5) enforcement of these programs, and (6) qualifications of personnel utilized to operate the programs.

- Several facilities appear to have excellent programs and are described in more detail later in this section. They are: NASA's Flight Research Center, (2) NASA's Jet Propulsion Laboratory, and (3) Department of Interior, Bureau of Reclamation. Additionally, the DOD is known to operate extensive hearing conservation programs. No information regarding these programs was obtained, however, except for an applicable BuMed Instruction from the Navy.

- The Army provided as part of its submittal on Noise Control activities an excellent example of an effort which deals with the reduction of employee exposure to noise levels which, although less than those known to cause hearing impairment, are judged undesirable for the general welfare of the workers. The project described later in this section involved the quieting of computing room noise at Edgewood Arsenal.

- An extensive program was reported by the DOI's Bureau of Reclamation. It has been in operation for over five years and is operational throughout all reclamation regions in seventeen western states. Their program includes twenty-five professionals and certified technicians and is comprehensively planned and operated on a regional basis. It is further characterized by the following excerpt from their submittal to EPA.

"Since 1968 over 5000 sound level or octave band analyses have been made of projects and equipment. All equipment is calibrated carefully and audiometric examinations are conducted routinely. Technicians are certified and services of otologists and audiologists are used for advice in hearing conservation. Hazardous noise areas are identified and posted. Noise control measures are taken wherever feasible and hearing protection equipment accompanied by education programs are used wherever necessary. Baseline audiograms are taken accurately on all employees

exposed to potentially hazardous noise levels. In addition to this, employees who have significant hearing loss are referred to their private physician for consultation and advice."

DESCRIPTION OF FEDERAL PROGRAMS IN NOISE ABATEMENT AND HEARING CONSERVATION

Summary descriptions of noise abatement and hearing conservation programs in reporting Federal agencies are provided in the remainder of this Section. Organization charts identifying specific components responsible for implementing noise abatement and hearing conservation activities within these agencies are included in Appendix B.

Government Printing Office (GPO)

The agency's overall objective is to assure that noise levels are kept within those set by OSHA. However, much of the industrial equipment presently in use by the GPO was procured before noise control was made part of the purchase consideration. Therefore, some equipment presently in use exceeds currently acceptable noise levels. The GPO is using available engineering disciplines and technologies to reduce these to acceptable standards wherever feasible.

The basis for noise abatement within the GPO is the requirement for employee hearing protection as directed by Congress under the Williams-Steiger Occupational Safety and Health Act of 1970 (OSHA). GPO Instruction 670.5, Hearing Protection Program, spells out the responsibilities and duties of the Safety Officer, Director of Engineering Services, Medical Officer, Supervisors, and all GPO employees in carrying out their noise abatement and hearing conservation programs. The responsibility for assuring that employees are not exposed to damaging or excessive noise levels is vested in the Safety Office of the Personnel Service, Occupational Health and Safety Division.

The GPO does not have any personnel assigned exclusively to noise abatement activities. In this agency, noise reduction is considered a regular function of the Engineering Service with engineers trained in noise reduction engineering principles. Since personnel are not assigned full-time and all duties to date have been collateral duties, a breakout of noise abatement related personnel costs is not available. Likewise, no dollar allocations for specific noise abatement or hearing conservation tasks or projects have been identified.

Council on Environmental Quality (CEQ)

This agency reports no noise abatement or hearing conservation activities for FY 73.

Department of Agriculture (USDA)

This agency reports no noise abatement or hearing conservation activities for FY 73.

Department of Commerce (DOC)

This agency reports no noise abatement or hearing conservation activities for FY 73.

Department of Defense (DOD)

The Noise Control Act of 1972 (PL 92-574), which requires compliance by all Federal agencies, applies in general to the Department of Defense. However, DOD enjoys one of the few exceptions to the law in that the Act's referral to "products" specifically excepts ". . . any military weapons or equipment which are designed for combat use, . . ." (Section 3 (B) (i). The Occupational Safety and Health Act of 1970 (PL 91-596) which also applies to the DOD does not allow specific exceptions for the military.

DOD directive 5100.50, Protection and Enhancement of Environmental Quality, specifies actions to be taken for the control of all forms of pollution, including noise resulting from the operation of facilities, equipment, vehicles, and other property owned or operated by DOD.

The department submitted individual responses for each of the military departments (Army, Navy, Air Force, and Defense Supply Agency) rather than a comprehensive summary statement covering the entire DOD. Therefore, no information is available which reflects overall DOD noise abatement and hearing conservation program plans, directions, policies or funding levels.

Department of the Army. The noise abatement activities of the Army are assigned to the Office of the Surgeon General. The responsibility in turn is delegated to the Bio-Acoustics Division Division of the U.S. Army Environmental Hygiene Agency. Mission statements are contained in Army Regulations 40-4 and 40-5.

The Division has set priorities and is attacking major problem areas within the Army. Current projects include the occupational hearing loss and community aspects of detonation or blast noise, helicopter noise, industrial noise, computer and office equipment noise, and generator noise. The Division has also established a data base on noise emissions of all equipment found within the military system. This data base is currently operational on a limited basis. Manpower resources permitting it will be expanded to include ambient noise data, criteria information, and noise abatement information. Because of the limited manpower available, primary efforts are expended in areas having widespread application throughout the Army.

No formal noise abatement program exists. However, periodic on-site surveys are conducted by the Division throughout the Army complex.

The surveys review and identify noise-hazardous areas (i.e., above 85-dBA) in addition to reviewing the overall administration of the local hearing conservation program. Recommendations are then made for appropriate action to be taken for engineering control of these sources. In view of the ever increasing number of requests for services of the Bio-Acoustics Division in the areas of acoustical engineering and community noise it is anticipated that manpower and equipment requirements will be expanded proportional to the workload. Ultimately, the Division hopes to be able to advise all major Commands of their acoustical control needs so that the Army can lead the way to a quieter environment within both the military and civilian work, living, and recreational areas.

Specific noise abatement projects conducted by personnel of the Surgeon General's office during the reporting period include:

- Evaluation of Environmental Impact of Noise from Helicopter Operations at Wheeler Air Force Base

  An evaluation was made to define the extent to which noise from proposed U.S. Army helicopter operations at Wheeler Air Force Base could affect nearby communities. Under certain conditions, the noise generated by helicopter operations was found to result in adverse community response. Recommendations to achieve further reduction of aircraft noise levels in the community were made.

- Sound Pressure Level Measurements of Diesel Generators

  Noise measurements of diesel/generators were obtained for the U.S. Army Air Defense Command (ARADCOM). The diesel generators measured were the Waukesha (150/175-kw), Hol-Gar (60-kw), Caterpillar (150/175-kw), and Cummins (150/165-kw).

- Computer Room Noise

  Noise measurements were made within the computer facility of the Wilmington District, Corps of Engineers. Noise levels exceeded the guidelines for hearing conservation set by TB MED 251, the various guidelines setting noise levels for proper working environments suggested by sources such as MIL STD 1472A, as well as standard references in the acoustics field. Evaluations and recommendations were made for the control of noise levels through existing engineering practices.

- Evaluation of Airfield Noise

  An evaluation of jet noise was requested for Dannelly Field, Montgomery, Alabama. Noise levels generated by commercial DC-9 and military Phantom jets were found not be hazardous to the unprotected ears of the Army National Guard personnel for the existing pattern of operations at this facility. However, noise from Army helicopters was determined to be hazardous without ear protection. The establishment of a hearing conversation program for flight line and maintenance personnel and the use of protective devices were recommended. Results of a brief survey conducted for the Army National Guard located at Birmingham, Alabama were also included.

- Acoustic Recommendations for MTST Office Machine Usage at U.S. Army Environmental Hygiene Agency

  A study was made to identify the noise environment in a room containing six IBM-MTST machines. These produce noise levels as high as 82-dBA and recommendations for enhancing working conditions were made.

In addition to the above listed Surgeon General's office projects, the Army Material Command Human Engineering Labs at the Aberdeen Proving Grounds

reported on an inhouse activity to identify and evaluate excessive noise areas in AMC. This project involves a survey of existing and upcoming noise regulations, including Federal, State, and Army directives, and the establishment of liaison with other Federal noise abatement groups (including EPA). An objective is a recommended noise standard for AMC equipment.

Personnel resources for the Surgeon General's projects include eight military and civilian employees with a FY 73 budget of $143,977. This includes $2 thousand for contracted services. No current budget figures are available for the AMC noise abatement activities. However, the previously mentioned Aberdeen project was funded at $114 thousand in FY 72.

Department of the Navy. The Navy's noise abatement program was initiated in 1971 by the Chief of Naval Operations as a comprehensive effort to control noise associated with jet engine runups at Naval Air Rework Facilities and at Naval Air Stations. The Navy's hearing conservation program is delineated in BUMED Instruction 6260.6B (5 March 1970). Maximum permissible exposures correspond to OSHA standards. Additionally, ear protection devices are mandatory for all personnel exposed to artillery file under any conditions (combat or training) and for all personnel exposed to gunfire in training or test situations.

There is no separate organization for noise abatement in the Department of Navy. The responsibility is vested in the Navy Environmental Protection Division within the organization of the Chief of Naval Operations and corresponding organizations within subordinate commands. In the Marine Corps the noise program is administered within the Office of the Quartermaster General.

The Navy's inhouse noise abatement program* is rather extensive, involving approximately 100 personnel in a variety of activities and organizations. Present plans are to spend approximately $105 million in this area during the next five years. Specific projects planned for the FY 1973-1977 period include:

- Replacement of baffles in jet engine test cells at Alameda NAS--$125 thousand (FY 73).
- Purchase of restrictive easements over land around NAS Miramar--$5.85 million (FY 75).
- Rehabilitate test cell for BQM Aerial Target, NAS North Island--$30 thousand (FY 73).
- Installation of sound attenuation measures on steam pressure reducing stations at Naval Training Center, San Diego--$31 thousand (FY 74).
- Relocation of rocket testing and pyrotechnic test firing from Seal Beach--$50 thousand (FY 74 = $3 thousand, FY 75 = $47 thousand).
- Installation of muffler system on Dynamometer Test Stand at Public Works Center, Norfolk--$9.3 thousand (FY 75).
- Quieting of transmitter power plant at Nea Makri, Greece--$2.142 million (FY 74 = $11.5 thousand, FY 75 = $2.130 million).
- Procurement and installation of noise suppressors and acoustically treated enclosures for engine test facilities at various air stations --$61.93 million (FY 74-77).

*The Navy's five-year plan for noise control is contained in a special report to EPA, "Noise Pollution Control Report," dated 31 December 1972.

- Development of advanced noise suppression devices for aircraft engine testing--$4.826 million (FY 73-77).
- Construction of noise suppression devices, systems, and facilities at various locations--$23 million (FY 75-77).
- Various studies of specific noise problem areas--$1 million (FY 73-77).
- Construction of modern noise suppression devices, systems, and facilities at various locations--$7 million (FY 74-77).

The total cost of the Navy noise abatement activities in FY 73 amounted to approximately $2.075 million. This included, in addition to $1.785 million for the above listed projects, 41 contracted noise abatement studies at Navy and Marine Corps air stations costing $290 thousand. The objectives of the latter studies were to record noise levels within and outside the air station boundaries. These are used to plot composite noise rating contours for Navy and Marine Corps planning purposes and to influence planning and zoning outside the stations. In FY 74 it is planned to contract approximately $1.3 million for Navy noise abatement studies.

Department of the Air Force. There is no central organization with the Air Force responsible for noise abatement activities. However, certain projects of the Environmental Health Laboratories (EHL) as well as specific noise control-related activities like the acquisition of sound suppressors for jet engine maintenance operations are considered noise abatement activities within the Air Force.

The EHL engaged in a variety of small studies which included the following during FY 73.

- Evaluation of the noise environment for the proposed site of a new hospital at Travis AFB--$2,475.

- Prediction of down-range noise levels associated with Athena-H rocket firing at Utah Launch Facility, Green River, Utah--$1,700.
- Noise measurements at proposed site for civilian development near Offutt AFB--$1,600.
- Analysis of noise transmission between apartments in base-housing at Plattsburg AFB--$438 thousand.
- Development of a composite noise rating concept for Castle AFB--$350 thousand.
- Measurement of noise levels associated with F-100 aircraft operating out of Tucson International Airport--$500 thousand.
- Effect of sonic booms on mink reproduction in connection with claims filed against DOD by breeders--$6,969.
- Evaluation of possible locations for jet engine runup facilities and the need for a noise suppressor at Tulsa, Oklahoma--$1,150.

The total noise abatement activities with EHL were budgeted at approximately $19 thousand for FY 73. The sound suppressor program accounted for about $3.7 million for construction and equipment in the same period. Estimated resources for FY 74 are $3.3 million.

No information was obtained on hearing conservation programs in the USAF, although such programs are known to be in operation.

Defense Supply Agency (DSA). DSA has no organizational element whose sole responsibility is noise abatement. A survey of DSA field activities failed to identify any operation which creates community noise problems and the agency has no history of noise complaints from the community.

Department of Health, Education, and Welfare (HEW)

The only reported noise abatement or hearing conservation program in HEW was in the Social Security Administration (SSA). The noise control program at SSA is aimed at controlling both the noise and ill affects of the high-sound pressure level (high-intensity noise) produced in mailrooms and by other equipment used by the Agency.

Noise abatement within the SSA is the responsibility of the Division of Operating Facilities of the Office of Administration. The Employee Health Service provides necessary medical services and the nucleus of a comprehensive hearing conservation program at the headquarters operation having a population of approximately 18 thousand in Baltimore.

The SSA is in the process of pinpointing operating and shop areas in which noise levels are at or above 85 decibels. They are maintaining surveillance records in such areas as the print shop, carpenter shop, mailrooms, the computer and data processing installation as well as other areas in which teletype machines, paper bursting equipment and other noise producing equipment are used. Ninety-five percent of the noise control program is being conducted within the SSA headquarters with the remaining 5% in their nationwide field operations.

The SSA is developing management directives that will spell out responsibility and detail a program to control exposure to hazardous noise levels. These directives will provide for:

- Orienting personnel in the undesirable effects of noise
- Keeping noisy work areas under surveillance
- Issuing personal protective devices and instructions for their care and use

- Minimizing exposure of personnel to intense noise in work areas
- Monitoring audiometry

The SSA does not have personnel assigned full-time to noise abatement or hearing conservation programs. These activities are jointly conducted by the various staff functions and the professional personnel working for the Office of Administration. Since the noise activities are on an as-needed basis there is no breakdown of salaries or resources allocated for corrective measures. Expenditures are allocated on a day-to-day basis and the only example cited was a $78 thousand program to correct noise problems in the carpenter shop and the exhaust ventilation system.

Department of Housing and Urban Development (HUD)

A major mandate of the Department of Housing and Urban Development is the goal of a "suitable living environment for American families." Noise is a major source of environmental pollution which represents a threat to the serenity and quality of life in population centers and noise exposure may be a cause of adverse physiological or phychological effects as well as economic loss. Therefore, it is an objective of HUD to encourage the control of noise and its sources through land utilization patterns that will separate uncontrollable noise sources from residential and other noise-sensitive areas. The thrust of this policy is to withhold all forms of HUD assistance for construction on sites which have unacceptable noise exposure.

The responsibility for administering the HUD noise policy (Circular 139.2) lies with the Assistant Secretary for Community Planning and Management. The Office of Community and Environmental Standards advises the Assistant Secretary in policy development related to all environmental matters including noise. The headquarters staff assigned to noise policy activities are located in the Environmental and Land Use Planning Division, Office of Community and Environmental Standards. The Division has a

multidisciplinary staff with responsibility for environmental, urban design, water resources, and transportation areas. However, headquarters noise policy activities are carried on by an urban planner and urban economist on a part-time basis only.

Responsibility for compliance with headquarters environmental policies is vested with the Assistant Regional Administrators for Community Planning and Management and with the Assistant Directors for Planning and Relocation in the HUD area offices. These positions are designated as Environmental Clearance Officers.

Major HUD noise abatement activities are:

- Planning Assistance

  HUD requires that noise exposure be given adequate consideration in all programs which are provided financial support for planning. This provides assurance that new housing, and other noise sensitive accommodations will not be planned for areas whose current or projected noise levels exceed HUD standards. In this regard, HUD places particular emphasis on compatible land use planning in relation to airports and other sources of high-noise supporting the use of planning funds to explore appropriate methods of reducing noise to acceptable levels. Reconnaissance studies and, where justifiable, studies in depth of specific noise control problems are considered allowable planning costs.

- New Construction

  HUD discourages the construction of new dwelling units on sites which have or are projected to have unacceptable noise exposures by withholding all forms of HUD assistance for such dwelling units. This policy also applied to college housing, group practice facilities, nonprofit hospitals, and nursing homes.

- Existing Construction (including rehabilitation)
  HUD considers environmental noise exposure an important factor in determining the amounts of insurance and other assistance. Within cost limitations, HUD encourages modernization of buildings in noisy environments when such efforts will improve the noise exposure level.

- Grants and Allowances
  HUD extends assistance to State and local governments for the alleviation of community noise as may be provided for by the Congress.

- Information and Guidance
  HUD maintains a continuing program designed to provide up to date information on noise abatement techniques to public and private bodies. It also provides information on improved methods for anticipating the encroachment of higher noise levels and the means to deal with this encroachment. Through these HUD attempts to foster a better understanding of the consequence of noise.

- Construction Equipment, Building Equipment, and Appliances
  HUD encourages the use of quieter construction equipment and methods in population centers, the use of quieter equipment and appliances in buildings, and the use of appropriate noise abatement techniques in the design of residential structures and other structures with potential noise problems.

- Acoustical Privacy in Multifamily Dwellings
  HUD encourages the use of building design and acoustical treatment to afford acoustical privacy in multifamily dwellings.

Information was not available relative to HUD's internal noise abatement or hearing conservation programs. The only cost figure provided was an estimate of $30 thousand for total staff salaries without any indication as to the number of persons supported part- or full-time by these resources.

Department of the Interior (DOI)

The Department of the Interior submitted data covering three of their components; The Bureau of Mines, The Bureau of Reclamation, and the National Park Service. No information was obtained regarding noise problems or abatement efforts at the Department level nor does DOI indicate whether they have a Department-wide hearing conservation program.

Bureau of Mines. While the Bureau apparently does not have a specific long-term noise abatement program, their overall objective is to monitor noise exposure and to supervise overall reduction of noise to allowable limits. Various research projects are underway at the Pittsburgh Technical Support Center aimed at alleviating noise problems that arise in and around mining operations.

The Division of Health of the Directorate of Coal Mine Health and Safety, acting under Section 206, PL 91-173, Federal Coal Mine Health and Safety Act of 1969 has issued a noise standard (30 CFR 70, 500 et seq.) which made applicable to each (underground) coal mine and each operator of such mine the noise standards prescribed under the Walsh Healy Public Contract Act, as amended, in effect October 21, 1969. This noise standard was also made applicable to the surface work areas of underground coal mines and surface coal mines.

Coal Mine Health and Safety does not have a staff assigned full time to noise abatement work. However, the Chief of the Division of Health estimates that 10% of his time and 50% of a staff industrial hygienist's time is spent on

noise abatement efforts. The enforcement of the Bureau's health and safety standards is the responsibility of some one thousand field inspectors stationed throughout the coal fields. Part of their inspection duties is to investigate and evaluate the miners exposure to noise. The Bureau gives no specific amount of time spent in this area; however, it is estimated that noise abatement activities account for no more than 3-5% of their time. No estimate of the cost of these activities was obtained.

Bureau of Reclamation. The Bureau of Reclamation's report on their noise abatement activities indicates that they have a well organized and aggressive effort to control both their inhouse and over-the-fence noise problems. Noise abatement activity is considered to be one of their regular design, planning, and operating functions. Although personnel are not organizationally assigned to the noise control function (with the exception of one staff acoustical engineer), a number of the Bureau's personnel have received special noise control training and are available to work on noise problems as they arise.

To establish a uniform guideline for all its personnel, Reclamation has initiated effort to publish a Noise Control Handbook for Reclamation Operations. Although funds are lacking for the handbook, efforts were underway to establish funding. Consideration should be given to coordinating this effort with those by the Coast Guard/Navy, and other departments who have or are in the process of producing a similar handbook not only as a cost effectiveness measure, but also to insure comprehensiveness.

The Bureau recognized at an early date that specific noise control measures could be incorporated in the project design stage. This is now routinely handled by designers in the 15-man Structural and Architectural Branch of the Engineering and Research Center at Denver, Colorado. Because noise is inherent in some equipment, reduction of its effect is now

incorporated in the layout and designs of new facilities. Previously, other considerations distorted facility design and resulted in high-noise environments. For example, at one power plant a study revealed a cost saving if the turbine runner could be removed from below the turbine distributor rather than up through the generator. This arrangement precluded encasement of the turbine draft tube cone and required large open passageways from the draft tube area to other areas of the plant resulting in considerably more noise in the plant than from the usual installation. Future cost studies for installations include provisions for noise abatement to alleviate problems such as this.

The following are of some of the noise alleviating design solutions being used by the Bureau.

- Isolating objectionable noise-producing equipment by distance, if practicable, or by sound-retarding barriers. An example is locating the air compressors in a room some distance away from where personnel are normally stationed and, where possible, setting compressors on foundation slabs rather than intermediate floor slabs.

- Avoiding straight open corridors from sources of noise to areas normally occupied by personnel. For example, in power plants where the control room is on the same level as the access to the turbine pits, the access passages are oriented to direct noise away from the control room. At unattended facilities, plant operation is controlled from a remote station by supervisory control equipment. This type of operation reduces the noise problem to a sound-retarded communication booth.

- Providing for future additional measures at minimum cost, if found necessary. A practice now in use is to size openings to permit a future installation of standard size sound-retarding doors.

- Substituting concrete bearing wall enclosures for beam and column construction.
- Completely encasing turbine spiral cases in installations where partial encasement has been used in the past. Complete encasement is somewhat more costly in that additional plant height is required and more concrete is used.
- Isolation of pumping units where pump encasement is not possible. Isolation can be affected by utilization of sound-retarding walls and doors between pumping units. Isolation is also indicated for impulse wheels.

The hearing conservation program far exceeds any other noise related activity engaged in at Reclamation. The program is fully operational and is managed by the Regional offices with overall supervision by the Chief Safety Engineer, and technical assistance afforded by the Engineering and Research Center. Since 1968 over 5,000 sound level or octave band analysis readings have been made in Bureau-operated facilities on Bureau-administered construction projects, and on or near contractor and Bureau heavy equipment.

Each Region has obtained sound level and octave band noise analyzing equipment, audiometric examination and calibration equipment, and certified technicians to conduct audiometric exmainations and noise surveys. They have also contracted for the services of an audiologist or an otologist as a hearing conservation consultant, identified and posted locations with proper signs where high-noise levels are generated, obtained hearing protection equipment, developed educational use programs, and started to obtain baseline audiograms on all employees exposed to noise levels exceeding the recommended levels. In addition, employees found to have a significant hearing loss are being referred to their private physicians for consultation and additional examinations. Should followup or annual audiograms on referred employees indicate further losses, personnel actions are requested.

To date, excluding heavy equipment, 288 locations exceeding the 85-dBA limit have identified. Once such areas are identified, employees are informed of the hazard, and proper protective measures initiated until further analysis can determine if sound level reductions can be obtained. Studies have indicated that most operators of heavy equipment are exposed to noise levels in excess of the threshold limit values, and personal protective devices should be worn during operational periods.

The program is operational throughout the Reclamation area with hundreds of persons involved. Approximately 25 are professionals and the remainder subprofessionals.

The National Park Service. The National Park Service reported that they do not have a comprehensive noise abatement program and that no definitive projects were undertaken in 1972. In a more positive light, an initial Park Service effort has been directed at the establishment of regulations prescribing maximum allowable noise levels. This effort is primarily concerned with the control of noise from engine and motor driven sources. However, programs in this area are limited and preliminary in nature, and no funding or personnel allocation information was made available.

Department of Justice

The Department of Justice reported soley on hearing conservation activities within certain institutions under the jurisdiction of the Bureau of Prisons. The Bureau has in effect a hearing conservation program in institutions where noise levels are in excess of 90 decibels. This program follows the OSHA guidelines.

Although the Bureau has general supervision over the operations of more than 30 Federal correctional institutions, their report covered only four.

These are the U.S. penitentiaries at Atlanta, Georgia; Terre Haute, Indiana; Lewisburg, Pennsylvania; and Leavenworth, Kansas. Minimum noise level exposure is reported in areas where inmates work in textile, metal, and wood industries. Textile mills have the highest exposure levels. Audiometric testing equipment has been purchased at a cost of $6 thousand per institution and is used under the direction of the Safety Officer and Medical Department of each of the above mentioned facilities. Hearing protection equipment is also provided to the inmates where appropriate.

Information was not provided concerning the other institutions under the Bureau's direction. The Department of Justice did not provide information regarding noise abatement or hearing conservation activities in other subordinate areas. No personnel are assigned soley to noise related activities and, escept for the cost of audiometric testing equipment, other resources were not identified.

Department of Labor

The Assistant Secretary for Occupational Safety and Health (OSHA) has the responsibility for the occupational safety and health programs of the Department of Labor. However, noise abatement activities are only a portion of the total OSHA area of responsibility. Other areas include general safety and health standards for occupational hazards such as toxic substances, radiation, and fire protection. Information was not furnished concerning the Department of Labor's internal noise control efforts or hearing conservation programs.

In carrying out the mandate of the Occupational Safety and Health Act of 1970 (PL 91-596), OSHA develops and promulgates occupational safety and health standards, develops and issues regulations, conducts investigations and inspections to determine the status of compliance with these safety and

health standards and regulations, and issues citations for noncompliance. The Administration has 10 Regional and 50 Area offices established throughout the United States to support these activities.

The OSHA Act provides that States must submit plans if they desire to assume responsivility for the development and enforcement of standards which relate to any occupational safety or health issue for which a Federal standard has been promulgated. At the present time the various States are in the process of drafting, submitting, and acquiring OSHA approval of their plans. In the interim period, until such State plans come into effect, OSHA is enforcing the existing regulations. This requires the services of approximately 500 Compliance Safety and Health Officers and approximately 60 industrial hygienists in the Regional and Area offices who perform investigations and inspections for all OSHA health and safety standards. The Compliance Officers spend an estimated 3% of their time on noise abatement and related activities at an approximate annual cost of $135 thousand. The industrial hygienists spend approximately 5% of their time on noise programs, with an estimated annual cost of $54 thousand. Coordinating and reinforcing these field operations are four national office professionals who devote approximately 5% of their time to noise programs at an annual cost of $5 thousand. In addition, approximately $250 thousand was spent in 1972 to provide noise testing equipment for field personnel.

OSHA is authorized to accept and use the services, facilities, and personnel of any agency of any State or subdivision to support these activities. Provision is also made for reimbursement of the States for this effort. Supported under this provision are some 50 industrial hygienists plus various other clerical, secretarial, and administrative persons who are employees of agreement States. Approximately 3% of their time is devoted to noise abatement programs at a cost of $30,764 dollars. The Act also provides for direct grants to assist in developing State plans. It is estimated that the

States received $120 thousand for noise-related planning activities. This represents 3% of the total 1972 grant money.

Of the proposed FY 73 OSHA budget, approximately $500 thousand is earmarked for noise abatement activities. Similar portions of the projected FY 74 and FY 75 budgets are $400 thousand each. The Act provides for Federal financing of up to 50% of OSHA programs for agreement States. The budgeted OSHA share for FY 73, FY 74, and FY 75 is estimated at $200 thousand, $300 thousand, and $400 thousand respectively. However, the exact budget in these years is difficult to ascertain since the degree to which the various States will undertake to administer the OSHA requirements, the number of agreement States, and the rapidity of when the agreements shall become effective is difficult to project with certainty.

Department of State

This Department reports no noise abatement or hearing conservation activities for FY 73.

Department of Transportation (DOT)

Noise related programs in DOT are primarily activities directed towards the development of techniques for reducing the noise environment in which the transportation media operates or which is developed by transportation systems. Within DOT headquarters, the Office of Noise Abatement under the Assistant Secretary for System Development and Technology conducts extensive research with the ultimate goal of providing departmental leadership and direction in the development of public and private programs for the abatement of environmental noise caused by transportation systems. (See Sections 3 and 4 of this report for a discussion of these research projects.)

The following paragraphs describe the noise-related activities of the various components of DOT.

U.S. Coast Guard. The Ocean Engineering Division of the USCG is involved in reducing the noise pollution associated with the operation of sound (fog) signals through the control, relocation, redirection, or multiple operation of these signals. Sound signal pollution affects all Federal waterways except those free of fog, e.g., Southern Florida, Puerto Rico, Hawaii. Efforts to reduce this type of noise pollution include:

- Control--Procurement of fog detection devices to restrict operation of signals to periods of low visibility
- Relocation--Use of buoy sound signals, thereby removing the sound signal from shore areas
- Redirection--Determination of suitable baffles to alternate nonseaward radiation
- Use of arrays to focus sound
- The National Bureau of Standards is performing a study for the USCG entitled "Psychophysical Evaluation of Acoustic Navigation Aids: Preference and Aversiveness." The dollar allocation for this study in FY 72 was $10 thousand.

The Naval Engineering Division of the USCG is concerned with noise abatement aboard ships and boats. Noise abatement aboard ship presents special problems due to weight, environmental, and fire retardant requirements. The Division's responsibility for the design and maintenance of USCG vessels includes noise abatement for both hearing impedance avoidance and habitability.

Because of a lack of consolidated information specifically oriented toward shipboard noise control, the USCG entered into a contract for the production of a Noise Abatement Handbook, a design engineering manual for surface ships. The original contract was in the amount of $51, 329. However, subsequent to the award, the Naval Ship Engineering Center joined the USCG in this project, expanded its scope to suit Navy needs and contributed to the funding so that the final contract was for $71,900.

USCG Safety Manual, CG-405, consolidates Agency safety policies with a specific chapter devoted to a hearing conservation program. It specifies all aspects of the program including standard audiometry procedures, noise surveys, and hearing protection devices. Information was not obtained concerning the number of persons involved in the hearing conservation program.

The USCG noise program funding for FY 73 included $3,500 for personnel expenses plus $180 thousand for procurement of detectors to limit the operation of fog horns to periods of low visibility only. Their FY 72 funding included $5 thousand for personnel, $25 thousand for contracts and grants (including the relocation of buoys), and $5 thousand for miscellaneous noise-related expenses. Projected expenditures for FY 74 and FY 75 are $115 thousand and $50 thousand respectively.

Federal Railroad Administration (FRA). The Federal Railroad Administration reported no formal activities directed toward noise abatement. The FRA did report that they conducted measurement and evaluation efforts to determine horn/whistle audibility or effectiveness and the cause of wheel screech on rails and in retarder operation. These efforts could have bearing in future noise abatement activities. No further information was obtained.

National Highway Traffic Safety Administration (NHTSA). NHTSA's ultimate goal is to reduce accidents involving motor vehicles and to reduce deaths and injuries occurring in such accidents. Two NHTSA research study areas are concerned with measuring noise levels and their effect upon the driver and his performance rather than noise abatement per se. These are the noise generated by air bag deployment and the effect vehicle noise has on driver alertness. Some portions of this research could lead to noise abatement as a matter of course. (See Section 4 for a detailed discussion of these research projects.) No other information was obtained pertaining to NHTSA noise abatement activities.

Urban Mass Transportation Administration (UMTA). Under authority of the Mass Transit Act of 1970, the Rail Programs Branch of the UMTA, Office of Research, Development, and Demonstration is concerned with all phases of urban mass transportation for the purpose of assisting in the reduction of transit needs, the improvement of transit service and equipment, and meeting total transit needs at minimum cost. As part of these activities UMTA is attempting to make both current and future rail systems as quiet as practical. This effort includes:

- An assessment of the current conditions and identification of requirements
- Evaluation of existing noise abatement technology
- Development and demonstration of new techniques
- Preparation of a Rapid Transit Noise Abatement Handbook

These efforts are aimed at all aspects of existing and proposed rapid transit systems in order to make them acceptable to passengers and the community.

Projects to achieve these goals are underway at the Transportation Systems Center, Cambridge, Massachusetts. (See Section 4 for detailed discussions of these research projects.) No other noise abatement or hearing conservation information was received from UMTA.

Federal Highway Administration (FHWA). The Federal Highway Administration encompasses highway transportation in its broadest scope seeking to coordinate highways with other modes of transportation to achieve the most effective balance of transportation systems and facilities under cohesive Federal transportation policies. FHWA is concerned with the total operation and environment of the highway systems with particular emphasis on improvement of highway-oriented aspects of highway safety.

The Environmental Development Division is responsible for providing noise standards, procedures, guidance, technical information, and technical training to State and FHWA personnel. They are concerned with the planning and design of highways to assure that measures are taken to achieve highway noise levels that are compatible with different land uses; and due consideration is given to other social, economic, and environmental effects.

There are two full-time and six part-time professional personnel involved in this area. During 1973 a contract was let for the development of a noise training course for FHWA and State personnel. This provides for training courses in each of the nine Regional offices at a total cost of $132 thousand. The total division noise-related budget for FY 73 consisted of personnel salaries of $60 thousand, miscellaneous expenses of $70 thousand, and contracts and grants of $132 thousand, totaling $262 thousand. The projected budgets for FY 74 and FY 75 are $130 thousand per year.

Federal Aviation Administration (FAA). The noise abatement activities of the FAA are directed toward aircraft noise and sonic boom research programs to advance the understanding of the effects on man and other ecological systems, and the mechanisms of acoustic prediction measurement and control to support required regulatory action. (Section 3 of this report discusses the research projects under the auspices of the FAA.)

Department of the Treasury

Information regarding noise abatement and hearing conservation was obtained from a number of the Offices, Bureaus, and Services of the Treasury Department. Although the noise control effort of the Treasury Department is vested in the Office of Central Services within the Office of the Secretary of the Treasury, it appears that this Department does not have anyone assigned specifically to noise control. Rather, managers and supervisors whose operations are noise producing (buildings management, printing and reproduction,

communication and personal property, and the Fiscal Division) are required to review and correct objectionable activities on an Ad Hoc basis. Activities found to be not amenable to correction or abatement are reported to the Director of the Office of Central Services.

The Office of Central Services has no separate issuance regarding noise abatement or hearing conservation. Instead, this office follows the promulgations and guidance of the department Environmental Quality and Safety Officer. At this time, the Office of Central Services has no separate line items in its budget for noise abatement activities. Rather, these activities are initiated as part of other programmed activities (space renovation planning, printing plant operations, etc.), and the level of noise abatement planning has not reached a point where separate consideration is deemed necessary.

Secret Service. The Secret Service advised that their only area of concern is their firing ranges where steps have been taken to provide the maximum in acoustical treatment and to furnish employees with protective devices. The Secret Service report does not indicate the degree to which their program includes noise abatement in areas other than the firing ranges nor does the report indicate the existance and execution of an active hearing conservation program in accordance with OSHA.

Internal Revenue Service. The Internal Revenue Service indicates that their only involvement with noise abatement is an indirect consideration for equipment selection and installation. Their reply to the EPA questionnaire does not clearly indicate an adherance to the OSHA guidelines for noise abatement or the existence of a formal hearing conservation program.

The Bureau of Customs. The Bureau of Customs hearing conservation program is outlined in their Circular FAC-11-FSB, "Facilities, Protecting Hearing Against Excessive Noise." This directive circular provides that personal protective equipment shall be provided and used and authorizes Bureau of Customs personnel to wear a hearing protection device of a type suitable to the user.

The Bureau also identified a specific noise abatement problem at the Blue Water Bridge border crossing at Port Huron, Michigan. Although this location is under the control of the Michigan State Highway Commission, representatives of Customs and the Immigration and Naturalization Service were planning to meet with Highway Commission officials in an attempt to resolve the noise problem at this site.

Bureau of the Mint. At the request of the Bureau, the Industrial Hygiene Services Branch of NIOSH conducted hazard evaluation studies at Mint industrially oriented facilities. Among the hazards evaluated, noise was one of the predominant features in all the facilities. The noise levels ranged from a low of 75-dBA to a high of 112-dBA, especially in the rolling areas and press rooms. No indication of corrective noise abatement actions taken or planned was indicated by Bureau personnel.

However, a mandatory hearing conservation program does exist throughout the Mint service. Audiometric testing is given to all new employees and continues periodically throughout their service. Personal protective equipment is provided against the effects of noise. In the future, it was indicated that more emphasis will be given to conducting engineering and administrative noise abatement studies throughout the Mint service.

Consolidated Federal Law Enforcement Training Center (CFLETC). The CFLETC's only noise abatement activity during the calendar year 1972 consisted of the erection of a board fence between a portion of the dignitary protection training area and the Baltimore-Washington Parkway. The primary purpose of this fence is visual screening with a secondary purpose to buffer and deflect the noise resulting from the occasional shots fired in this area.

Information was not provided concerning the availability or use of hearing protection by individuals firing on the various ranges or the existence of a hearing conservation program for persons permanently assigned as instructors.

Bureau of Engraving and Printing. The Bureau of Engraving and Printing periodically requests the Public Health Service to conduct industrial hygiene surveys (including noise level measurements) intended to insure the safety of Bureau employees. As standard engineering practice acoustical materials are used in those areas where the noise level is a consideration. The Bureau's buildings encompass three isolated areas where the noise level is high. Personnel who work in these areas are required to use ear protection devices. The Bureau did not indicate whether they have a formal hearing conservation program requiring periodic audiometric examinations.

Atomic Energy Commission

This agency reports no noise abatement or hearing conservation activities for FY 73.

Civil Aeronautics Board

This agency reports no noise abatement or hearing conservation activities for FY 73.

Environmental Protection Agency (EPA)

EPA reported no internal noise abatement or hearing conservation activities for FY 73. (See Section 7 for a discussion of EPA noise activities.)

Federal Communications Commission (FCC)

This agency reports no noise abatement or hearing conservation activities for FY 73.

Federal Maritime Commission

This agency reports no noise abatement or hearing conservation activities for FY 73.

Federal Power Commission

This agency reports no noise abatement or hearing conservation activities for FY 73.

General Services Administration (GSA)

The General Services Administration's primary effort towards the establishment of limitations on noise emission has been by the inclusion of appropriate controls or limits in the specifications and regulations for which it is responsible. Specifically, the Public Buildings Service of GSA has taken steps to reduce noise levels in the following areas.

- Construction equipment sound levels
  GSA has established maximum permissible sound levels for construction equipment. The sound levels are published in the Special Conditions section of GSA specifications.
- Enforcement of construction equipment sound level standards
  All Regional Administrators were advised to purchase portable sound level meters and to monitor construction sites on both a scheduled and an ad hoc basis.

- Operating mechanical equipment sound and vibration
  Limitations on sound and vibration of building systems equipment have been issued in the Vibration Isolation section of GSA specifications. Enforcement of this criteria is within the precinct of the Contracting Officer;and material not complying is to be rejected.

- Acoustical privacy in open office space
  GSA has issued requirements in the Integrated Ceiling and Background section of the specification for sound attenuation and generation in order to provide speech privacy.

  Additionally, specifications which were revised to include noise abatement provisions cover the following items.

  - Portable penumatic drill
  - Penumatic grinder
  - Pneumatic impact wrench
  - 21 inch rotary gasoline powered lawn mower
  - 24 inch through 60 inch rotary gasoline engine powered lawn mowers

GSA did not provide information concerning the other subordinate activities under its jurisdiction. There was no reported information concerning a hearing conservation program. The GSA does not have personnel assigned exclusively to noise programs; and no estimates were made as to the number of individuals or the percentage of their time spent on noise programs. Information was not provided regarding costs or budgeting.

Interstate Commerce Commission

This agency reports no noise abatement or hearing conservation activities for FY 73.

National Aeronautics and Space Administration (NASA)

The NASA report on noise activities consisted of individual reports for their headquarters and field installations.

NASA does not have a formal agency-wide noise abatement program. Rather, activities are carried out according to the nature of the facility on an as-needed basis. These are primarily aimed at abating over-the-fence noise which the agency may impose upon its neighbors. Where applicable, specific abatement projects have been reported and are described in the following sections.

Hearing conservation programs are carried out at NASA Headquarters and each field center. The type of hearing conservation program varies according to the nature of the activities performed at the specific installation. The Agency adheres to the noise standards set forth in the Department of Labor's Occupational Safety and Health Standards, 37 CFR 1910.95. NASA also has issued a handbook, A Guide to Hearing Conservation in Noise Exposure, which provides guidance for all agency components.

Information was not provided to indicate the total funding for either noise abatement or hearing conservation programs. The allocation of resources for these activities is generally not separable but consists of a portion of an overall effort. However, funding for specific projects has been listed, if separably identifiable, as a noise activity. Also, where provided, estimates of the proportional share of noise-related activities are shown for each NASA facility.

NASA Headquarters. The NASA Headquarters noise activities are aimed at the conservation of hearing and the enhancement of working conditions so as to maintain speech interference levels as low as possible. The

program is the responsibility of the Environmental Health Branch of the Office of Occupational Medicine and Environmental Health. Actual health services are provided by six personnel including one physician, three industrial hygienists, and two nurses. Audiometric examinations are given to all persons included in the Headquarters annual physical examination program (about 1000 persons).

Types of noise sources identified in and around the major office buildings include ventilation equipment, office machines, printing shop equipment, traffic, construction, and automatic data processing equipment. However, no significant noise problems are reported to exist and no comprehensive program plan has been developed. No specific information was obtained regarding the assessment and/or abatement of these sources of noise.

Costs of noise programs at NASA Headquarters are not separably identifiable, since they are only a part of the various functions performed in a comprehensive medical and environmental health program.

Ames Research Center (ARC). All noise related activities at ARC are coordinated by the office responsible for administration of the Occupational Health Program. The program employs five professionals: three medical, one industrial hygienist, and one health physicist. No specific information was obtained pertaining to the hearing conservation program at ARC except for the intent to meet OSHA standards.

One specific noise abatement project was reported. A sound absorbing structure is being constructed over the 11 foot transonic wind tunnel in order to reduce the impact of operations on adjacent cities. The FY 73 funding for this project is $493 thousand.

Goddard Space Flight Center (GSFC). Although no comprehensive program plan exists, GSFC program objectives are the prevention of noise-induced hearing loss and the overall reduction of sound levels in work areas. Sources of noise identified include boiler and refrigeration unit noise in power plants, sound levels generated by computers and related equipment, construction equipment noise, equipment noise in fabrication and maintenance shops, ventilation system noise in offices, leakage from equipment for testing spacecraft hardware for sound and vibration effects, and street noise.

The GSFC noise abatement and hearing conservation program includes:

- Regular periodic audiometric testing of all of the approximately 4000 GSFC employees.
- Special annual audiometric testing of some 275 employees who are exposed to high-sound levels.
- Continued surveillance of identified sources of high-sound levels.
- Review of contractor health and safety plans. Where appropriate, GSFC requires provision of engineering and administrative measures and/or protective equipment.
- Review of facility construction plans to ensure inclusion of necessary sound reduction services, where appropriate.
- Landscaping of Center roads, employing vegetation for sound attenuation.
- Provision of personal protective equipment in areas where engineering and administrative methods are inadequate for reducing noise exposure to acceptable levels.

No specific cost breakdown is available for these activities since they are part of the services provided under a comprehensive occupational medicine and environmental health services contract.

Flight Research Center (FRC). The goals of the noise abatement activities at the FRC are to conserve hearing and/or prevent noise-induced hearing loss to employees by providing an effective hearing conservation program within the resources available. Six personnel are engaged in these activities including the Medical Director, Medical Officer, Industrial Health Nurse, Director of Safety, Acoustic Engineer, and Medical Assistant.

No over-the-fence noise abatement problems or programs were reported. General abatement procedures include:

- Survey and charting of work areas is done at FRC with a noise meter. The frequency of these noise surveys is dictated by changes in the operational condition at these work areas.
- Evaluation and recommendations relating to the adequacy of the noise control are made to the Medical Director.
- Protective equipment is provided where necessity is indicated.
- Indoctrination and continuing education are provided to workers concerning noise hazards and the use of personal protective equipment.
- Medical support, advice and consultation is provided to assist in solving problems regarding noise in the work environment.

The FRC hearing conservation program includes the following activities:

- Audiometric tests of all FRC employees during their annual physical examination.
- Annual audiometric tests for contractor employees working in hazardous areas.

- Immediate audiometric examination of any worker who suspects a hearing loss as a result of noise exposure.
- Biannual audiometric tests for personnel who work on the flight line or in areas of high-ambient noise.
- Audiometric tests as part of pre-employment and preplacement examinations.
- Medical referral service for any workers with hearing problems.

Information was not obtained regarding personnel or resources applied to the noise-related activities at FRC.

Johnson Space Center (JSC). JSC does not engage in the type of programs that inherently include large noise generating equipment or systems. Therefore, there are no conflicts with -- with no measures necessary to control -- the imposition of noise on community neighbors. The noise abatement program at this Center is one which is occupational health oriented and is directed toward employee protection in individual work areas. To this end, a listing of areas reflecting some degree of noise problems is maintained. In the majority of cases the levels are such that they are an inconvenience as opposed to a hazard. Worst case conditions are effectively relieved by protective devices such as ear plugs or external cups.

The Industrial Hygiene Section is responsible for monitoring and surveillance activities to identify and evaluate intermittent noise problems in working areas. These studies determine whether the problems involve hearing damage risk, speech interference, nuisance noise levels, or community noise pollution. Control measures appropriate to each situation are recommended in the report of findings and conclusions, which is submitted to the cognizant organization, to the Operations Safety Office, and to the Engineering Division if facility modifications are indicated.

Indicative of the attention given noise as a facility design parameter are the following specific projects conducted by the JSC Engineering Division.

1. Noise study of central heating and cooling plant. This project identified sources and characteristics of the noise environment in JSC Building 24 and developed concepts for attenuating conditions which might be detrimental to employees working in the facility. The study was accomplished under contract during 1972 at a cost of $3,820.

2. Design analysis of proposed changes to vibration and acoustic facility. It was necessary to examine the noise generating properties of proposed changes to this major test facility. The effort was accomplished under contract at a cost of $15 thousand.

The Health Services Division of the Life Sciences Directorate has the responsibility of conducting a hearing conservation program at JSC. Annual health screening examinations are offered to all civil service employees and these examinations are mandatory for both civil service and contract employees exposed to potentially hazardous noise levels (85-dBA). Examples of such job categories are Acoustics and Vibration Workers, Centrifuge Subjects, Flight Controllers, Scuba Divers, Thermochemical Workers, Welders, and Solderers.

Although no breakdown of the resources allocated for the total noise program at JSC was obtained, it was indicated that Occupational Medicine and Environmental Health contract personnel expend approximately 0.6 of a man-year of effort annually in this area at a cost of approximately $6,500.

Kennedy Space Center (KSC). The KSC noise program consists of periodic re-evaluation of each noise hazard area, implementation of engineering and/or administrative controls where necessary, minimizing the number of personnel required to use ear protection, and surveillance over use of such protection. The audiometric program includes periodic audiometric evaluation.

Types of noise problem areas at KSC include high-pressure gas ventings, utility equipment rooms and generator stations, ultrasonic cleaning operations, burst disc and relief valve-testing operations, classified document shredder operations, and sandblasting operations.

Occupational medicine and environmental health services at KSC are provided for the approximately 15 thousand employees under a comprehensive contract. The cost of the noise-related portion is not separable. Personnel involved in this activity include 8 medical doctors, 4 industrial hygienists, 3 environmental specialists, and 30 nurses and medical corpsmen.

Langley Research Center (LaRC). Noise generating activities at LaRC include aircraft operations, wind-tunnel operations, and industrial equipment noise. A community noise survey was performed by a contractor in 1972 to determine impact on the nearby community. A more recent contract has been let to study the propagation of noise from LaRC. An internal survey was also conducted building-by-building in 1969 to determine noise levels in working areas and the need for personnel protective measures.

Fifteen LaRC personnel are involved in the noise abatement program including a Safety Officer, Nuclear Engineer, Electrical Engineer, Environmental Engineer, did Audiology professor --in addition to graduate students, industrial hygienists, and engineering technicians.

The hearing conservation program provided by LaRC includes audiometry and covers approximately 500 employees. The only details available indicate that this program is in accordance with the OSHA requirements.

The only budgetary information provided by LaRC relates to the FY 72 contractor study. This was done at a cost of $15 thousand. There is no separate budget line item for the other noise activities.

Lewis Research Center (LRC). LRC reported no over-the-fence noise control activities. A hearing conservation program is conducted to protect workers in high-noise areas. Noise sources include jet and rocket engine operation, machine shops, data acquisition and processing equipment, pumps, and compressors. The hearing conservation program is conducted in accordance with the provisions of a safety manual which provides for:

- Education and information on the hazardous effects of noise
- Continuing surveillance of noisy work areas
- Issue of personal ear protective devices and instruction for their use and care in compliance with OSHA standards
- Minimizing the exposure of personnel to hazardous noise in work areas
- Periodic audiometric examinations

The Plum Brook Station, which is a satellite of LRC, also conducts a hearing conservation program due to the operation of special research equipment.

Marshall Space Flight Center (MSFC). The Center's occupational noise exposure control program is a continuing effort program established under the surveillance of the Safety and Manned Flight Awareness Office and managed by the Management Services Office's Environmental Health Service. Noise levels in the various operational areas are monitored by Environmental

2. Industrial noise generation and control. These include efforts to identify significant sources of noise generated by the operation of new industrial facilities. Sound source modifications or attenuation devices are usually recommended. Approximately 5 man-days per year are required for this activity.

3. Acoustic environmental assessments and environmental statements for community exposure. This involves the definition of the acoustic environment for rocket static test firing with regard to community-related problems. Approximately 0.1 man-year of effort is required for this activity.

4. Planning for test operations which generate noise. This includes studies concerning acoustic environments to be created by new programs (e.g., Space Shuttle), studies in support of overall planning efforts for large rocket engine tests, optimization of environmental exposures, and selection of test sites and facility configuration for testing. Approximately 0.1 man-year effort is required.

All occupational medicine and environmental health activity at MSFC (hearing conservation) is performed by the MSFC Medical Center. Various Medical Center personnel including physicians, industrial hygienists, and registered nurses participate in the administration of this hearing conservation program. No reliable estimates of the amount of these individuals' time devoted to the noise program are presently available. Approximately 330 MSFC personnel are currently enrolled in the hearing conservation program. Personnel who may be subjected to noise hazards are given mandatory physical examinations and/or audiometric examinations at least annually.

Medical Center personnel support the noise abatement activities of the Center by participation in the following activities.

- Reduction of the ambient noise to the lowest possible levels. This includes participation by industrial hygiene personnel with other appropriate Center elements in the redesign of facilities, assisting and advising in lowering noise levels of specific items of equipment, and continued monitoring to determine the effectiveness of any corrective actions.
- Prevention of noise hazards. Industrial hygiene personnel routinely review design drawings and Standard Operating Procedures with a view to identifying potential environmental hazards including high-noise levels.
- Issuance of personal hearing protection. As an interim measure pending the abatement of high-noise levels, and in instances where noise cannot be lowered to safe levels, personnel are issued ear-muff type protection and/or individually fitted ear plugs.

Similar hearing conservation programs are in effect at the MSFC Mississippi Test Facility and the Michoud Assembly Facility and are conducted by the institutional support services contractors at those locations. Periodic visits to both sites by the MSFC environmental health personnel include reviews of the programs.

Wallops Station. The Wallops Station noise control program is primarily directed to assure compliance with the Occupational Safety and Health Act of 1972. At present, the State of Virginia has not defined noise control standards; however, it is not anticipated that noise levels from any of Wallops' operations will exceed the noise standards when adopted. Rocket launch operations are isolated from public areas by two miles of marshland and the noise

levels from these launches are very low and of very short duration. Wallops' industrial sites have low-noise levels and are also isolated from public areas.

The major areas of noise program activity at Wallops Station include:

- Identification of Noise Sources and Hazards Levels

  A noise level survey of all Station activities has been initiated. To date only two activities have been identified having noise levels which require personnel protection. One involves the infrequent exposure of aircraft mechanics to jet engine noise levels in excess of the OSHA standard. The other activity is the exposure of operating personnel to noise levels generated by an Advanced Data Acquisition System antenna.

- Noise Exposure Protection

  Ear protection has been provided for those personnel required to work in the high-noise level areas described above. Ear protection has been recommended for other areas where noise levels are high but do not exceed the OSHA standards. Warning signs are posted in high-noise areas.

- Audiometric Examinations

  During 1972, 366 personnel were given audiograms or audiometic tests. Additionally, 31 of these employees who work in high-noise areas were given periodic audiometric tests during the year.

- Noise Hazard Elimination

  An engineering review of noise hazards is to be performed to determine if redesign of systems to reduce noise levels is technically and economically feasible. Additionally, safety engineering reviews of all new facilities will include evaluation of potential noise hazards.

Wallops Station does not have any contracts specifically for noise activities. Two service contractors perform these functions on a part-time basis. It is estimated that both of these contractors devote approximately 5% of their time to noise-related activity. Approximate service contract costs for the assigned Industrial Hygienist and Doctor of Medicine are $2,789 annually.

Jet Propulsion Laboratory (JPL). As a private contractor, JPL is regulated by both California and Federal requirements. These are supplemented by JPL Safety Practice 12-7-72, Noise Levels and Protection. This exceeds OSHA requirements and requires ear protection if exposure exceeds 85-dBA for an eight-hour day.

Periodic sound level surveys are conducted in noisy areas and periodic autometric tests are conducted for personnel who may be exposed to excessive sound levels. Where excessive levels are determined, abatement of the noise is made at the source or administrative controls instituted. This program has been in effect for many years.

Various noise-related problems are encountered varying from those caused by construction equipment to the high-level noise chamber for environmental testing of spacecraft equipment. Wind tunnel compressor plants and gas and diesel electrical power generation plants also present a problem because of the size and quantity of the equipment. Control rooms are acoustically isolated from noisy plant areas. Personnel are required to wear ear covers when it is necessary to leave the control room in order to check equipment in the plant area. Isolation mounts are used to effect noise control on smaller equipment. Acoustic baffles are used to reduce the noise from items such as computer keypunch machines. Other general noise control provisions include restrictions on hours of operation for construction contractors utilizing noisy

equipment and a requirement for construction contractors to muffle internal combusion engines and compressors. There are no specifically identified over-the-fence noise problems

Approximately 84 people are included in an annual audiometric program. Three inhouse professionals including one environmental hygienist and two nurses devote part of their time to the program. Cost of the program is not specifically budgeted, but is estimated at $3,500 for salaries and miscellaneous expenses. A projected separate budget for FY 74 and FY 75 has not been prepared.

National Science Foundation (NSF)

This agency reports no noise abatement or hearing conservation activities for FY 73.

Smithsonian Institution

This agency reports no noise abatement or hearing conservation activities for FY 73.

Tennessee Valley Authority (TVA)

Noise abatement activities in this agency have been limited to the investigation and rectification of specific individual problems or complaints. These are related to the operation of thermal electric generating plants, power transmission systems, and a fertilizer production plant,as well as the general problem associated with the use of heavy construction equipment and blasting. A somewhat more active role is planned starting in FY 74 with the implementation of a TVA Community Noise Control Program.

In past years noise sources giving rise to complaints have included safety relief valves on steam plants, coal car shake-outs, air-blast circuit

breakers, transformers, and blasting operations. These have been investigated and handled as the complaints were received. For new facilities, such as the gas turbine peaking plants and substations utilizing air-blast circuit breakers, noise specifications are included in the contracts and purchase specifications. Evaluation of noise impact is included in environmental statements prepared on TVA projects.

The specific goals of the Community Noise Control Program include:

- To continue the present level of activity in FY73, responding only to requests and complaints
- To add an acoustical engineer in FY 74 for concerted professional efforts to reduce and prevent excessive noise pollution by working with TVA operating and design group
- To inventory and evaluate noise sources in TVA, starting in FY 74
- To develop reasonable noise design criteria and purchase specifications starting in FY 75
- To keep abreast of legislative requirements concerning noise control and to make every effort to assure compliance by TVA

The noise abatement activity in the agency is concentrated in the Hazard Control Branch of the Division of Environmental Planning. The current (FY 73) level of effort is 0.2 man-years ($3,800), which will increase to 1.1 man-years ($15,300) with the implementation of the Community Noise Control Program in FY 74.

United States Postal Service

The Systems Engineering Design Branch is responsible for coordinating the effects of numerous postal service elements that include noise abatement as one of their major concerns. The Postal Service reports that none of their currently installed equipment exceeds the 90-dBA limit imposed by the Healy Act.

The Service is attempting to maintain the lowest noise levels feasible; and procurement contracts for new equipment generally limit levels at operator positions to 80-dBA. Surveys to establish existing sound levels in postal facilities throughout the nation were provided through the Postal Service Laboratory Division. This Division also provided the initial standards for noise levels and noise level measurements.

The Postal Service has in effect an active contract to develop noise reducing modifications for present equipment. These actions are based on the goal of defining an optimum noise level that balances the cost of noise suppression against employee environment. This contract is part of a project entitled "Sound and Vibration Control in Post Office Facilities." This project, scheduled to be completed in the summer of 1973, involves the development of system and equipment modifications to reduce noise levels. Follow-on programs to retrofit postal equipment will depend largely on the cost/benefits of the retrofits developed.

The Postal Service has ten professional personnel engaged in noise related efforts. They are supported by approximately 490 safety specialists who are trained in the basic problems of noise abatement and sound measurement techniques.

The contract effort to develop noise control techniques for existing postal equipment is valued at $210 thousand,of which $33 thousand is in the FY 73 budget. The approximate cost of personnel involved in noise abatement for FY 73 is $100 thousand. In addition, travel expenses and instrumentation prorated against noise control is estimated at $50 thousand per year. In FY 73, it is estimated that $50 thousand will be spend in establishing noise criteria and correcting noisy installations.

Veterans Administration (VA)

This agency reports no noise abatement and hearing conservation activities in FY 73.

SECTION 7

ENVIRONMENTAL PROTECTION AGENCY ACTIVITIES

The preceding sections of this report covered Federal Government noise research and technology activities (Sections 3, 4, and 5) and noise abatement and hearing conservation programs (Section 6). The activities of EPA's Office of Noise Abatement and Control (ONAC) were not included in any of the earlier sections, since its role is not readily described in that context. Rather, its activities are characterized most clearly in terms of the provisions of the Noise Control Act of 1972 (PL 92-574).

In recognition of the urgency of a number of aspects of the general noise pollution problem, the Act levied on EPA several specific tasks to be accomplished within a stated time period. These mandates dominated ONAC's activities during most of FY 73 and continue to do so in FY 74. The Act requires EPA to

1. Promulgate regulations for the certification of low emission products for procurement by the Federal Government
2. Publish a criteria document describing the best known information on relationships of various effects of noise to various levels of noise
3. Present to the Congress a report on aircraft and airport noise
4. Propose regulations to the FAA covering aircraft noise and interact and work with them to support adoption of the regulations
5. Propose and promulgate noise regulations for operation of interstate rail carriers and their facilities.

6. Propose and promulgate noise regulations for operation of interstate motor carriers

7. Publish a report describing the levels of noise deemed necessary to protect public health

8. Publish a series of noise regulations for control of major sources of noise based on the identification of such sources and information as to technology and costs

9. Initiate regulations requiring the labeling of noisy products or of products intended to reduce noise

10. Develop and implement a program for the coordination of all research and control activities of the Federal Government. Related to this mandate is the requirement to publish "from time-to-time," a report* describing and assessing the efforts of the Federal Government to control noise.

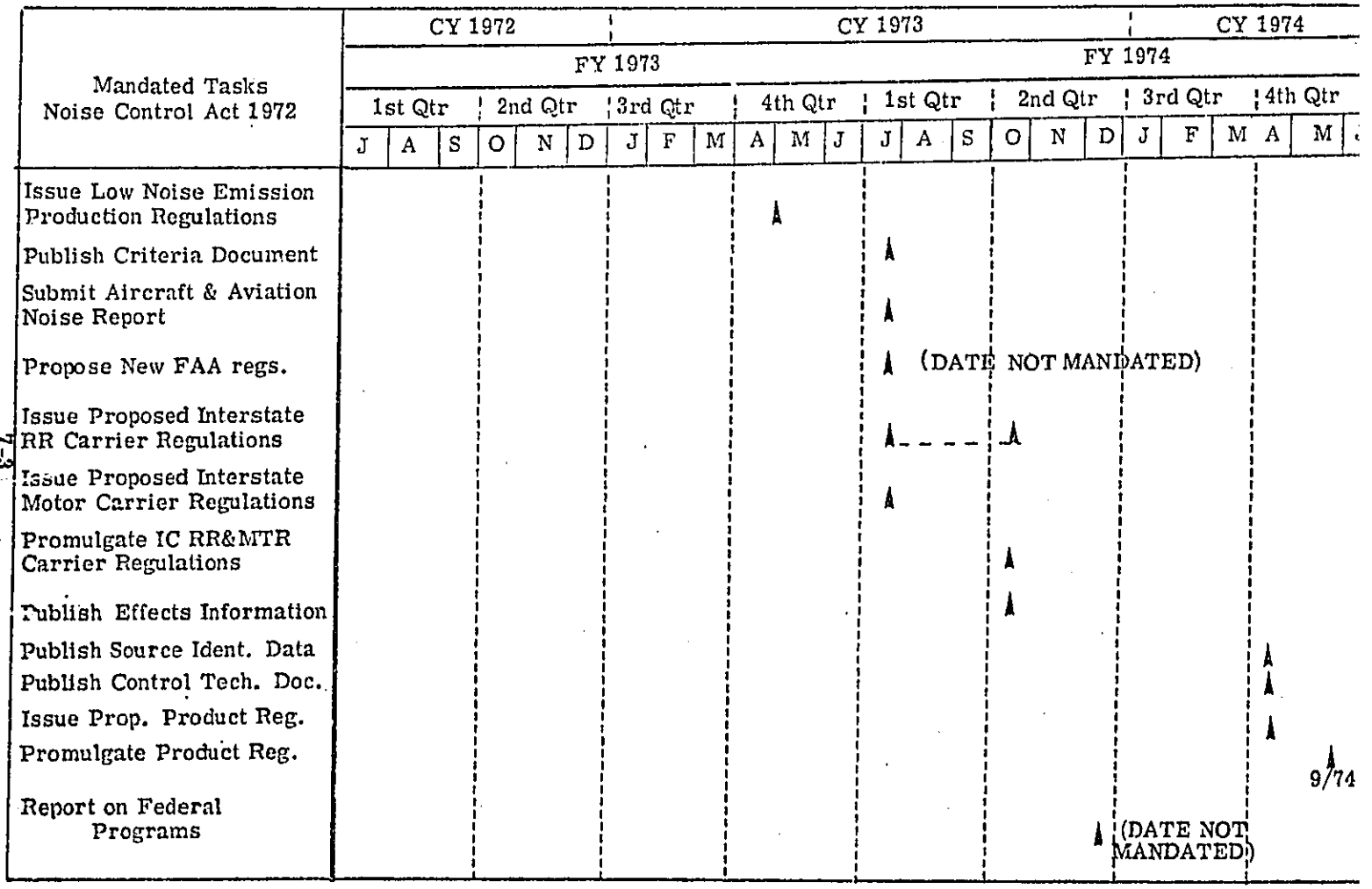
Work plans were accordingly developed to accomplish the prescribed mandates within the time specified for each. Figure 7-1 presents the schedule for completing the indicated tasks. As depicted in Figure 7-1, the EPA has made substantial progress in the implementation of the Noise Control Act of 1972. Major accomplishments include:

- Publication of the required report to Congress on aircraft and aviation noise. In accordance with the requirements of the Act, this report addressed:
  - Adequacy of Federal Aviation Administration flight and operational noise controls

* This presentation is the first such report.

FIGURE 7-1

OFFICE OF NOISE ABATEMENT AND CONTROL
SCHEDULE OF TASKS



- Adequacy of noise emission standards on new and existing aircraft, together with recommendations on the retrofitting and phaseout of existing aircraft
- Implications of identifying and achieving levels of cumulative noise exposure around airports
- Additional measures available to airport operators and local governments to control aircraft noise

- Publication of a criteria document reflecting the available scientific knowledge most useful in indicating the kind and extent of all identifiable effects on the public health or welfare which may be expected from different quantities and qualities of noise.
- Proposed regulations for the control of noise from interstate motor carriers.
- Proposed regulations relating to the Federal Government's procurement of low-noise emission products.
- Initiation of the review of the Federal Agencies' noise control programs and established proposals for coordination of such programs.
- Submittal and acceptance of proposed model laws for consideration by State governments.

The mandate to coordinate all Federal noise programs has no time constraints associated with it. This task, as well as some of the other broader aspects of EPA's responsibilities, has necessarily received a lower degree of priority than the ones with associated regulatory deadlines.

In addition to the mandatory work described above, the Act authorized EPA to (i) conduct and sponsor research, as necessary, to complement programs

of other agencies on the effects, measurement, and control of noise; (2) provide technical assistance to State and local government to facilitate their development and enforcement of ambient noise standards; and (3) disseminate noise information to the public. These areas and the Federal coordination role will be receiving increasing attention in the future.

Coordination of Federal Programs

Coordination of noise-related activities in the Federal Government most certainly exists--although to a varying and unknown degree--among the elements comprising the various major noise programs, such as NASA's Quiet Engine Program, DOT's Refan Program, or DOT/UMTA's Rail Technology Program. On the other-hand, it is not at all clear the extent to which coordination is adequate or even exists among different programs within the various components of a single agency or between major agencies. The most clear cut example of the lack of adequate coordination in the past was in the aircraft noise area which heavily involved NASA, DOT, and DOD. A major step has been taken, however, by the recent formation of a joint DOT/NASA office to plan and coordinate aircraft noise research and technology. Other areas also require coordination however, and it was not possible in the course of this study to assess the extent to which these areas are, in fact, coordinated. They include: (1) basic research on aircraft noise, (2) the broad area of receiver effects, and (3) noise survey work. Each of these areas is rather active, being worked by numerous organizational entities, and involving large expenditures. For example, it was found that there were 55 projects of a related nature being conducted or sponsored by eight different NASA centers, accounting for approximately $4 million. (Details on these findings are provided in Section 3.) The need to ensure coordination of this work is obvious.

The other major aspect of coordination which is of concern to EPA concerns sensing the overall direction and progress of noise activities in the Federal Government. EPA is interested in the larger view and, in general, is not concerned with the assessment (in any usual sense of the word) of specific individual projects. Rather, it is concerned with the understanding of collections of projects or programs and with the long-range objectives of such activities, their major milestones, and their funding requirements and how they relate to one another in some coherent manner. Only with such a comprehensive understanding of the numerous and diverse activities of the Federal Government can EPA comply with the intent of the Noise Control Act of 1972 and create a plan that will achieve the broad objective of an orderly and cost-effective abatement and control of noise pollution. Further, only with this understanding can EPA make informed judgments regarding the status and progress of such activities and determine whether such work is being effectively and properly directed.

An obvious prerequisite for EPA to make correct judgments and recommendations is that this agency acquire maximum understanding of the status, plans, and programs of all noise activities in the Federal Government. Accordingly, EPA intends to fully exercise its lines of communications with all agencies in order to ensure the timely flow of all relevant information. This means that face-to-face contact will be necessary and, particularly where long-range plans for noise activities are lacking, working with the agencies to create the necessary information is essential.

It goes without saying that the development of an effective coordination role by EPA will require resources concomitant with the task.

Current Activities

The majority of EPA resources have been committed in areas required to implement the major provisions of the Noise Control Act of 1972, such as: interstate motor carrier regulations, the airport/aircraft study, railroad regulations, the preparation of a criteria document, and the identification and regulation of major noise sources. However, there have been positive initial steps taken in establishing the coordination role of EPA with regard to other Federal agencies.

Preparation of an Annual Report. This report is the first such effort. It will serve as a baseline for further efforts by: (1) providing a status report of the Federal Government's efforts to control noise, (2) clarifying the need for coordination of an EPA role, and (3) identifying EPA's needs for information. It should also help to identify areas of related work requiring greater coordination and indicate whether the overall distribution of effort is in balance with the actual needs.

Program Review Symposium. EPA is currently preparing to conduct a Federal agency noise control and noise research program review this fall. In that review, EPA plans to review the major points of its first annual report. This will be followed by presentations of those agencies significantly involved in noise activities. General areas to be covered will be FY 74 activity, FY 75 plans and long-range program objectives such as five-year plans, and an investigation into utilization of existing computerized noise data bases. This symposium-type program review should enable EPA to acquire additional information on the range and extent of ongoing Federal projects and to further define its coordination role.

Review of Environmental Impact Statements. EPA has also placed considerable emphasis on the evaluation of Environmental Impact Statements (EIS).

Consequently, there has been noticeable improvement in consideration of noise as an environmental pollutant over the past year. EPA reviews on the average approximately 15 EIS's per region per month and three at headquarters. Of these EIS's, approximately 80% deal with highway improvements, modifications, or proposed new highways. The remaining 20% are split between airport expansion or modification and fixed site potential noise sources such as nuclear power plants. In order to achieve more consistent treatment of EIS's, EPA is developing--with the assistance of an Interagency Agreement with the Committee on Hearing, Bioacoustics and Biomechanics, National Academy of Science-National Research Council (CHABA)--a comprehensive set of guidelines for use by both the preparers and reviewers of Environmental Impact Statements. This will help to ensure that noise is adequately considered.

Review and Comment on Proposed Regulations. EPA has in the past year received and advised upon several proposed standards or regulations pertaining to noise; which have been promulgated by Federal agencies. For example, EPA commented on advanced notices of proposed regulations for truck interior cab noise levels. Comments were also made on advanced notices of proposed rule-making for FAA Fleet Noise Level Regulations. A series of meetings were held with DOI/Bureau of Mines concerning noise levels which they were considering for metal and nonmetal mines. Written assurances have been received from DOI indicating they will propose to their advisory committee that their noise exposure standard be lowered to 85-dBA from its current 90-dBA. As a result, EPA agreed to permit DOI/Bureau of Mines to publish their proposed regulations for health and safety for metalic and nonmetalic mines. Review and comments were provided on DOT/Federal Highway Administration's proposed regulations for new highway noise levels. EPA has also had a series of meetings with DOT/FAA personnel in regard to a new aircraft noise description system called Aircraft Sound Description System (ASDS). At pre-

sent, this noise descriptor has not yet been officially promulgated and is still being used as an internal order. The DOT/FAA apparently views ASDS as a substitute for the Noise Exposure Forecast (NEF) system in current use by planners.

Planned Activities

EPA expects to achieve the following goals in the area of interagency coordination of Federal agency noise control and noise research programs.

1. Develop and implement a program which will (a) promote the efficient utilization of available resources, and (b) ensure that the total distribution of effort is consistent with the relative need for attention among the various aspects of the general noise pollution problem.
2. Ensure that agencies carrying out work have the necessary technical capabilities.
3. Ensure that all work being carried out is consistent with the intent of the Noise Control Act.
4. Coordinate the development of consistent Federal noise standards for occupational noise.
5. Ensure that the required consultations with EPA by all Federal agencies proposing standards and regulations respecting noise is achieved.
6. Ensure that all necessary steps are taken to make available to EPA,in a timely manner, environmental impact statements concerning noise.
7. Ensure that regional mechanisms are developed to provide effective Federal interagency coordination to deal with the necessary evaluation of control and research program activity.

The Use of Ad Hoc Committees. EPA intends to utilize Ad Hoc committees to fulfill specific requirements, such as the analysis of differences between the DOT/NASA jet engine retrofit alternatives. The members would be drawn from all Federal agencies involved. These committees would be task oriented, problem-solving bodies, who would provide EPA with their best technical judgments on specific issues requiring EPA action. The committee structure would enable EPA to handle a wide-range of tasks without significantly increasing the permanent staff or impacting the work-load of any one individual. Such committees would make the most effective use of the available manpower both within EPA and in other Federal agencies and would lead to the most complete accomplishment of the goals listed previously.

It is intended that Ad Hoc committees will also be utilized in the previously indicated year-end program review. This will likely provide an efficient mechanism to develop a unified Federal Government budget request for noise-related activities and for the development of priorities and needs.

Ad Hoc committees also will be useful in dealing with special advisory functions such as those that were provided by the National Aeronautics and Space Council and the Office of Science and Technology prior to their dissolution. Such special requirements can be fulfilled by an Ad Hoc committee made up of representatives from the National Science Foundation, National Academy of Sciences, National Research Council, National Academy of Engineering, National Bureau of Standards, NASA, EPA, DOT, DOD, and invited members of the academic, scientific, and industrial community.

EPA intends to coordinate the research activities of those agencies primarily involved in Aircraft Noise Research (mainly NASA, DOT, and DOD) through the use of Ad Hoc committees or working groups established specifically for that purpose.

Summary of Resource Requirements

The funding history of EPA's noise control program is shown in Table 7-1. The present (FY 74) budget level is 47 permanent positions (plus 24 temporaries) and $4,236.7 thousand. Funding for Federal Activities totaled $285 thousand in FY 73 and the same amount in FY 74.

TABLE 7-1

EPA NOISE CONTROL PROGRAMS--BUDGET HISTORY: 1972 - 1974

	FY 72		FY 73		FY 74	
	Positions Perm.	Budget ($1000)	Positions Perm.	Budget ($1000)	Positions Perm.	Budget ($1000)
ABATEMENT AND CONTROL						
Standards, Guidelines, & Regulations	8	752.7	--	1,145.0	20	2,285.0
Technical Information & Assistance	1	70.0	12	876.4**	15	940.5**
PROGRAM MANAGEMENT AND SUPPORT	3	59.0	3	26.4	8	199.2
RESEARCH AND DEVELOPMENT*	--	366.0	--	280.8	--	--
SUBTOTAL (Office of Noise Abatement and Control)	12	1,247.7	15	2,328.6	43	3,424.7
RESEARCH AND DEVELOPMENT					3	550.0
ENFORCEMENT					1	20.0
REGIONS***					--	242.0
TOTAL (EPA)					47	4,236.7

* Research and Development appropriation--allowance made to Office of Noise Abatement & Control in FY 72 and FY 73.

**Includes $285 thousand for Federal Activities in FY 73 and the same amount in FY 74.

***Eleven (11) temporary and Intergovermental Personnel Act positions allocated to Regions in FY 74.

NOTE: Current authorization includes 24 temporary positions in FY 74.