A Methodology for Preparing Environmental Statements

Arthur D. Little, Inc., Cambridge, Massachusetts

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A METHODOLOGY FOR PREPARING ENVIRONMENTAL STATEMENTS

ARTHUR D. LITTLE, INC.
ACORN PARK
CAMBRIDGE, MASSACHUSETTS 02140

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(AIR FORCE SYSTEMS COMMAND)
TYNDALL AIR FORCE BASE
FLORIDA 32401

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TYNDALL AIR FORCE BASE, FLORIDA 32401

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1. Subject report was prepared under contract by Arthur D. Little, Inc., and provides another approach for preparing Environmental Statements. The report is written for a person with a technical background, but without experience in environmental analysis. Use of this methodology is optional; however, it does provide valuable guidance and information. It should be reviewed for use as one of the many tools available in preparing Environmental Statements.

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DONALD G. SILVA, LT COL, USAF, BSC
Director of Environics

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This report provides instructions for Air Force field personnel in the methods for preparing environmental statements. The report covers the following areas:

a. Introduction to the environment.
b. Review of Air Force procedures for assessment and reporting impacts of various actions.
c. Establishing and maintaining an environmental baseline data and information system.

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d. Preparation of the proposed action
e. Description of the existing environment,
f. Identification of impacts,
g. Other Topics - alternatives, unavoidable impacts, and use of resources.

The report is written for a person with a technical background, but without experience in environmental analysis. It provides "how-to-do-it" guidance for field personnel who are assigned the responsibility of preparing environmental statements. The bibliography contains 33 listings.

PREFACE

This report was prepared by Arthur D. Little, Inc., Cambridge, Massachusetts 02140, under Contract Number F29601-73-D-0027, Call Order Number 004, Job Order Number 21033E25, with the Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico. This report summarizes work done between May 1974 and August 1975. Captain George B. Carroll (OL-AA, AFCEC) was project engineer.

This report has been reviewed by the Information Officer and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

DONALD J. ARMSTRONG, Jr
Capt, USAF
Environmental Community Planner
Environmental Planning Division

DONALD G. SILVA
Lt Colonel, USAF, BSC
Director of Environics

ROBERT E. BRANDON
Technical Director

ROBERT M. ITE
Colonel, USAF
Commander

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SUMMARY

The National Environmental Policy Act of 1969 (NEPA) requires any federal action which may affect the environment be reviewed for its environmental consequences. Air Force policy and programs relating to environmental protection are contained in AFR 19-1 and AFR 19-2. One of the reports which may be required in accordance with AFR 19-2 is the preparation of environmental statements, which are formal documents describing actions that may have significant effects on the environment or which are highly controversial with respect to environmental impact.

The purpose of this technical report is to provide instructions for Air Force field personnel in the methods for preparing environmental statements. The report begins with an introduction to the environment and its need for protection, followed by a brief review of the procedures which are used by the Air Force to assess and report the impacts which may result from various actions. This background material is followed by a discussion on how to establish and maintain an environmental baseline data and information system, which can be used for annual environmental assessment studies as well as specific actions for which formal environmental statements are required.

The report then describes how to prepare the description of the proposed action, including construction, operations and de-activation phases, and abnormal events which may be associated with the action. The next section deals with the descriptions of the existing environment, divided into three regimes: physical (land, air, water), biotic and human environments. The air traffic environment is treated as a separate topic. Two areas of potential impact are given special attention because of their importance to Air Force activities: (1) air quality, for which methods of making emission inventories and evaluations are discussed, and (2) noise, for which the AICUZ (Air Installation Compatible Use Zones) system is described.

The report then describes how the action and the existing environment data can be merged to identify potential impacts and how to evaluate them in quantitative and qualitative terms. The remaining sections of the report deal with the other subject matter required in an environmental statement, such as the treatment of alternatives, unavoidable impacts, and use of resources.

The report is written for a person with a technical background but without experience in environmental analysis. It is intended to provide how-to-do-it guidance for field personnel who are assigned the responsibility of preparing environmental statements.

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SECTION I

INTRODUCTION

1. THE ENVIRONMENT AND ITS NEED FOR PROTECTION

a. Description of the Environment

The planet Earth consists of the physical environment, populated by biota. The physical environment consists of land, water, and air, also referred to as lithosphere, hydrosphere, and atmosphere, respectively, while the biota, or biosphere, includes all living organisms including man. Of particular importance is the human environment which man creates. This includes not only the physical changes which he makes in his surroundings but the social structures which he establishes. Since each part of the environment--air, water, land and biota--is physically and chemically linked with one another, many and all human actions will affect or impact all parts of the environment. Consequently, the major task in assessing the environmental impact of an action involves distinguishing important impacts from relatively insignificant impacts.

b. Environmental Damage

What is environmental damage? This question is not always easy to answer. A given action may be deleterious in one context, but beneficial in another. It may even be simultaneously damaging and beneficial. For example, chlorination of drinking water safeguards human health, but it is damaging to bacteria and may even reduce photosynthesis and total primary production in the impacted water body. Because, as we have seen, all parts of the environment are related, we must be concerned for all parts; nevertheless, practicality demands that we assign some priorities to the parts. These priorities are:

- Man
- Water } Essential to human health
- Air }
- Biota - Essential to human nutrition
- Land

Our first concern must be the human environment--human health, welfare, and the quality of human life. We are, after all, protecting the environment for ourselves, the human species. Next, we must be concerned with those parts of the environment whose pollution represents the most immediate damage to human health--air and especially water. Because we depend on the biosphere for food, it is also highly crucial that that segment of our environment not be endangered. Finally, the land which provides living space, growing space for foodstuffs, and resources must not be neglected.

The assessment of environmental impact involves consideration of beneficial as well as detrimental effects, although quite properly, the latter is commonly given the greatest emphasis. While the possibilities for environmental impacts are endless, significant environmental damage usually falls into one or more major categories (Figure 1). Chemical pollution of the environment, such as air pollution, oil spills, improper disposal of toxic wastes, etc., is perhaps the most familiar form of deleterious environmental impact and has attracted a great deal of public attention. There is also a growing public concern over the misuse of natural resources, and this concern will intensify as shortages of mineral resources (including strategic materials, water, and fossil fuels) become more acute. Some necessary materials subject to shortages, such as wood and paper goods, come from the biosphere and their supplies can be reduced by alteration of the physical environment as well as by preemptive use. Destructive alteration of topography results from construction, paving, and earth moving activities. The hydrosphere can also be involved, as in the cases of ditch-digging, wetlands filling or drainage, stream channelization, and dredging.

The number of concurrent uses of land, water, or airspace is limited, thus one use commonly preempts many others. The paving of an airstrip, for example, preempts that land from other uses such as agriculture or housing. Channelization of a stream need not preempt uses such as irrigation, industrial process and cooling water, sewage disposal, or even drinking water supply, but may preempt aesthetic and recreational use.

The delicate ecological balance of the biological environment can be disturbed in a harmful way by destroying or modifying habitats. This includes obviously harmful actions such as destroying vegetation and some more subtle impacts--such as interfering with animal migration and other movements by the erection of fences or other barriers. Noise and excessive human activity can seriously reduce the fecundity of some species. Rare species may be endangered and their continued existence in a given area threatened, but less obvious changes in the composition of a biological community (or ecosystem) can also be very important, especially so since the stability of ecosystems depends strongly on their diversity.

No one will deny that dangers to public health and safety represent very serious deleterious environmental impacts; however, the accurate assessment of other impacts upon the human environment may be very difficult and unclear. The expansion of an air base, for example, may improve the national security, yet preempt land from use for agriculture, badly needed housing, and/or business development. The expansion itself and the resulting creation of new job opportunities may inject added funds into the local economy and encourage community growth, yet this community growth may overburden public facilities and create a host of problems of its own. Most difficult of all to evaluate is the impact upon the

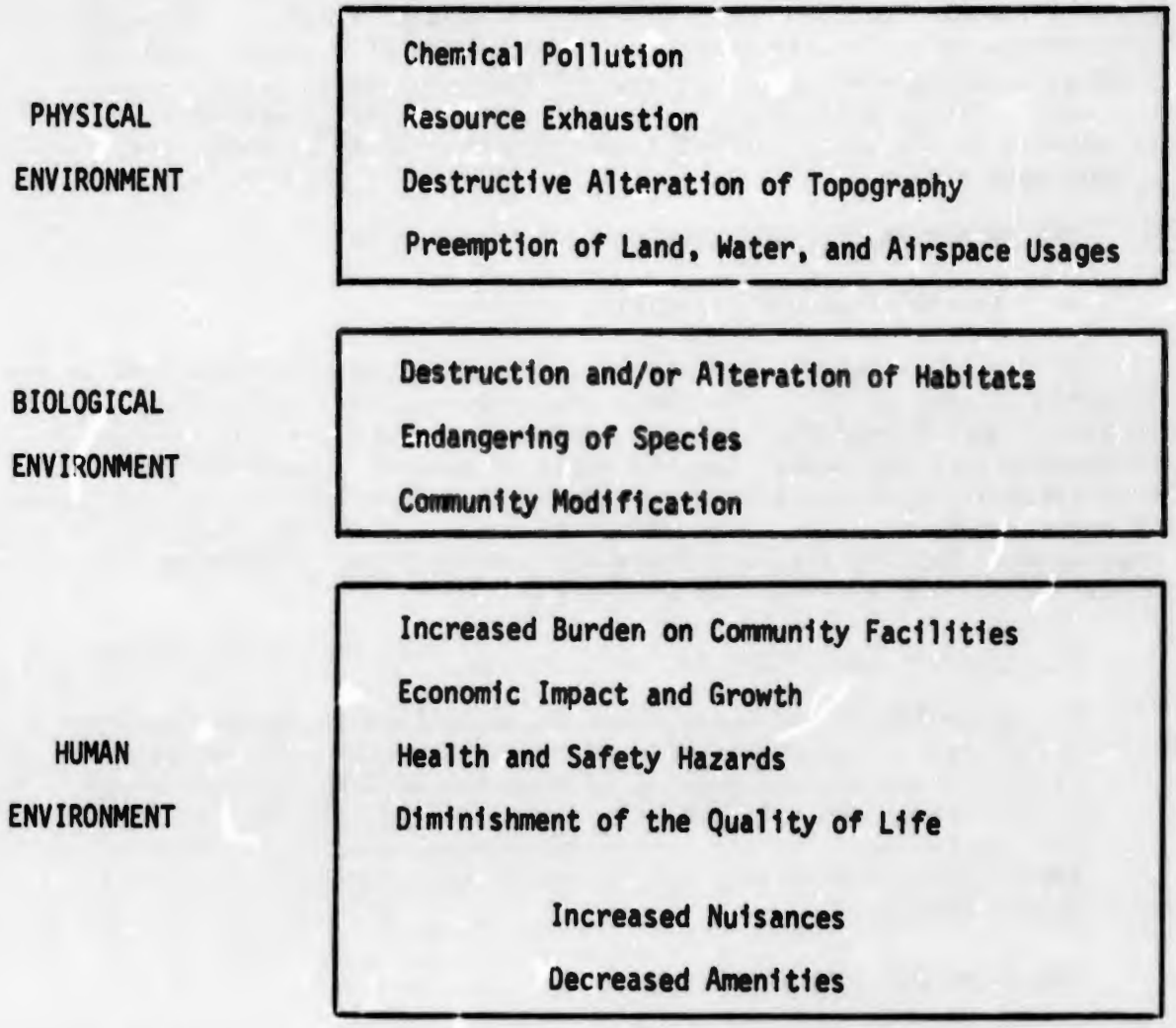

Figure 1. Some Major Categories of Environmental Damage

intangibles on the quality of life. Expansion of the air base may entail the destruction of a view or of an historic or handsome building. How much is a view worth? How serious is the loss of another piece of our historical heritage? The large and obvious impacts are relatively easy to identify and evaluate, but the continuing, small, incremental destruction of our environment, the accumulation of nuisance, and the gradual alteration of amenities are difficult to assess until it is too late. Yet in many respects an environment is more seriously threatened by the small, incremental steps than it is by large and conspicuous actions.

2. THE RESPONSIBILITY FOR ENVIRONMENTAL PROTECTION

a. Federal Laws and Expediting Procedures

Until recent years, environmental damage either went unnoticed or was accepted as part of the unavoidable price of progress. Material shortages during World War II gave Americans advanced warning of the consequences of the unwise use and waste of national resources, and more recently there has been growing public concern over the deterioration of our environment. The Congress of the United States has responded to this concern by enacting very important laws designed to protect the environment. Three of the key laws are:

The National Environmental Policy Act of 1969 (PL 91-190)(NEPA)

"...to declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality."

The Clean Air Act Amendments of 1970 (PL 91-604)

"...to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population."

The Federal Water Pollution Control Act of 1972 (PL 92-500)

"...to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

By and large, the Courts have recognized the necessity and urgency of the goals embodied in these laws and have interpreted these statutes stringently.

Executive Order 11514 (March 7, 1970) defined the responsibility of federal agencies to "...monitor, evaluate, and control on a continuing basis their agencies' activities so as to protect and enhance the quality of the environment," and to "develop procedures to ensure the fullest practicable provision of timely public information and understanding of federal plans and programs with environmental impact in order to obtain the views of interested parties." This order also directed the Council on Environmental Quality (CEQ) to issue guidelines to federal agencies for the preparation of the environmental statements required by Section 102(2)(C) of NEPA.

On August 1, 1973, CEQ published revised guidelines for the preparation of environmental statements (Guidelines for Federal Agencies under the National Environmental Policy Act). These guidelines contain general guidance for determining when an environmental statement is required.

The guidelines state: "The statutory clause 'major federal actions significantly affecting the quality of the human environment' is to be construed by agencies with a view to the overall, cumulative impact of the action proposed...Such actions may be localized in their impact, but if there is potential that the environment may be significantly affected, the statement is to be prepared. Proposed major actions, the environmental impact of which is likely to be highly controversial, should be covered in all cases."

On March 19, 1974, the Department of Defense published a revision to its implementing Directive 6050.1, "Environmental Considerations in DOD Actions." This directive established DOD policy, assigns responsibilites, and provides guidance for the implementation of Section 102(2)(C) of NEPA, which requires the inclusion of environmental considerations in the decision-making process.

In addition to the CEQ established by NEPA, in 1970 the Environmental Protection Agency (EPA) was organized as an independent agency in the Executive Branch of our government "...to permit coordinated and effective governmental action to assure the protection of the environment by abating and controlling pollution on a systematic basis."

b. State and Local Environmental Protection Laws

In addition to federal laws and regulations intended to protect the environment, there is fast growing a host of state laws and regulations, and local ordinances directed toward this same goal (Figure 2). While the federal laws are more generally stated, state and local governments, being closer to specific environmental problems, have been able to promulgate regulations and ordinances which are sometimes more highly specific and in some instances more restrictive than their federal counterparts. State laws and regulations are often the result of federal laws and involve administrative functions which have been assigned to the states, e.g., the issuance of wastewater discharge permits and the control of regional air quality.

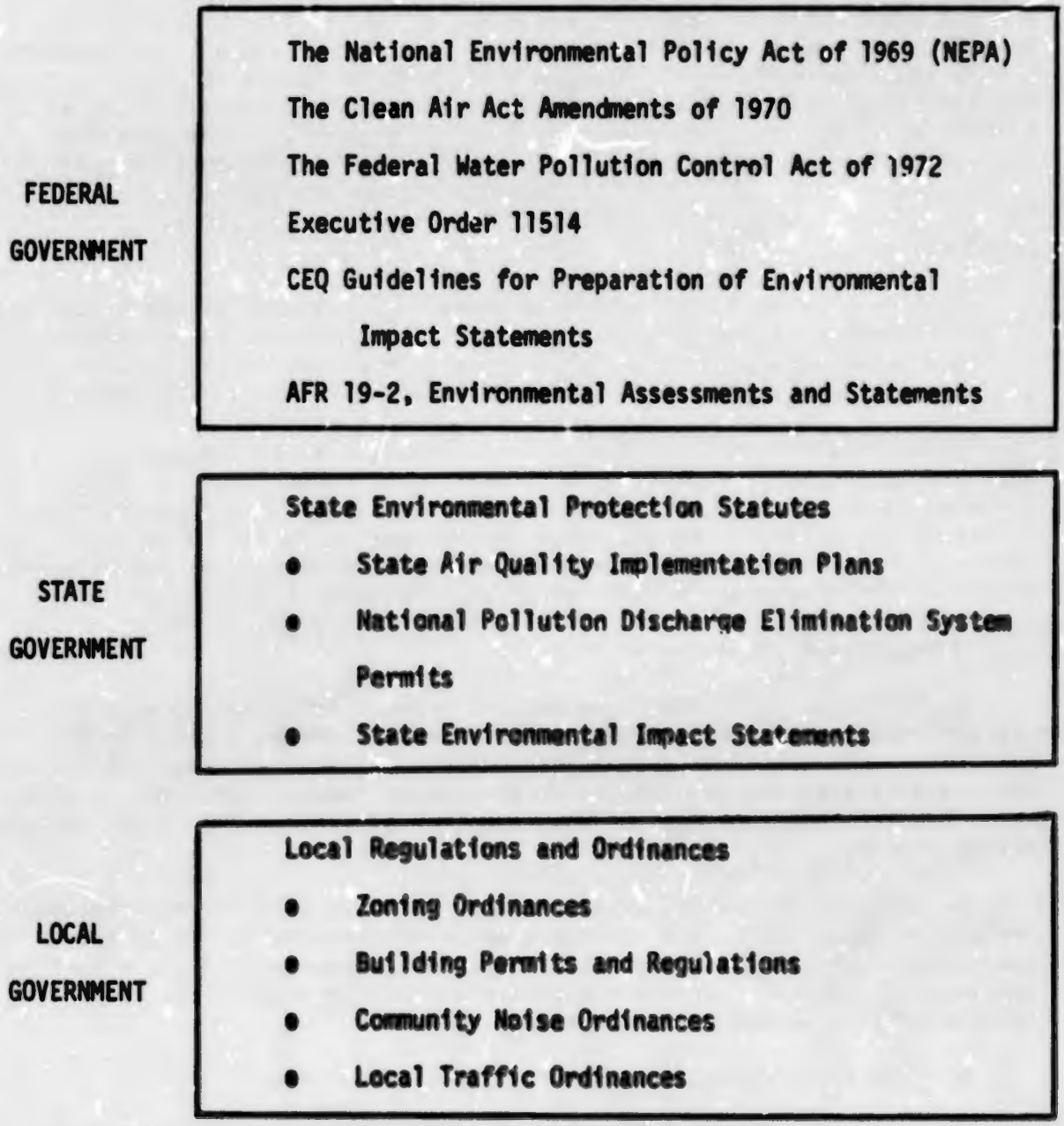

Figure 2. Some Bodies of Environmental Laws and Regulations

Figure 2 outlines the national levels of environmental law, while Figure 3 lists the guardians of our environment, the governmental bodies and persons concerned that the laws and regulations are observed. These range from federal agencies down to the concerned private citizen. The importance of private groups and persons must not be underestimated. These are the persons impacted, these are the people whose environment is most directly threatened. Nationwide conservation and environmental protection groups have been particularly vigilant, but local groups have also been active. These include historical societies; fish and game clubs; garden clubs and neighborhood associations; ski and other recreational clubs; and, of course, impromptu associations of taxpayers.

c. Air Force Responsibilities and Regulations

AFR 19-1, Pollution Abatement and Environmental Quality, establishes a program of environmental protection. It establishes policy, and responsibilites are assigned for the development of an organized, integrated, multidisciplinary, environmental protection program in order to assure that the Air Force, at all levels of command, conducts its activities in a manner that protects and enhances environmental quality.

AFR 19-2, Environmental Assessments and Statements, establishes policies, assigns responsibilities, and provides guidance for the preparation of environmental assessments and statements. It requires HQ USAF Air Staff Offices, major commands, and operating agencies to establish and implement procedures to assess the environmental consequences of any proposed action at the earliest practicable stage and to use these assessments and statements in the decision-making process.

Some of the key steps which are defined in AFR 19-2 will be reviewed in Section II of this report. However, it is essential for the individual who is assigned the responsibility for preparing environmental statements be thoroughly familiar with the detailed procedures which are defined in AFR 19-2.

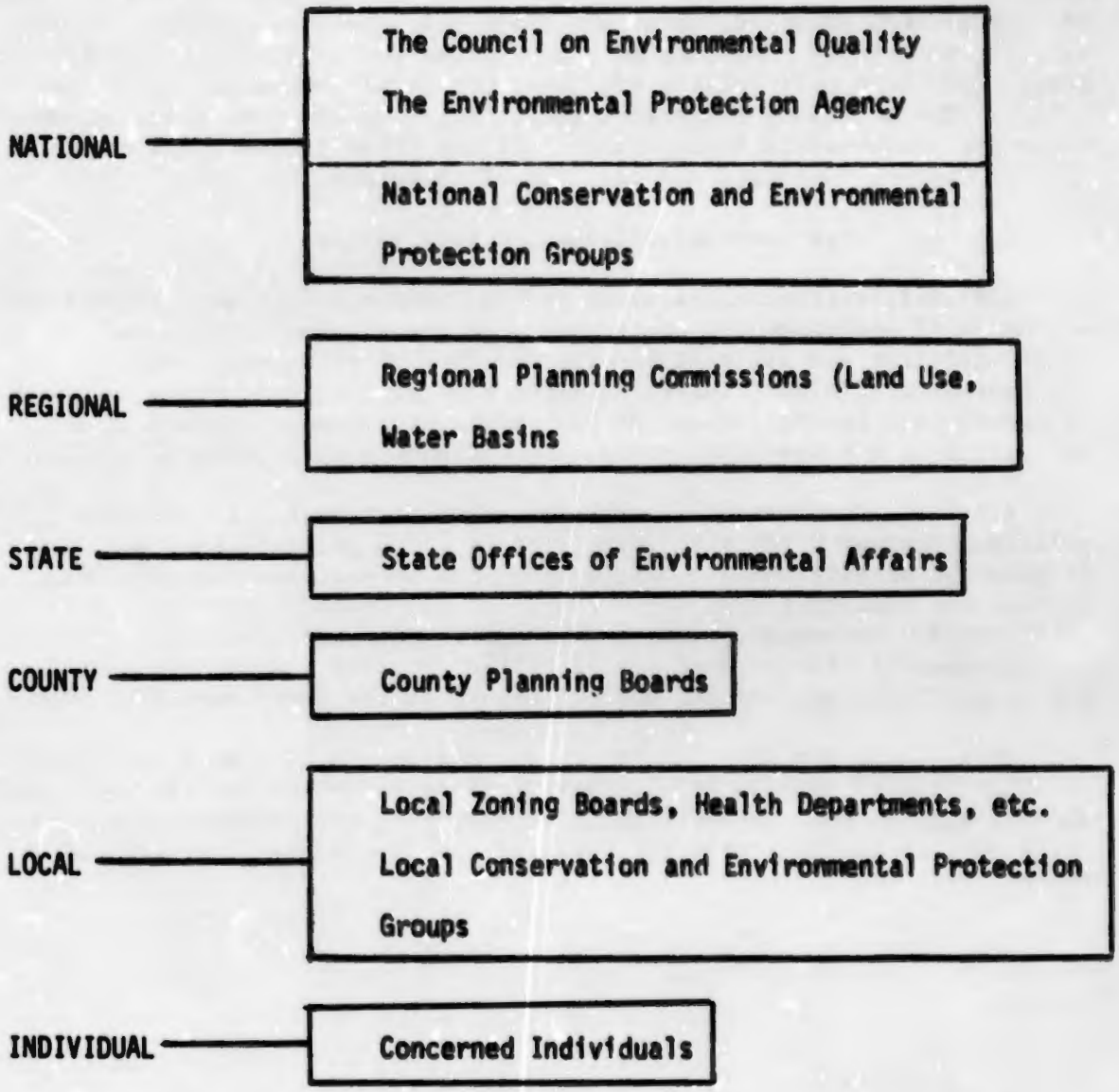

Figure 3. Representative Guardians of Our Environment

SECTION II

ENVIRONMENTAL REVIEW PROCEDURES

1. ENVIRONMENTAL REVIEW

a. Purpose

The purpose of the environmental review procedure is to protect the environment to comply with environmental protection laws, and to expedite the intent of the Congress of the United States. This can best be accomplished by insuring a careful consideration of the possible environmental impacts, and at the earliest feasible point and throughout the planning process of future actions which may be controversial and/or may significantly affect the environment. The intent of the review procedures which have been developed and which will be examined below is to accomplish, effectively and accurately, this purpose. It should be kept in mind that the intent of environmental review is not to stop necessary actions, but rather to consider fully their environmental impact, to examine alternatives seriously, and, insofar as is practical, to explore ways of mitigating unavoidable adverse environmental impacts.

b. The Review Procedure

AFR 19-2, Environmental Assessments and Statements, (22 November 1974) establishes policies, assigns responsibilities and provides guidance for the preparation of environmental assessments and statements. It is essential a copy of this regulation be obtained and reviewed by personnel who are assigned the task of preparing environmental assessments/statements. It contains a wealth of procedural steps which are not described herein but which must be followed in the review process.

A few of the basic concepts contained in AFR 19-2 are discussed below, including a discussion of an annual statement covering continuing operations. It should be noted that this technical report is concerned primarily with the preparation of environmental statements. Environmental assessments will be covered in another document. However, the assessments are discussed briefly since they are a precursor to the preparation of statements, and the methodology used for statements can be applied in less detail for the preparation of assessments.

2. DEFINITIONS OF ENVIRONMENTAL REPORTS

There are two types of environmental reports, each having subset categories:

- Environmental Assessments (EA)

  (a) Informal Environmental Assessment (IEA)
  (b) Formal Environmental Assessment (FEA)

- Environmental Statements (ES)

  (a) Candidate Environmental Statement (CES)
  (b) Draft Environmental Statement (DES)
  (c) Final Environmental Statement (FES)

The five categories of reports are prepared sequentially, that is, an IEA could eventually lead to a FES. Whether this complete cycle occurs is dependent on the nature of the action and the degree of potential environmental impacts. (It should be noted the term "environmental statement" is synonymous with environmental impact statement, commonly abbreviated EIS.)

The informal environmental assessment is an initial evaluation of potential impact on the environment of any proposed action. It serves to answer the question of whether further studies are necessary. If not, the documentation may consist of the words, "there are no anticipated environmental impacts."

The formal environmental assessment is prepared for actions that (1) have or could have an environmental effect, (2) involve or are likely to create public controversy, or (3) are a line item in the annual budget. The formal assessment is prepared in the same format as an environmental statement, although it contains less detail. It highlights both the positive and negative impacts. It is not necessary to go into depth to highlight these impacts. The function of the assessment is to document the evaluation process and to identify the positive and negative impacts that are likely to occur.

If, as a result of the assessment, or if required by AFR 19-2, it is determined an environmental statement is or may be required, it is developed in three stages. The first is preparation of the candidate environmental statement, which is forwarded to HQ USAF/PREV with the recommendation that it become a draft environmental statement. As such, the candidate statement must be prepared in a manner and to a degree of completeness that ideally only a change in title is necessary to produce a draft environmental statement.

One of three decisions is then made as a result of the review by HQ USAF: (1) the report is approved and forwarded to higher channels as a draft environmental statement, (2) the CES is returned to the originator for revisions and modifications, followed by resubmittal, or (3) a negative determination is made, that is a brief publicly available record which is prepared stating the reasons for deciding a proposed action is not a major action, has no significant effect on the quality of the human environment, and is not highly controversial with respect to environmental impact.

A draft environmental statement is submitted by the Secretary of the Air Force to the Council on Environmental Quality and to other agencies and interested parties for comments. It is available to the general public and to conservation groups. In some cases, a public meeting is held during the time the DES is out for review.

All parties, including both federal, state and local agencies and private individuals and groups, may then submit questions and comments relative to the DES. These must be incorporated in the final environmental statement, together with answers and any modifications or additions to the basic text of the DES. The FES is prepared at the field level by the same persons who prepared the FEA and the DES, and it is submitted through the same chain of command as was the DES.

Although it seldom happens, the FES could serve as a basis for halting or delaying the proposed action. If this were to occur, it could be as a result of agreements at the level of heads of agencies meeting with the Chairman of the CEQ. However, many proposed actions have been delayed as a result of litigation brought by parties opposed to the action on procedural grounds. This basis is typically that a draft environmental statement was not prepared when one was allegedly required, or the DES was incomplete (often because some viable alternative was not evaluated).

The above description of the reporting process is very abbreviated and is intended primarily as background. The reader should refer to AFR 19-2 for complete reporting information.

3. ENVIRONMENTAL ACTIONS

AFR 19-2 defines an action as one which includes, but is not limited to, the following:

(1) Recommendations or favorable reports relating to legislation, including that for appropriations.

(2) Policies, regulations, instructions, manuals, or other major policy statements.

(3) Projects, programs, and continuing activities conducted by the Air Force, or projects and activities conducted by federal or state agencies on Air Force land.

In addition to this general definition, Attachment 1 of AFR 19-2 contains specific listings of types of actions which require the submittal of candidate environmental statements (Paragraph 4). Actions which do not require the submittal of formal assessments or statements are also listed (paragraph 5). These paragraphs should be examined for an understanding of the types of actions that will be of concern.

A problems arises when there are a multitude of small independent actions associated with some larger class or group action. The impacts from any single action may not be of sufficient magnitude to warrant a statement, but the combined effects may be. For example, the impact on air quality from the operation of one vehicle would be insignificant and even not measurable at the regional level; yet the operation of thousands of vehicles could be very significant.

A similar situation arises in connection with the many separate actions which may take place at a facility during a year's operation, including actions taken as part of the Military Construction Program (MCP) for the base. If one were to examine these actions separately, it is possible that no individual action would warrant the preparation of a statement. However, if all actions are considered as a single lumped action, the total impacts may be sufficient to justify the preparation of a single statement covering the combined actions.

SECTION III

ENVIRONMENTAL BASELINE DATA AND INFORMATION SYSTEM

1. INTRODUCTION TO DATA AND INFORMATION SYSTEMS

The preparation of required environmental statements can be painless, and hectic last minute crises avoided, by keeping a careful, up-to-date environmental data and information filing system. Such an accessible and orderly storage system will enable environmental documents to almost write themselves. In addition to facilitating the preparation of environmental documents such a system will also provide fast and accurate access to the detailed data and information upon which the documents and their conclusions are based. This can be particularly important during the public phases of the review procedure when the statements and/or conclusions of the environmental document might be questioned and the source upon which they are based must be speedily produced.

The use of any data and information system is the end process. Before a system can be used it must first be defined, then established and maintained. Finally, a retrieval method is required in order to identify and obtain the desired data and information. Systems can range from a simple storage box to sophisticated computer systems. However, for the purpose of preparing environmental statements as explained in this report, it is likely that a system consisting of a five-drawer file and a box of index cards will suffice. Before describing such a system, it will be helpful to review some terms relating to, and attributes of, data and information systems.

- Data. "I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it." This quotation of Lord Kelvin serves to define data; i.e., they are generally numerical in form and result from a measurement. Each element of data (datum) must be qualified as to what is being measured, units used, location and time. The basic measurements are termed raw data; they may then be corrected, transformed, made part of a larger collection of data and convered to statistics. For example, the stage of a river (elevation of water surface) may be adjusted for a known error in gage setting, then converted to an average depth of flow, further transformed into flow rate in cubic feet per second, and eventually combined with other data to provide mean annual flow values.

- Information. Information can be defined as the body of knowledge about a subject which cannot be categorized as data. Information tends to be qualitative rather than quantitative in nature, e.g., maps, photographs, reports, lists of names (i.e., the wildlife species indigenous to an area). Information can include processed data such as statistical values which tell something about a basic data set. Not all writers distinguish between data and information, and they may use the terms interchangeably or use one term to mean both data and information.

- Baseline Data and Information: The set of data and information that applies to the initial state of a system, from which changes in the state of the system can be described. It should be noted that there can be several sets of baseline data and information (e.g., one for the start of each year) depending on the action involved and the selected time of reference. The term is sometimes also used in a loose sense to simply mean basic or fundamental data and information, the exact definition of which depends on the study involved.

- Data Storage Considerations. Raw data is often recorded on charts or digitally on maps, or it may simply be logged on a sheet of paper. The advantage of storing all raw data is that a complete record is available, albeit in a bulky and not always practical form. Storing only the statistics of data can save space and time for the user, provided the transformations do not mask something which may be needed. For example, storing only mean monthly stream flows (derived, for example, from hourly stage readings) could mask flood events or low flows on weekends due to reservoir regulation.

  Since complete raw data are generally stored by responsible other agencies (i.e., USGS), it will generally suffice to store only summaries for the local environmental data system.

- Information Storage Considerations. The primary problems with information storage are the various formats and potentially large volume of documents involved. A separate rack or map file drawer is useful for maps and drawings. Tables, figures and small reports can be placed in folders by categories and stored in a file cabinet, together with the data summaries. Books and large loose-leaf binders and reports can be placed in a bookshelf. In many cases, the required information is stored elsewhere at the base; in this case, it is sufficient to store only a reference indicating the type of document and the location where it can be obtained.

- Cataloging. This is an art and its specific form depends largely on the types of documents involved and the personal preferences of the organizer of the file. Letters, for example, are generally filed by originating branch and date. Books and technical papers may be cross referenced by title, author, and subject. The latter can include an abstract and a key-word index in the event that several subjects are important in identifying the document. If no index file is maintained, cataloging titles can be placed in the file drawer label holder, or fastened to the edge of a shelf. However, if an index file is maintained, it is possible to assign serial numbers to each document, and maintain the document file in simple numerical order. Thus, the index file itself must be cataloged; the storage location of any document is immaterial as long as the identifying number is on both the card and the document. This system simplifies the storage and retrieval task but demands the index card file be kept up to date.

With these definitions and their related considerations in mind, it is possible to design a potential data and information system for use in preparing environmental statements as required by AFR 19-2.

2. GENERAL DESIGN OF A DATA AND INFORMATION SYSTEM

The system should be designed to meet these criteria:

- Be complete enough for the purpose intended (to aid in the preparation of environmental statements)
- Provide easy storage and retrieval, by both the original designer and future personnel who are assigned the EIS task
- Provide for file maintenance through the discarding of obsolete or duplicate material
- Be dynamic to permit future modifications and expansion.

Methods for meeting these criteria are discussed below. Since Air Force installations vary in size, it is to be expected the relative size of the environmental data and information system will vary accordingly. However, for conceptual purposes, one can imagine the system as consisting of a five-drawer file cabinet with a supplementary metal box for 3- x 5-inch index cards. The actual system must, of course, be consistent with Air Force policy on files, and as established by each base.

a. Completeness - The Subject Matter

The five suggested major subject categories are listed in Table 1. The first file is dedicated to storing laws, regulations, standards, and criteria which relate to environmental protection. The criteria are important as reference points for comparing the ambient and changed conditions, e.g., the National Primary and Secondary Air Quality Standards. The file can be subdivided to reflect the organizational bodies which issue the documents.

The second file, ACTIONS, is dedicated to storing information about the actions for which environmental statements may have to be (or have been) prepared. There are two suggested subsets: specific and continuing. The former refers to major construction projects, missions changes, test range activities, etc., while the latter refers to actions which are continuing in nature. This subcategorization is not too important, but the information which is stored in the file must be adequate to fully describe the action. As environmental statements are processed, it should be possible to discard the file folder since the action will have been described in the environmental statement. However, some actions, such as the construction of a new power plant, will contain important data for future use (such as boiler emissions), and these data should be preserved for future use unless it is readily available from other base sources.

TABLE 1. GENERAL CATALOGING FOR
ENVIRONMENTAL DATA/INFORMATION SYSTEM FILE

1. LAWS, REGULATIONS, STANDARDS AND CRITERIA

   1.1 Federal Laws, Executive Orders
   1.2 Federal Regulations, Standards, Criteria
   1.3 Air Force Regulations
   1.4 State Laws, Regulations, Standards and Criteria
   1.5 Regional Plans
   1.6 Local Ordinances

2. ACTIONS

   2.1 Specific - by name (e.g., MCP line items, test range operations)
   2.2 Continuing - by year (e.g., the five-year master plan)

3. THE ENVIRONMENT

   3.1 Physical (Air, Land, Water, Resources)
   3.2 Biotic (Flora, Fauna, Ecological Systems)
   3.3 Human (Population, Economics, Recreation, Transportation, etc.)

4. ENVIRONMENTAL ANALYSIS AND IMPACTS

   4.1 Air Quality
   4.2 Water Quality
   4.3 Noise Analysis
   4.4 Solid Waste Disposal
   4.5 Hazardous and Toxic Materials

5. REPORT PREPARATION, EXAMPLES, AND CONTACTS

The third file contains data and information about the environment. Three subsets are suggested; physical, biotic and human regimes. Each of these can be further divided as indicated in Table 1. The subdivisions for the physical and human regimes are relatively well defined, but those for the biotic regime may not prove practical due to the diversity found in many biological studies.

The fourth file contains information about how to perform analyses, e.g., simple air dispersion modeling. Methods for taking samples and having them analyzed can also be stored in this file.

The fifth file serves as a location for documents not expressly classified in the first four files. It can include information on report preparation, sample environmental statements, lists of contacts for obtaining information, etc.

b. Storage and Retrieval

If only a single individual were to use the file system, and if its contents were limited to one file cabinet, it would not be essential to maintain an index file since the one person could generally remember where various documents should be filed, and little time would be wasted in thumbing through the file in search of a document. However, since several persons on base are likely to need to use the file, and since new personnel will become responsible for it as a result of transfers, it is necessary to establish a coding system for storage and retrieval.

Each document should be assigned a unique code number, consisting of the general file name and the document's location in the file. The file name could be "EDIS" (Environmental Data and Information System); the location number could be the category folder followed by a sequence number. Thus, a document containing local noise ordinances may be labeled "EDIS-1.6-1." The document code number should be marked clearly on the front cover of the document.

An index card for the document should then be prepared using a format as shown in Figure 4. This card can also be used for notations concerning the information and as a sign-out card if the document is borrowed from the file.

Index cards can also be prepared for documents which are not actually stored in the document file cabinet, but which are available elsewhere on the base or the local community. For example, a regional planning report may be available at the base engineering library, and it may contain information which applies to several environmental subjects. Figure 5 shows an index card for this type of document.

EDIS - 1.6 - 1

Noise Ordinances, City of Centerville
Office of the Mayor, 1968

(Note: telecon 10/74 with J. Smith, City Solicitor; above still in effect but may be revised in Spring 1975)

Borrowed 11/6/74 - Lt. J. Doe

Figure 4. Sample EDIS File Index Card

EDIS - 1.5 - 3 (Mark AFB Engr. Library)

John Smith Associates, Inc.
Regional Land Use Management Plan
Regional District Commission, Centerville XO, 1971

Geology - pp. 20-25
Land Use - pp. 30-50
Population - App. B

Figure 5. Sample Index Card for Report Located Elsewhere on Base

An index card file is not essential for a data and information system, and it can be (and should be) omitted if the manpower is not available to maintain it. However, the numbering of documents is essential to permit the return of documents to their appropriate file location.

c. File Maintenance

An incomplete or outdated file can be worse than no file since it can lead to errors of both omission and commission. To some extent these can be avoided if the user of the file is alert and does not assume the file is in excellent condition. However, in establishing a file, the person responsible for it must also assume responsibility for keeping it current and reasonably complete.

Several actions can be taken to maintain an environmental data and information file. For data which are normally taken on a continuing basis (e.g., air or water quality samples), arrangements should be made to have copies sent to the file. It is also possible to have one's name placed on mailing lists for data which are published annually, e.g., water supply papers or town reports.

The efficiency of a file is also reduced if it contains too much outdated material. An annual review of documents should be made to discard outdated material; also, when a new or revised document is received, the old one should be discarded. However, not all old data and information is outmoded for the purpose of preparing environmental statements. For example, annual surveys made of indigenous wildlife species can serve as baseline data to indicate long-term trends. As a rule, data should be preserved, whereas information can be discarded upon receipt of an updated report. However, a final decision can only be made by careful consideration of each document.

d. File Dynamics

Environmental systems are both large and complex, and the preparation of environmental statements requires interdisciplinary investigations. Accordingly, one should not be surprised to find a multiplicity of subjects appropriate to an environmental data and information system. It would be expected that the file would continue to grow for several years before reaching a more or less steady state. Very often each new action for which a statement is prepared involves some new area of investigation, the study of which will generate new items of data, thus expanding the utility of the system.

The filing procedures which have been described are flexible, and they permit easy expansion and additions to the file. Whenever a particular location gets too filled, it may be desirable to establish further file subsets. Thus "water" may be subdivided into "hydrology," "water supply," and "wastewater treatment."

3. INFORMATION SOURCES AND DATA COLLECTION

After the data and information system has been designed, a file obtained, and dividers and folders have been labeled, the next step is to obtain, code and store the documents. This task may seem immense, partly because of the complexity of environmental systems, and partly because there is never an end in sight. It may therefore help to solve the problem by understanding it in terms of some separable concepts.

The first of these is the vast majority of data required for environmental statements already exist somewhere in printed form. Collection of new data and information is both time consuming and expensive, and this approach should only be used as a last resort after a review of the existing literature has been completed.

The second concept is there are two time frames for data collection: one in advance of the time the data and information are required for report preparation; the other during report preparation. Some time should be allocated to the former, say an hour or two a week, with emphasis on basic data that will be needed for essentially any environmental statement (e.g., meteorological and climatological data). This is particularly applicable to data which take time to order and receive. When the time comes to prepare a statement for a specific action, there will be a need to collect data and information relating to the action. As these documents are collected, they should immediately be cataloged and added to the data and information files.

The third concept is data and information are available at three general source levels: within-base, off-base (municipal, regional), and at the federal-state level. As a general rule, each level will have data specific to its area of jurisdiction, although higher levels may be able to disaggregate their data for subset geographical areas. Very often persons within each level know other persons in the same area who can provide environmental information. Therefore, when a contact is made and the nature of the problem has been explained, it is wise to ask for names of other individuals in the area who might be contacted. Private and non-profit organizations, such as sportsmen's clubs, historical societies, and environmental organizations, should also be contacted since they often have site-specific information which is not available elsewhere.

The fourth concept is you cannot expect to get data and information if you do not ask for it. A simple telephone call is often adequate; however, a letter request may be necessary to obtain more detailed reports. Personal visits to agencies or other potential sources are very useful and productive, since it is possible to review the documents in order to select those of value and to take notes on other material which may only be available on a loan basis.

Finally, it may be found either insufficient or no data and information are available concerning a file category. This fact alone is useful to know, and it should be recorded in a memo to the file including the sources which were contacted and the basis for reaching the conclusion. Consideration should then be given to initiating an action to obtain the data by field investigation.

With these concepts in mind, it should be possible to develop a useful and comprehensive data and information system. Names of typical sources to be contacted are given in the following sections of this report under each subject category.

SECTION IV

STYLE, FORMAT, AND CONTENT

1. GENERAL

Since environmental studies cover a large number of disciplines, the person assigned the responsibility of preparing the reports will probably find that his own professional training can only be applied to certain areas of the investigation. However, by study of this and other related environmental manuals and publications, and by obtaining experience as a result of preparing reports, one should soon become qualified as a general environmentalist. This means the person should be able to recognize the magnitude and importance of potential impacts and know when to seek guidance and assistance from the appropriate technical specialists.

One skill which must not be omitted is report writing. Environmental statements offer a particular challenge since they must be written for the layman, using the general style of newspaper reporting; yet they must contain sufficient technical data and analysis to permit reviews by specialists in various fields. Books on the general subject of technical report writing are available in most libraries, and they should be reviewed before attempting to write a major report for the first time. Copies of impact statements prepared by others can be obtained from issuing agencies, and samples of these should be examined to obtain a sense of what makes a good or poor report.

2. STYLE

The difference between a good and an unsatisfactory environmental statement depends on the material it contains and the manner in which this material is presented. In addition to the military and governmental personnel responsible for reviewing environmental documents, environmental statements are intended to inform the public. In the case of controversial actions the environmental statement will be examined carefully by very critically disposed public eyes; thus, as public documents, the contents and the style of environmental documents are extremely important. Unclear information is almost as bad as missing or inaccurate information. Some important "DO's" and "DON'T's" are listed in Table 2.

TABLE 2. DO'S AND DON'TS FOR
ENVIRONMENTAL STATEMENT PREPARATIONS

DON'T	
DON'T	try to pad, don't add non-relevant or duplicate material.
DON'T	try to evade crucial points, don't omit important facts and problems.
DON'T	exaggerate beneficial impacts.
DON'T	try to avoid or de-emphasize deleterious impact.
DON'T	write down to your reader.
DON'T	assume a great deal of detailed technical knowledge on the part of the reader.
DON'T	try to "snow" the reader with complicated graphs, equations or other such devices.
DON'T	be flippant or casual. Treat all matters seriously.
DON'T	include unsupported conclusions and opinions.
DON'T	make value judgments.
DON'T	view the preparation of environmental documents and environmental reviews as a nuisance that the Air Force must endure.

DO	
DO	be brief, accurate and clear.
DO	stick to the facts.
DO	indicate the sources of important bits of information.
DO	make good use of photos, figures, tables, charts and other clear illustrative material.
DO	be objective and thorough.
DO	anticipate questions to be raised by the public.
DO	try to anticipate and be sympathetic with public fears that the action may precipitate.
DO	assume that your reader will be intelligent, interested, and fair.
DO	take your job seriously, and
DO	your best.

In your environmental statement you will be making statements which can have four levels of strength (Figure 6). Best of all, of course, is a documented quantitative statement of fact (A). If you have to make some kind of estimate (B), be sure to indicate how the estimate was arrived at. If no quantitative estimate is possible (C), it is still very useful if either an upper or lower limit can be estimated. In particular, try to avoid saying an impact is negligible or unimportant without defining what is meant by these terms. Nothing is more irritating to critical eyes than an oversight in an environmental document. Therefore, mention a possible impact (D) even if there is very little you can say about it that is concrete. Even a guess is better than nothing at all, provided you carefully distinguish facts, estimates, and opinions.

3. FORMAT

The first step in preparing an environmental statement is to develop a detailed outline of the report. The required contents are listed in Section 2 of Attachment 2, AFR 19-2 (22 November 1974). The principal sections are as follows:

a. Title Page
b. Summary Sheet
c. Table of Contents
d. Body of Statement

1. Introduction

    a. Project description
    b. Existing site characteristics

2. Relationship of Proposed Action to Land Use Plans, Policies, and Control for the Affected Area
3. Probable Impact of the Proposed Action on the Environment
4. Alternatives to the Proposed Action
5. Probable Adverse Environmental Effects Which Cannot Be Avoided Should the Proposal Be Implemented
6. Relationship Between Local Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity
7. Irreversible and Irretrievable Commitments of Resources That Would Be Involved in the Proposed Action Should It Be Implemented
8. Considerations That Offset the Adverse Environmental Effects
9. Details of Unresolved Issues
10. Bibliographic References

A Best

DOCUMENTED, QUANTITATIVE STATEMENT OF FACT

According to Ms. Smith[27] of the Regional Historic Commission, there are no historical or architecturally significant buildings or sites and no registered landmarks in the impacted area.

B Better

QUANTITATIVE ESTIMATE

If the system is generated 24/hr/day only during the two months of drought (July-August) a total of 48,000,000 gallons of water will be used.

C Good

QUALITATIVE OR SEMI-QUANTITATIVE ESTIMATE

The contribution of these sources to regional atmospheric turbidity is expected to be negligible (less than 1%).

D Adequate

MENTION OF THE IMPACT

Because of their transitory nature and highly variable flock sizes, no reliable estimates can be made of the numbers of migratory wildfowl which might be affected.

Figure 6. Four Types of Quantitative and Qualitative Statements in Descending Order of Preference

It may be helpful to use a decimal paragraph numbering system, since this permits several people to prepare different sections and yet have each contribution clearly identified as to its location in the report. For example, the existing site characteristics may be developed as shown in the following partial outline:

1.0 INTRODUCTION

1.1 Project Description
(etc., with its own breakdown)

1.2 Existing Site Characteristics

1.2.1 Physical Environment

1.2.1.1 Terrestrial Regime

1.2.1.1.1 Geographical Location

1.2.1.1.2 Topography

1.2.1.1.3 Geology and Soils

1.2.1.2 Atmospheric Regime
(etc.)

1.2.1.3 Hydrologic Regime
(etc.)

Once a subsection such as "1.2.1.1.2 Topography" has been written for a particular installation, the text should not change over a period of years, and it could be reused for several reports. Furthermore, subsections of this type can be prepared in advance of an action and simply filed for future use.

4. USE OF ILLUSTRATIONS

The amount of text can often be reduced substantially and the ideas of the report communicated more effectively by use of graphical material. Common examples are:

- Maps and Plans. These are used to show spatial relationships. A location map should be included in all reports; it should show the installation within a state boundary, including principal cities and other major physical boundaries such as oceans. A regional map should also be included; it would show a county area, the installation boundaries, major transportation and river systems. The location map can be included as an insert to the regional map if desired. Finally, a site plan or base map should be included, with the

location of actions identified. Topographic maps, as prepared by the U.S. Geological Survey, can be used to advantage although the amount of detail they contain may not reproduce well during final report printing. Site plans with overlays can be extremely useful. Examples are those showing noise contours, soil and vegetation types, or restricted areas.

- Charts and Graphs. Typical examples are pie diagrams, used to display the component percentages of some action, and histograms and bar graphs used to display numerical distributions, sometimes as a function of time. Figures of these types are convenient for summarizing tabular values, particularly when the numerical values are of less importance then their relationship to each other or the whole. Graphs must be clearly labeled, and they should not be made misleading by plotting only a part of the range of a variable unless this fact is clearly stated.

- Diagrams. The one-line diagram is the most common; it is used to show a functional relationship between two variables. It may be developed from a mathematical expression or from data measurements. Diagrams can be made more complex; for example, additional variables can be plotted by adding lines. Choice of units and scale should be selected to best represent the concept involved. Since impact statements must be understood by the general public, complex diagrams should be avoided; if necessary, they should be placed in a technical appendix.

- Photographs and Drawings. Photographs can be extremely helpful in portraying an area, particularly oblique aerial photographs. However, the details are generally lost in the reproduction process, and the plates from which they are printed must be prepared professionally to obtain reasonably clear reproductions. A good source for such photographs or plates is the base information office, which may have copies that have previously been cleared for issuance to the press for public information brochures.

Illustrations can be used to clarify a concept (e.g., organizational charts, flow diagrams for a process, aircraft flight patterns), or to illustrate a structure (e.g., cross section of a drainage ditch) or a biotic species (e.g., tumbleweed). Drawings, including lettering and legends, should be designed to remain legible after the reproduction process. Avoid colors, which cannot be reproduced economically, using instead cross hatching or commercially available shading materials.

5. AVOIDING DUPLICATION AND UNSUPPORTABLE CONCLUSIONS

To some extent, the required contents of an environmental statement are such that duplication may occur. For example, Section 3 involves the discussion of all impacts, while Section 5 involves the discussion of those adverse impacts which cannot be avoided. Obviously, 5 is a subset of 3. However, in this case one should not merely repeat the discussion of 3 in 5, but rather list the impacts by title only in 5 and explain why they are unavoidable. Conversely, when writing 3, describe the impacts but save the conclusion they are unavoidable until 5.

Another common area for duplication involves the description of the action, the description of the environment, and the impacts. For example: "The proposed 1,000-foot runway extension will cross an existing brook, but this is not expected to affect the surface drainage patterns due to the small catchment area of the brook and the permeable nature of the soil."

Unsupportable conclusions are often found in impact statements. This may occur because the author failed to include the data and information necessary to support a conclusion but, more often, it reflects the author's feeling that definite conclusions must always be reached. It should be noted that impact statements are intended to be reasonable efforts to evaluate and report on beneficial, adverse, or neutral impacts. However, there are times when the non-availability of data and information or the lack of analytic methods precludes reaching a conclusion. In such cases, this situation should be stated as the reason no conclusion could be reached.

6. CONTENT OF REPORT

The required contents for an environmental statement, including preface material, are given in Attachment 2, AFR 19-2, 22 November 1974.

Typical sections and subsections for use in environmental statements are identified in subsequent sections of this report. Not all subsections may be needed for a specific action, and it is up to the principal author of the statement to decide which topics are relevant. However, if a topic which is normally discussed is deleted for a specific action, it is wise to include it as a paragraph heading, then give the reasons for excluding the discussion. For example, in the section on impacts: "Hydrologic Regime. The proposed action will have no significant impact on surface or ground waters or on water quality." By this technique, reviewers will know this potential impact area was considered by the author and not simply overlooked.

Whenever possible the sources of facts should be cited. Number such sources sequentially as they appear with superscripts and include a list of references, listed by the number, e.g.:

27. Smith, J. H., Ms., Chairperson, Regional Historic Commission, Private Communication, August 10, 1974.

28. Anon., Data Summary: Hampton City, Div. State Planning and Community Affairs, Richmond, Va., 1973, pp. 14-18.

29. Budahn, P. J., "Study to Gauge F-15's Noise Impact," Daily Press, May 25, 1974.

SECTION V

DESCRIPTION OF THE PROPOSED ACTION

This section of the environmental statement should describe the proposed action and provide a statement of its purpose. Simple actions may sometimes be described in a few paragraphs, but larger and more complex actions must be subdivided so that each phase can be discussed in order. The manner of subdividing the action will depend on its nature and sometimes on the personal preferences of the author. A suggested breakdown, which follows, is based on the general concept that actions will vary over a period of time, and different potential impacts may occur during the construction, the operational, and the phasing-out time periods associated with an action. These three phases are introduced with a general description, and followed by a subsection dealing with any unique attributes of the action.

1. GENERAL DESCRIPTION

This should serve to introduce the reader to the overall action. It should include the nature of the action, its location, and the object or purpose of the action. If the object of the action relates to the national defense, there should be a brief description of how the proposed action will strengthen the national defense. The relationship between the proposed action and national policies (e.g., pollution control laws and regulations) should also be mentioned. If a proposed action is part of a larger system or a long-term plan, these should also be described and the relationship of the proposed action to such systems should be described.

In some actions, such as the beddown of a new aircraft, it is possible to include a subsection which describes the performance and emission characteristics of the aircraft. Such descriptions can be inserted from standard releases or by reference to an environmental statement which was prepared in connection with the development of the equipment.

2. CONSTRUCTION PHASE

This phase should cover those parts of the total actions which are unique to preparation and activation. This is primarily construction, although personnel re-assignments should also be included if significant. Construction activities generate their own form of impacts (e.g., dust, noise, soil erosion from stripping and excavation, truck traffic), and any special protective measures which will be applied during construction should be included in the text.

For some actions, the significant impacts occur mainly during construction. The installation of an underground POL pipeline is an example. In this case, the clearing of the right-of-way, the excavation of the ditch, the scarred appearance of the land, and the potential soil erosion prior to the time vegetation has been re-established are the principal impacts. During the operational phase (which can be 50 years or more), the only significant impacts are the corridor effect of the cleared right-of-way passing through forests, and the annual maintenance to keep the right-of-way cleared. Thus, in describing this type of action, attention must be given to construction methods (how deep will the ditch be dug, blasting techniques for ledge, how will streams and rivers be crossed), and environmental controls to be applied (intercepting ditches for runoff, sedimentation traps, reseeding and mulching). If possible, these descriptions should be obtained directly from the proposed construction plans and specifications.

The construction phase section should also contain a listing and description of all facilities to be constructed in connection with the action. The description should include size, location, approximate cost, and other pertinent information such as architectural style or treatment. However, operating characteristics (e.g., for a new power plant) should be reserved for the next section.

3. OPERATIONS PHASE

Here one should describe the action as it will occur when the project is fully operational. This is the phase most people think of as the principal action to be described, and if the construction and abandonment aspects are of minor importance, this is the only phase that needs to be addressed.

An "operation" implies people are doing something, generally making use of constructed facilities and equipment, using various supplies and energy (input resources), and creating outputs in the form of waste products. The description of the operational phase of the action must address each of these to the extent necessary to later identify and, when possible, to quantify the impacts on the environment.

a. People

If the action involves an increase, decrease, or transfer of personnel, the change in numbers of people should be given. The numbers directly attributable to the action should be identified separately from total installation population. Also, if a transfer of personnel is likely to cause a change in the distribution of military/civilian, young/old, or single/family ratios, these should be identified. If the action does not involve a significant change in personnel, this should be clearly stated (since it can save considerable work during impact analysis).

In deciding what change in number of personnel constitutes a significant amount, consider the results in terms of housing units (either new requirements or empty units placed on the local market), the impact on community and/or base schools and hospitals, the impact on vehicular traffic, and the economic impact on the community. If there is any question, the personnel changes should be full described.

b. Constructed Facilities

These include dormitories, shops, power plants, runways, etc. During the operations phase, these facilities can cause impacts when they are in active use and when they are inactive (or passive). For example, an active power plant requires inputs of fuel and generates outputs of energy and waste products in the form of solids (ash), liquids and heat (cooling water), and gas (stack emissions). The power plant can also create impacts whether or not it is operating. Examples are the aesthetic impact of the building, its interception of precipitation and possible change in runoff, and possibly an increased hazard to air traffic due to its stack.

Runways are not active in the sense of power plants, but their relatively large impermeable surface may affect local surface drainage patterns.

Obviously, the description of all constructed facilities and their operational characteristics can be a sizable task. Only those aspects which may result in an impact need be described in detail. However, include at least a brief description of all facilities involved in the action in order to meet regulatory requirements and to allow reviewers to reach independent conclusions. Describe facilities which may cause an impact in sufficient detail to allow the later identification and if possible the quantification of the impacts.

c. Equipment

This applies primarily to aircraft, but, it can also include vehicles. The number of sorties or trips should be estimated as should their time distribution. If the characteristic noise and exhaust emissions have not previously been given, they should be included.

d. Test and Training Activities

The activities at training ranges and testing facilities must be described to indicate types of ordnance detonated, rockets fired or other material being tested. The waste products of such actions should be described in quantitative and qualitative terms, as well as noise output and any other unusual emissions such as smoke. The time the tests will take place should also be discussed, i.e., season, days of week, and hours during the day. Methods for controlling brush fires should be discussed, and methods for cleanup of waste materials.

4. ABANDONMENT PHASE

Some projects may cause impacts after they have completed their operational life, and there may be special actions which are planned in anticipation of this. An example is a sanitary landfill. When a particular site has been filled, there may be a final covering of soil and planting of vegetation. Special provisions may be made to control leachate and to vent gaseous products of decomposition, and to maintain the area as a result of long-term consolidation.

If a proposed action is likely to cause environmental impacts after it is abandoned or de-activated, the description of the action should include any measures which may be taken at that time to mitigate the adverse impacts.

5. ABNORMAL EVENTS

Some actions may create situations in which an abnormal event (accident) could cause significant adverse impacts. These events are often characterized as having a very low probability of occurrence but a high level of adverse impacts if they should occur. Examples would be the crash of an aircraft in a populated area, the explosion of an ammunition depot, or the accidental release of large quantities of hazardous or toxic materials to the environment. Other examples are the rupture of the Alaska pipeline with an attendant spill of crude oil in the arctic tundra, or the loss of crude oil from a very large oil tanker.

If the action being described includes the possibility of this type of abnormal event, the description of the action should include a subsection which describes the abnormal event, the probability of its occurrence (based on analysis of the historic occurrences under similar actions), and the preventive and protective measures which are included in the plan of action.

Preventive measures are those which are employed to prevent the occurrence of the event, such as radar on ships to detect other vessels. In general, preventive measures include instruments which provide warnings that the system is beginning to malfunction, and other automated devices which serve to shut the system down. Routine maintenance and inspection are also examples of preventive measures.

Protective measures are those which serve to minimize the adverse environmental impacts after an abnormal event has occurred, such as floating booms to contain an oil spill from a tanker. Automatically closing valves on pipelines, fire sprinkler systems, fire fighting apparatus and hazardous waste cleanup crews are other examples of protective measures.

The subsection concerning abnormal events, if it is deemed necessary to have one, should be balanced in scope and depth with the other subsections which describe the action. The purpose is to recognize that accidents can happen, to indicate this fact has been recognized, and to describe the preventive and protective measures which have been included in the plan of action.

6. OTHER FORMATS

Because of the great variety of actions for which environmental statements may have to be prepared, it is impossible to prescribe a rigid format suitable for all actions. The format suggested above is based on the temporal aspect of actions (construction, operation, abandonment) and special or abnormal events.

However, other formats are possible and may be easier to write and for the reader to follow. If the action involves a large area or several areas, a spatial breakdown could be used. In other cases, a functional format may be best, e.g., the various missions of several commands.

In order to select the best format, outline several versions and select the one which seems easiest to write and which provides the reader with a logical sequence of descriptive items. With a good format, it should only be necessary to describe each item once, and the reader should be able to follow the action without having to reread the description.

SECTION VI

DESCRIPTION OF THE EXISTING ENVIRONMENT

1. GENERAL

The previous Section V concerned the description of a proposed action which will occur in, and potentially affect, a part of the earth's environment. This Section VI will explain how the pre-action state of this environment is to be evaluated and described. The next Section VII is concerned with the impacts (changes in the environment) which are expected to occur as a result of the action.

It is important to note the difference between Section VI and VII. The former can theoretically be prepared without any knowledge of the proposed action, provided the boundaries of the environmental system have been defined. The latter, however, can only be determined with a knowledge of both the proposed action and the state of the existing environment.

The term "Existing Environment" is used in a special sense which must be qualified. In a literal interpretation, it may be construed as a collection of baseline data and information which could constitute a "snapshot" view of the environment at the existing time. Actually, the environment is a dynamic system which is constantly undergoing change.

Data about present conditions may fail to adequately describe the environment. For example, the average annual flow in a stream or river must be based on many years of observation; this year's data alone may be a departure from the norm which may be either too high or too low to be representative. Similarly, data such as regional population are subject to change due to activities which are external to those described in the project action. These may be changes in the birth rate or as a result of migration.

While it is important to recognize this independently dynamic nature of the environment, it is almost impossible to accurately predict its future status. For this reason, the existing state is used as a basis for impact assessment purposes. The exceptions to this rule apply mainly to established programs and land use plans (e.g., the establishment of a new park) which can reasonably be expected to affect the future states of the environment.

The description of the existing environment is discussed below under four major divisions: the physical environment (subsection 2), the biotic environment (subsection 3), the human environment (subsection 4), and air traffic (subsection 5). The latter, of course, is a subset of the human environment, but because of its importance in Air Force operations, it has been described in a separate subsection.

2. PHYSICAL ENVIRONMENT

The physical environment consists of three components; the lithosphere (land), the atmosphere (air), and the hydrosphere (water). Another way of looking at it as the physical environment is the total environment minus all living things (including man), but, including the physical-chemical consequences of the presence of living things.

The methods for describing the physical environment are discussed under the following categories:

a. Terrestrial Regime (including topography, geology, soils)
b. Atmospheric Regime (including noise, air quality, radiation)
c. Hydrologic Regime (including surface and groundwater, water quality)

a. Terrestrial Regime (Land)

Unless previously covered under "Description of the Proposed Action," describe the geographical location(s) to be affected by the proposed action. This includes township, county, and state, and longitude and latitude, and installation name, if any. Specify the distance from the closest major cities and from such closest major environmental features as mountain ranges, major lakes and/or rivers, major deserts, state or national parks and forests and other recreational areas. Include a detailed map of the impacted area itself. If, within the impacted area, the impact is expected to be particularly severe on subareas, maps of these subareas should be included in even greater detail.

These map details should include all the impacted topographic features of the action area, including lakes, streams, rivers, mountains, deserts, valleys, etc., both natural and man-made. U.S. Geological Survey (USGS) topographic maps are ideal for this purpose since they show a wealth of detail, however, they may not be sufficiently up to date with respect to highways, roads, and other man-made features. Major route numbers should be shown. Aerial photographs may also be useful in addition to, but never in place of, detailed maps. The best sense of the terrain is frequently achieved through low oblique aerial photographs and/or ground level panoramic photographs. This material should all be carefully labeled, maps should be legible, and the specifically impacted areas should be clearly indicated either by shading or by heavy outline.

Mineral resources are shown in USGS geological survey maps. In these maps, which also indicate mines, surface mineral deposits (outcroppings) are shown in various colors, hence it may be desirable to make simplified black and white line drawings for these maps. In addition to the maps, major topographic and geological features should be discussed. While the USGS is concerned with resources, the U.S. Bureau of Mines is concerned with and can provide information on reserves, i.e., potentially extractable mineral resources. Soil conditions should also be described and the Soil Conservation Survey of the U.S. Department of Agriculture prepares soil survey maps. Again, brief verbal descriptions should accompany any maps and mention should be made here (and in the section describing the biotic envrionment) as to whether the area is farmed, forested, etc. since such information is relevant to the soil type and fertility.

Particularly if the action involves construction or large amounts of earth movement, soil mechanics as well as composition should be discussed; in particular, bearing quality, the depth to bedrock or other mechanically stable deposits, subsidence, frost-heave problems, erosion potential (wind and water), etc. If the action involves structures and/or equipment which could result in environmental damage if they were damaged by foundation instability or earthquakes, then a discussion of the frequency and intensity of seismic disturbances is critical.

If the action involves solid waste disposal, then present solid waste disposal practice should be discussed. If landfill sites are involved, these sites should be described, i.e., they should be located on the maps and their present burden and capacity should be described.

b. Atmospheric Regime (Air)

The description of the atmospheric regime is discussed below under three subdivisions:

(1) Noise
(2) Air Quality
(3) Radiation

(1) Noise

(a) Introduction

Noise can be defined as the part of sound which is annoying or undesired. Noise is potentially one of the most important impacts in connection with Air Force activities, particularly due to aircraft operations. Thus, it is important for the author of environmental statements to understand the nature of the problem and to know when to seek assistance from specialists in noise analysis. Before attempting to evaluate noise, the author should review a general text on the subject to learn how noise is measured and its characteristics (e.g., the noise spectrum, annoyance caused by narrow bandwidths, percussive noise, nighttime noise, etc.).

Sound levels can be measured and analyzed mathematically, but this requires special instruments and techniques that are generally not available at the base level, and for which outside assistance is required. However, noise complaints are usually generated by people on the basis of subjective judgments, and depending on the nature of the action it is possible for the author of the environmental statement to make first estimate evaluations of potential noise impacts by also using subjective judgments.

The EPA has identified those products (which can also be considered activities in another sense) that are the major sources of noise in the U.S.[1] In decreasing order of the number of people exposed, these sources are:

Urban Traffic
Aircraft
Construction Sites
Freeway Traffic

At locations near airfields, aircraft noise is the more predominant source. Removed from aircraft, urban traffic affects more people, but the noise level is generally lower.

Insofar as any Air Force action includes events that affect either the magnitude of the noise level or the number of people associated with the above four products (or activities), there will be some degree of impact. In other words, an impact can arise from two causes either independently or together; the activity can increase (noisier aircraft assigned, for instance), causing noise levels to rise, or the activity can remain constant while the surrounding noise-affected population density can increase.

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1 U.S. Environmental Protection Agency, "Identification of Products as Major Sources of Noise," Federal Register, Vol. 39, No. 121, pg. 22297, June 21, 1974.

Another approach in determining the possibility of impact is to consider those processes where the transformation of energy from one form to another is either at a high rate, large magnitude or at low efficiency. A prime example of a high rate of energy release is the jet engine, where the heat content of the fuel is transformed to move large masses of air at high speeds and at elevated temperatures to produce thrust. Large magnitudes of energy might be exemplified by a very high traffic flow rate of several thousand vehicles per hour on a freeway. Here each individual vehicle might not be considered as a significant noise source, but the total traffic flow definitely is. An example of inefficient energy use is the propeller type cooling fan used on heat exchangers (i.e., air handling systems). It is obvious that a noise source contains at least some or all of these attributes.

In the extreme case are those noise levels so dangerous that hearing loss can occur. This aspect is covered in detail with regard to Air Force personnel in AFR 161-35, Hazardous Noise Exposure. OSHA regulations[2] and EPA criteria[3] contain the requirements for the public sector.

By way of comparison, the annoyance type of impact generally involves large numbers of people, while the hearing loss type of impact affects a relatively small number of people, both of which can be significant.

There are several possible courses to take in describing existing noise conditions in an environmental statement. If noise is of no consequence, either before and after the contemplated action, it is unnecessary to provide a detailed description of the present noise environment. A simple statement to that fact is sufficient to indicate potential noise impacts were considered. The description of the proposed action should support this decision and conclusion.

If the planned action will result in noise impacts, either positive or negative, a description of existing conditions is required. In this case there are two additional approaches to describing the noise environment (and later the impact). Noise is a diffuse form of energy, varying considerably in time and extent. Because it is not time-wise cumulative, it is not readily available for accurate sampling. Thus, it can become very time consuming and expensive to provide a complete and accurate numerical description of the existing noise environment. This complete description

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2 U.S. Department of Labor, Occupational Safety and Health Administration, General Industry Standards and Interpretations, Volume 1, Section 1910.95, "Occupational Noise Exposure."

3 U.S. Environmental Protection Agency, "Public Health and Welfare Criteria for Noise," U.S. Government Printing Office, 550/9-73-002, July 27, 1973.

can be accomplished by calculated prediction, comparisons with similar situations or environments reported in the literature, or by field measurements. If field measurements are made, it is essential that very accurate predictions be made in order to provide an accurate statement of the impact due to this comparison of absolute levels. In this manner, the existing conditions (measured sound levels) and the predicted sound levels representing the result of the action will be compared on an absolute basis, thus requiring accuracy.

The alternative to the above is to characterize the noise environment in words first, with calculated sound levels at, say, critical locations. These calculations may not be very accurate, but the model and methods used to perform the calculations must be logical and consistent with the model and methods to be used in calculating the levels which result from the action. In this manner, the existing conditions (calculated sound levels) and the predicted sound levels will be compared on a relative basis; the difference in sound levels will tend to be accurate, thus reflecting an accurate incremental impact assessment.

The potential noise impacts will be discussed under two categories: those associated with aircraft flight operations and other major noise sources. These are covered separately in subsections (b) and (c) below. Noise from aircraft operations are analyzed using the Air Installation Compatible Use Zone (AICUZ) concept, which also includes potential impacts due to aircraft accidents.

(b) Non-Aircraft Noise Sources

- Vehicular Traffic

Initially the existing traffic conditions should be described by a word picture of the major arterial network surrounding the site, including in somewhat more detail those roads where at least half of the average daily traffic count consists of vehicles whose presence is, or will be, due to activities at the site. Except for unusual situations this is about the influence level (i.e., one-half or double) at which significant noise changes begin to occur. Additional information may be given to the reader of the environmental statement by relating this description to a map of the area showing the site, roads, vehicle count, etc. To correlate this presentation with the site activities, a description of the traffic and/or traffic count within the site must also be given. These data, if available at all, can be obtained for the Military Traffic Management and Terminal Service, Transportation Engineering Agency, 12388 Warwick Blvd., P.O. Box 6276, Newport News, Virginia 23606, through the cognizant civil engineering unit involved in the proposed action.

Since the local area planning agency also uses traffic information for road development, this agency, the state, or the city highway public works departments are logical sources for off-site information. Such information is generally titled as "Traffic Surveys."

The form of all of this traffic information should be: the Average Daily Traffic (ADT) (with directions, if appropriate), peak hourly (or half-hour) rates throughout the working day, past history of the area traffic growth, and plans for future highway development to the level of certainty compatible with the time frame of the proposed action.

Since the ultimate purpose of this portion of the environmental statement is to describe the present effects of traffic noise on people and surrounding land use, additional data is required. This data is the surrounding land use and zoning maps and population distributions, both of which are available from local community planning agencies.

The method for calculating highway traffic noise levels, with introductory fundamentals, is contained in Reference 4. The hand calculation method discussed in Reference 4 is described in detail in References 5 and 6. Although computer solutions are discussed in Reference 4, such analysis is generally used for detailed highway planning and construction and is not generally applicable to Air Force activities.

As discussed earlier, several different levels of detail are suggested for describing the existing noise conditions. Likewise, the calculated noise quantities can be obtained with different levels of completeness and accuracy. For instance, the method described in Reference 5 can be tailored to suit the intent by ignoring certain parameters completely if the subsequent impact is described in terms of relative noise levels. That is, the same parameters such as road grade corrections could appear in both the "before" and "after" situations and have no effect on the differences in the calculated noise levels. Naturally, if absolute noise levels are required to describe conditions for later comparison with criteria or standards, all relevant parameters must be included in the calculations.

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4 Bolt, Beranek, and Newman, Inc., "Fundamentals and Abatement of Highway Traffic Noise," Federal Highway Administration, NTIS/PB-222-703, June 1973.

5 Gordon, C. G., et al., "Highway Noise - A Design Guide for Highway Engineers," Highway Research Board, National Research Council, 1971.

6 Kugler, B. A., and A. G. Piersol, "Highway Noise - A Field Evaluation of Traffic Noise Reduction Measures," Highway Research Board, National Research Council, 1973.

The final form of a very complete traffic noise description could include a table of results with an accompanying map, if applicable. The table should list those sensitive locations referenced to the map and the corresponding calculated or measured noise levels. Alternatively, the table should list those numbers of people and/or the particular kinds of land use or zones in acres, subjected to certain increments of noise levels depicted on the map by one or more noise contours. To complete the understanding of the data presented, a reference level or levels must be given for comparison. Reference 7 provides noise levels and land uses as required for federally supported highway construction projects. Alternatively, References 8 and 9 provide criteria applicable to a wide range of noise situations, while Reference 10 provides criteria specifically applicable to residential housing. In general, local noise ordinances, if they exist, do not apply to traffic noises but rather to individual offenders. Thus, it is necessary to have a measure of the situation in terms of how the present traffic noise affects what number people or the amount of land subjected to specific noise levels.

When the initial assessment indicates noise impacts will be of minor significance, it is permissible to combine the presentation of before and after noise levels in a single presentation under the discussion of probable impacts. The purpose would be to simplify making comparisons and to avoid duplication of material in the report.

- Construction

Obviously there are no present conditions to be described that involve construction noise related to the contemplated action. The kinds of construction inherent with the action are described elsewhere in the report. The only discussion that might be required is

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7 U.S. Department of Transportation, Federal Highway Administration, PPM 90-2, "Noise Standards and Procedures," February 8, 1973.

8 U.S. Environmental Protection Agency, Office of Noise Abatement and Control, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety," March 1974.

9 U.S. Environmental Protection Agency, Office of Noise Abatement and Control, "Public Health and Welfare Criteria for Noise," July 27, 1973.

10 U.S. Department of Housing and Urban Development. Report TE/NA 171, August 1971.

whether existing construction would continue during the proposed action. A discussion of relevant local noise ordinances should also be introduced at this time. A discussion of noise from construction equipment and operations, building equipment, and home appliances can be found in Reference 11.

- Other Noise Sources

The treatment of other noise sources has been identified as a subcategory because such sources have been recognized as being major contributors to the degradation of the environment. They are generally uncontrolled by any regional regulatory agency. The treatment of what might be termed minor, but at times no less important, sources has not been formalized because of their great variety in size, number and relatively diffuse distribution in the environment. Control of these sources has been left to the local authority.

With no experience it is a practical impossibility to seek out, identify, and assess such noise sources. Although a compilation of noise complaints may serve as a starting point for identification, care must be exercised to insure the real basis of the complaints are the noise characteristics of the source.

It is at this time expert assistance is required. An acoustic consultant or specialist can provide an assessment of the present situation including field measurements as appropriate. His report can be abstracted to prepare the noise section on the present existing noise environment, and his entire report can be included as an appendix if noise impacts are expected to be significant.

(c) Aircraft Noise (AICUZ)

(i) Background

The Air Force has developed the Air Installation Compatible Use Zone (AICUZ) concept in an effort to guide, control, and regulate the growth and development of the land area close to military airports, and concurrently to prevent degradation of Air Force mission capability resulting from potential urban encroachment on such airports. The concept is based upon the development of land use compatibility guidelines defined by both the noise levels and the potential crash hazards due to the aircraft operations, and embodies a process of projecting, mapping, and defining aircraft noise and accident potential areas in the air base environs. Land use compatibility guidelines are then applied to these areas. These serve as the basis for Air Force recommendations on land use planning and control by the community.

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11 U.S. Environmental Protection Agency, "Noise From Construction Equipment and Operations, Building Equipment and Home Appliances," Decembe- 31, 1971.

The AICUZ program requires all appropriate governmental bodies and citizens be kept informed of Air Force views whenever AICUZ or other planning matters affecting the installation are under consideration. This involves:

- Providing information, criteria and guidelines to state, regional and local planning bodies, civic associations and similar groups.

- Informing such groups of the requirements of the flying activity, noise exposure, aircraft accident potential and AICUZ plans.

- Describing the noise reduction measures that are being used.

- Insuring all reasonable, economical, and practical measures are taken to reduce or control Air Force noise-producing activities. These measures include such considerations as proper location of engine test facilities; providing sound suppressors where necessary; and adjustment of flight patterns and/or techniques to minimize the noise impact on populated areas. This must be done without jeopardizing safety or operational effectiveness.

The following paragraphs describe briefly the mappings and zones derived from the application of AICUZ, after which a description is given of the information needed and the procedures followed to develop these mappings and their relation to land use compatibility guidelines.

(ii) AICUZ Land Use Zones

The AICUZ program designates land areas in proximity to air installations as Noise Zones (NZ) and as Accident Potential Zones (APZ) and provides land use compatibility guidelines for each of these sets of land areas.

Superposition of the NA and APZ mappings on Base drawings create Compatible Use Districts (CUD) which are the basic planning units of the AICUZ program. Through combination of the NZ and APZ land use guidelines, composite compatibility guidelines have been established for each of the Compatibility Use Districts.

Examples of the NZ, APZ, and of the resulting CUD for a typical Air Force installation having one major runway are shown on Figures 7, 8, and 9. The noise zones in Figure 7 are given in terms of the day-night sound exposure levels methodology, and contours are plotted for the L_{dn} 65, 70, 75, 80, and 85 dB levels, and define six land areas or noise zones.

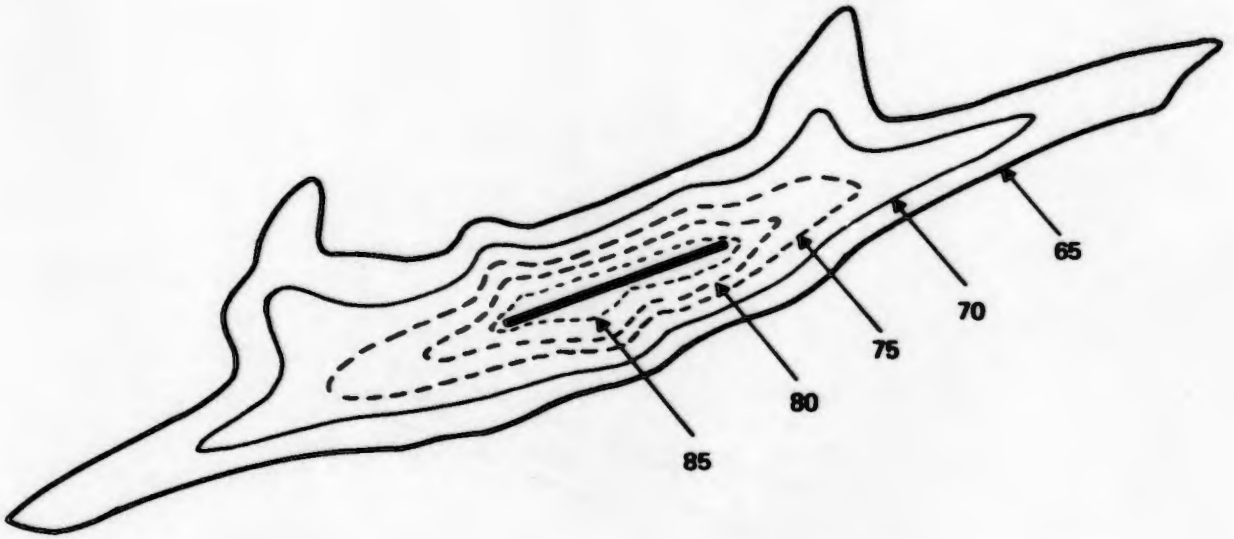

Figure 7. L_{dn} Noise Zones

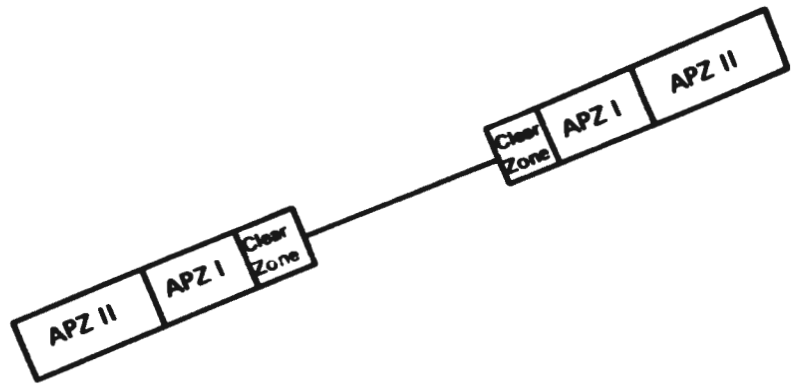

Figure 8. AICUZ Accident Hazard Zones

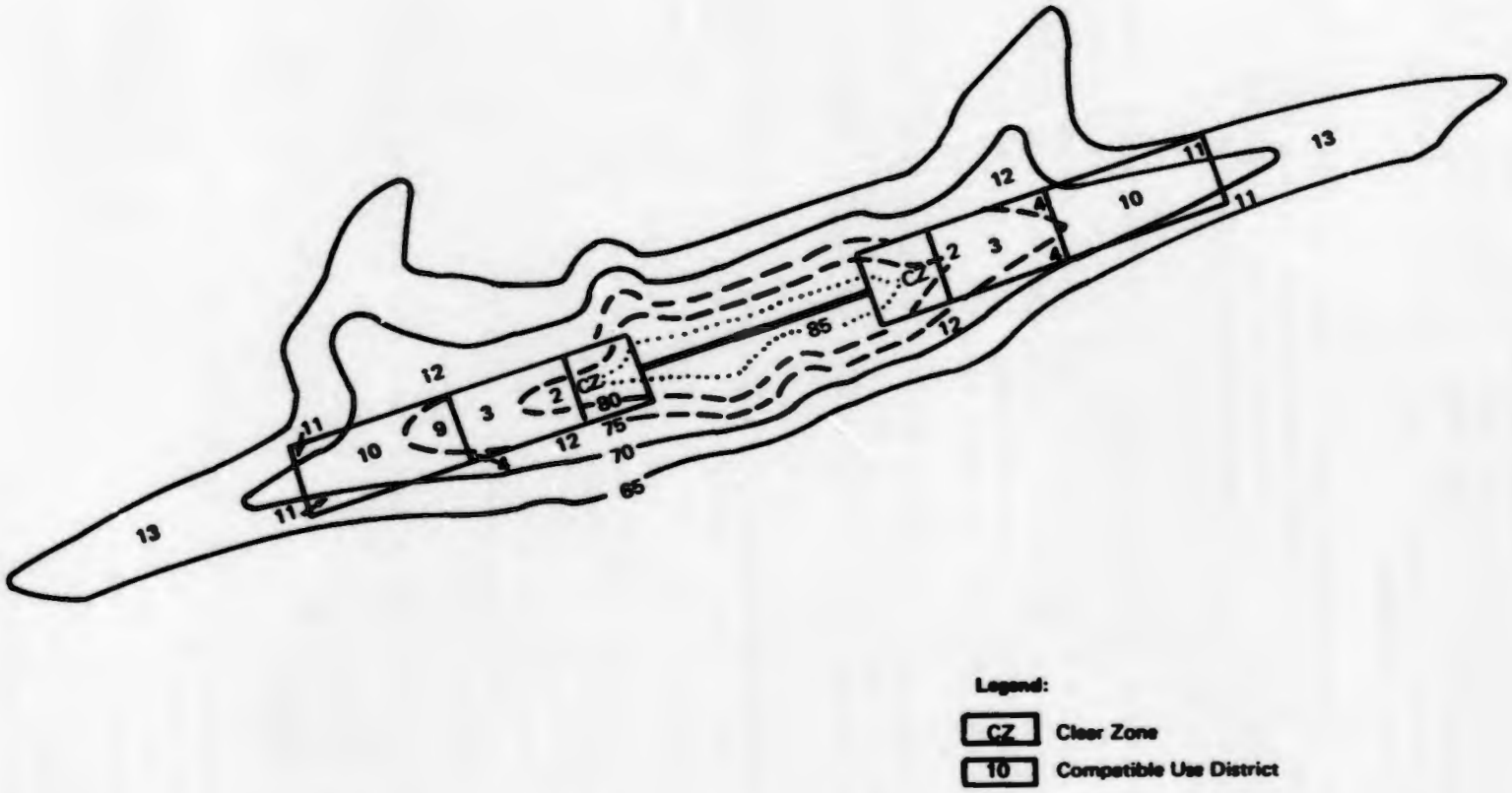

Figure 9. AICUZ Map Showing Compatible Use Districts

Land use compatibility guidelines for these zones have been developed as part of the noise exposure methodology. These guidelines, which have been quite generally used for both commercial and military airport activities, have been based on noise complaint case histories and on various subjective response criteria established by psychoacoustic testing programs.

Another noise exposure descriptor which has been widely used by the Air Force until recently is the Composite Noise Rating (CNR). A discussion of this and other noise measures developed specifically for aircraft operations and their relationship to each other is presented in Appendix B.

The accident hazard zones defined under the AICUZ concept have been established from a statistical evaluation carried out by the Air Force of 369 major aircraft accidents that have occurred within ten miles of airfields and which were directly related to airfield-associated in-flight mishaps. These accidents cover a five-year period and include all types of Air Force aircraft.

From this statistical evaluation, three zones have been defined, in relation to the runway geometry, within which the aircraft accident hazard potential is sufficiently high to warrant land use restrictions.

These zones include the Clear Zone (CZ), and the Accident Potential Zones I and II (APZ I and APZ II). These zones, as illustrated in Figure 8, extend from the threshold of active runways for a total length of 15,000 feet; the Clear Zone for 3,000 feet, APZ I for an additional 5,000 feet, and APZ II for an additional 7,000 feet for a total of 15,000 feet. For all base primary missions except fighter missions, each of these zones is 3,000 feet wide. For air bases whose primary mission involves fighter aircraft, the width of the Clear Zone is 2,000 feet, while the widths of the APZ I and APZ II remain as 3,000 feet.

Except for this modification in the width of the Clear Zone for fighter aircraft, the size and location (relative to the major runways) of these hazard zones are assumed to be the same for all military airports independent of the airport activity number and type of aircraft operations.

Land use guidelines have been established by the Air Force under the AICUZ program for each of these hazard zones. Within the Clear Zone, which has the most critical accident potential, all land uses are prohibited (i.e., incompatible) except for the following: agriculture; permanent open space; water areas; transportation rights-of-way; communication and underground utilities; and necessary navigational aids or operational facilities.

(It is the intent of the Air Force, as part of the AICUZ program, to acquire by fee or easement the land within the area designated as the Clear Zone. Fee land so acquired may be made available for outleasing for agricultural or grazing purposes.)

The acceptable land uses within Accident Potential Zone I include agriculture; recreational uses; open spaces, transportation, communication and utility uses; wholesale trade; and some types of industry and manufacturing. Generally, land uses which concentrate people in small areas are not compatible.

The acceptable land uses in Accident Potential Zone II include all of those allowed in Zone I plus low-density, single-family residences, various personal and business services; and commercial retail trade uses of low population density. High density uses such as schools, churches, restaurants, and multi-story buildings are not compatible according to this concept.

Superposition of the Noise Zones and the Accident Potential Zones on base drawings, as shown on Figure 9, create the AICUZ map with the Compatible Use Districts (CUD). The CUD are the basic land use planning units of the AICUZ concept, and through a combination of the NZ and APZ land use guidelines, compatible land use guidelines have been developed for the CUD. These guidelines are given in Appendix C for the variety of land use categories listed under the Standard Land Use Coding Manual (SLUCM).

(iii) Development and Implementation of AICUZ Program

The policy established for the development and implementation of the AICUZ program, as formulated by the Planning Task Force (AF/PREV) within the Directorate of Civil Engineering of HQ, USAF, and issued to all Air Force installations, consists of six phases:

- **Phase I:** Acquisition and organization of basic data required.
- **Phase II:** Review, refinement, and codification of Phase I data.
- **Phase III:** Preparation of Noise Exposure Contour maps by AF/PREV based on the information and results of Phases I and II.
- **Phase IV:** Preparation of AICUZ maps, land use compatibility plans, and zoning recommendations.
- **Phase V:** Presentation of AICUZ to and implementation by local governments.
- **Phase VI:** Maintenance of the AICUZ.

Description and instructions for implementation of these plans have been supplied to each Air Force air installation in the form of a series of AICUZ Information Bulletins (see References 12 to 18).

As outlined in References 12 and 15, the Phase I program involves the assembling of information concerning aircraft operations, runway usage, flight profiles, flight track usage, and flight operation noise data for each aircraft type of interest; the identification of all key interested parties to air installation activities, such as local government officials, major landowners, and interest groups, representatives of state and federal governments dealing with land use, etc.; assembly and preparation of maps and land use plans for the base vicinity; analysis of all aircraft accidents, in-flight emergencies, existing or potential hazards; assembly of data on engine maintenance and test programs; review and evaluation of such legal affairs as construction, noise, and pollution ordinances, state enabling acts for land use planning and zoning; economic and socio-economic impact factors such as payroll, local economy, base investments, retiree dependence on the installation, etc.; and weather factors as they relate to airspace, noise and operational requirements.

The Phase II program, which essentially is a review of the Phase I program, is carried out by Major Command personnel with base personnel participation. It is carried out separately for the flight operational and maintenance data and for the non-operational data relating to legal, economic, and land use and zoning information. The operational data review, as outlined in Reference 18, has two basic goals: first, to ensure that Phase I data provide a reasonable and accurate description of the flight operational data, and second, to prepare these data in the appropriate input format for Phase III (Noise Exposure Contour Generation). The review of the non-operational information, as outlined in Reference 17, is needed to identify deficiencies and errors and also to establish data standards and measure for evaluation of some non-operational elements (such as community evaluation), which are based to a significant degree on judgment factors. Completion of this review of the non-operational factors is a requirement prior to Phase IV.

The Phase III program is carried out by, or under, the direction of AF/PREV, leading to a mapping of noise contours for each situation or proposed action of interest.

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12 AICUZ, Phase One, HQ USAF, AF/PREV Planning Task Force, 27 October 1973.

15 AICUZ Information Bulletin Four, Guidance for AICUZ Phase I, HQ USAF, AF/PREV Planning Task Force, December 1973.

17 AICUZ Information Bulletin Six, Guidance for Non-Operational Elements of Phase II, HQ USAF, AF/PREV Planning Task Force, April 1974.

18 AICUZ Information Bulletin Seven, Guidance for Operational Review of Phase I Data , HQ USAF, AF/PREV Planning Task Force, May 1974.

In Phase IV, generally carried out by AF/PREV in conjunction with Base personnel, the noise contours and accident hazard zones are combined to form an AICUZ mapping for each of the air installation situations or actions. These mappings are compared with the corresponding land use and zoning in the affected areas to establish the compatibility of the existing uses of the land and of the projected uses according to the land zoning.

Land use compatibility guidelines to assist in these evaluations have been developed for a variety of categories tested under the Standard Land Use Coding Manual (SLUCM). A complete listing of these compatibility guidelines is given in Appendix C.

The Phase V program consists of the presentation of the AICUZ prepared by the Air Force, together with land use and zoning recommendations to the local governmental authorities and citizens for their consideration, adaptation, and implementation.

Finally, the Phase VI program includes all the activities of data collection and updating, coordination with local authorities and with AF/PREV, etc., needed to maintain the currency of the AICUZ program.

(iv) Sources of Information for Assessment of AICUZ Impact

The assessment of the impact of aircraft operational activity due to noise and accident potential comprises the major part of Phase IV of AICUZ. The procedure generally followed would involve identification of the major categories of land use within each Compatible Use District, and the establishment of the compatibility, marginal compatibility, or incompatibility of each of these land uses in terms of the Land Use Compatibility Guidelines established under AICUZ. As indicated, these guidelines are tabulated in Appendix C.

In most air installation environs, the major measures of the impacts will be associated with the number of people residing in the CUD, with the number of dwelling units, number of schools and students, and number of hospitals and nursing homes. Also of significance may be major public buildings, hotels and motels, terminals, shopping centers, and other land use categories which frequently may concentrate a large number of people in small areas.

The evaluation of the magnitude of these impacts requires demographic data, housing reports, and maps showing locations of the major buildings, schools, hospitals, etc. The main sources of these data are the various publications of the Census Bureau of the U.S. Department of Commerce, regional transportation planning groups, and the series of topographic maps prepared by the U.S. Geological Survey of the Department of the Interior.

Data from the Federal Census (most recent is 1970) has been statistically analyzed for both population and housing characteristics for most urban and for many rural areas in terms of states, Standard Metropolitan Statistical Areas (SMSA), counties, urbanized areas, cities, census tracts, and blocks, and for all incorporated places and unincorporated places of 1,000 inhabitants or more. An SMSA was originally defined for every city having a population greater than 200,000 but was later changed to cover each incorporated city of 50,000 or more inhabitants and including adjacent minor civil divisions or incorporated places having a population density of 150 persons per square mile or more. An urbanized area consists of a central city, or cities, and surrounding closely settled territory. The central city must have reported a population into which large cities and metropolitan areas are divided for statistical purposes. Its boundaries are established cooperatively by the Census Bureau and local authorities and are generally designed to achieve some uniformity of population characteristics, economic status, and living conditions. Initially, the average Census Tract had about 4,000 residents.

Blocks are usually well-defined pieces of land bordered by streets or roads, or on occasion by railroad tracks, streams, or other features. Block statistics, which contain data for individual blocks on selected housing and population subjects, have been prepared for each urbanized area and also for some communities outside urbanized areas which contract with the Census Bureau to provide this type of data.

Incorporated places are political units incorporated as cities, boroughs, towns, and villages, with some exceptions. Unincorporated places are delineated by boundaries for closely settled population centers without corporate limits.

As an example of the dimensions of some of these census categories, the figures from the 1970 Census appropriate for Oklahoma City are as follows:

State (Oklahoma): 69,000 sq. miles, 2.56 million people
SMSA (Oklahoma City): 2,143 sq. miles, 641,000 people
County (Oklahoma): 700 sq. miles, 527,000 people
Urbanized Area (Oklahoma City): 339 sq. miles, 580,000 people
City (Oklahoma City): 636 sq. miles, 367,000 people
Oklahoma City is then divided into numerous census tracts and blocks.

A comparison of the 1960 and 1970 counts are also available from the Census Bureau for SMSA's and for their central cities and constituent counties. For these areas, therefore, the general historical trends can be defined. The Census Bureau does not, however, produce any demographic or housing projections. For many of the proposed actions at air installations for which environmental statements must be prepared, the date of the proposed action may be several years in the future, and thus projections are particularly helpful in evaluating the impacts. Such projections are, however, available for at least some metropolitan areas from regional transportation planning groups. Such groups or councils have been formed in many metropolitan areas by the local governments, chambers of commerce, industrial interests, etc. for the purpose of urban and transportation planning. Generally, the results of these studies include statistical summaries and projections for population, housing, student counts, and certain economic data such as labor force, income statistics, etc. for a variety of areal subdivisions of an SMSA. Typically, the SMSA would be divided into sectors, districts, and traffic zones. The smallest areal unit, the traffic zone may typically be as small as a fraction of a square mile in area in central business district areas to as large as 10 or 20 square miles for rural areas at the boundaries of the metropolitan area. For those metropolitan areas for which these types of data have been assembled, the traffic zones are of a convenient dimension to use for impact assessments and, furthermore, since projections and trends are generally provided, estimates of the impact of proposed action can be carried out by interpolation to the time frame.

Again, using the Oklahoma City area as an example, the study area chosen for the Oklahoma City Area Regional Transportation Study, carried out in 1968 and updated in 1971, was approximately 1,250 square miles in area, and was divided into nine sectors, 27 districts, and approximately 650 traffic zones.

The other major source of information which can be useful for impact evaluation is the series of USGS maps for the area of interest. These maps contain boundaries of urban areas, locations of buildings in rural areas, identification of schools and hospitals, and other significant topographic features. For some rural areas, these maps, together with other county or local maps, may be the only source of data on housing density and, hence, of population estimates.

(2) Air Quality

The maintenance and improvement of air quality is a major environmental objective, and there are few actions which do not involve potential air pollution. Methods for describing the present air quality are discussed below under five subsets:

(a) Analysis Methodology
(b) Emission Inventory: On Base (See also Appendix A)
(c) Emission Inventory: Off Base
(d) Qualitative Impact Analysis
(e) Quantitative Impact Analysis

(a) Analysis Methodology

(i) Purpose of Analysis

The purpose of the air quality analysis is to determine the impact of air pollutants emitted by the Air Force facility and the change in this impact which will result from the action. The term "impact" is used to denote the potential for harmful or undesirable effects on health, property, wildlife and plant life, and human activities which may result from the emission of air pollutants by the facility. The procedures for evaluating the air quality at a facility prior to the proposed action are discussed below. The evaluation of the impact which may result from the action is discussed in Section VII. Generally, the procedures for the two impact analyses will be the same and will differ only in the input information used in the analysis. In some cases, however, the present impact of the facility may have been determined by a prior analysis and the only analysis required may be of the impact of the action. In these cases, the procedures described here are applicable to the analysis of the impacts due to the action.

(ii) Nature of the Analysis

The investigator conducting the air quality impact analysis must be aware at the outset that he is embarking on an exercise which is far from exact. The impact of air pollutants at any location is the total effect of many sources of a variety of pollutants, and the individual effects of these sources vary in time due to changes in source characteristics and meteorological conditions. The nature and quantities of pollutants issuing from sources generally are not known very accurately, and the mechanisms by which the pollutants are conveyed from the sources to the point of impact cannot be predicted with a great degree of confidence. Consequently, the investigator must adopt the attitude he will do the best he can with the information and resources which are available to him. By following the procedures prescribed here, he will at least develop a valid assessment of the relative importance of his facility to the overall air pollution problem in the vicinity. Given some previous insight into the importance of air pollution as a community problem, the investigator will be able to place the impact of his facility into proper perspective. If required to go beyond this result, the investigator will be able to develop a quantitative estimate of the impact of his facility by using generally accepted analysis procedures. An impact estimate derived in this manner will be recognized as the result of a responsible effort to evaluate the impact.

A second comment to the investigator at the outset of the analysis is concerned with the multiplicity of the information involved in the analysis. As the investigator will soon discover, the analysis requires the collection, cataloging, and processing of a variety of information derived from a variety of sources. The purpose of the analysis will be served best if the analysis is conducted in a well-organized, methodical manner. The investigator should develop a detailed data collection and analysis procedure which serves three important functions:

- Identifies the data necessary for the analysis.
- Identifies the sources of data used in the analysis.
- Provides a format for reporting the data along with the results of the analysis.

If such a procedure is prepared and used, the investigator's task will be easier in all stages of the analysis. The procedure will also enhance the credibility of the analysis results by reflecting the investigator's comprehension of the problem and in indicating the origins of the information used in the analysis. If the time comes to defend the analysis results, availability of the input information and results of the analysis procedures in an organized format will be of great benefit. This report has been formulated to provide guidelines for a systematic air quality analysis. However, the investigator will have to pattern his own analysis procedures and information records according to the characteristics of his facility. A review of these guidelines and of previously published air quality analyses for Air Force facilities should provide an adequate background for initiating a new air quality analysis.

(iii) Description of the Evaluation

The basic concepts involved in conducting an air quality analysis are described briefly here. A more thorough discussion of the background of the air quality problem will be found in the Air Force Environmental Protection Manual.

The term "air quality" is used to describe the state of cleanliness of the ambient air in a specified locality, area, or region. Air quality is degraded by the presence of air contaminants or "pollutants" in the form of gases, liquid droplets, or solid particles. The effects of air pollutants include hazards to health, damage to property and vegetation, restraints of activities (such as might be caused by a reduction in visibility), and aesthetic or nuisance effects such as smoke plumes and odors. Air quality may be expressed directly in terms of ambient concentrations of air pollutants or indirectly in terms of effects such as visibility reduction or odor level.

Concentrations of air pollutants in ambient air can be measured by standardized measurement methods, and these methods are in widespread use in urban areas to provide air quality data. These data are used for control measures to maintain the quality of the air within limits necessary to protect health and welfare. Data on air quality in urban areas generally are available from air pollution control or public health agencies for use in air quality impact analyses.

Quantitative information on rates of pollution emission in a particular area is necessary to determine the sources of degraded air quality and to plan air quality control measures. A summary of emission rates for sources in an area is called an "emission inventory." An emission inventory may be expressed in terms of the nature and locations of discrete sources or in terms of total emissions per unit area.

When the results of an emission inventory are expressed in terms of quantities of pollutants emitted per unit of geographical area, these results are called "emission densities." The emission density for a specific pollutant class and geographical area is in itself a qualitative indicator of the relative air quality of that area with respect to that pollutant. The emission density also is required as input information for quantitative analyses of air quality in the area and in adjacent areas.

Air quality at a specific location or within an area is dependent upon the magnitude and distribution of emission sources in the area and also upon meteorological factors which affect the dispersion of emissions from these sources. These factors include the wind speed near ground level and the stability of the atmosphere, and the combined effect of these factors is referred to as the "air pollution potential" for the region. Atmospheric stability refers to the processes which cause vertical and lateral mixing or spreading of air pollutants as they are carried away from their sources by the wind. Stability is characterized by rates of diffusion association with atmospheric turbulence and by a mixing height that is the upper elevation of the meteorological mixing layer. Vertical diffusion of pollutants occurs very slowly above the mixing layers in comparison with diffusion rates within the layer. Thus, the mixing height is a measure of the altitude to which pollutants can be expected to diffuse in their passage through the urban atmosphere. High wind speeds and mixing heights represent conditions of low air pollution potential. On the other hand, low wind speeds and mixing heights represent conditions of high air pollution potential since pollutants emitted under these conditions are effectively trapped within a shallow layer and have a long residence time in the urban atmosphere.

Air quality at a specific location is the total effect of all sources whose emissions are transported to that location by the processes of meteorological dispersion. This effect is termed the "impact" of these sources on the air quality at that location. Each source is considered to have its individual impact on the local air quality, and the combined effect of all sources is the total air quality impacts.

(iv) Laws and Regulations

The body of federal law providing for prevention and control of air pollution is called the Clean Air Act and includes the following specific acts and amendments:

- Clean Air Act of 1963 (PL 88-206).
- Motor Vehicle Air Pollution Control Act (PL 89-272, 1965).
- Clean Air Act Amendments of 1966 (P. 89-675).
- Air Quality Act of 1967 (P. 90-148).
- Clean Air Amendments of 1970 (P. 91-604).

Through this Act, the federal government has embarked upon a vigorous and comprehensive program to maintain acceptable air quality in the United States and to control the emission of pollutants for sources affecting air quality.

The Act requires the Administrator of the Environmental Protection Agency to issue standards for ambient air quality. Standards were issued in April 1971 for six pollutants (see also 40 FR 7042, February 18, 1975). The standards include primary standards which are intended to protect public health and secondary standards that are intended to protect public welfare (primarily property). In the judgment of the EPA Administrator, the primary standards are requisite to protect the public health with allowance for an adequate margin of safety, and the secondary standards are requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air.

The air quality standards for the six pollutants are minimum standards (maximum allowable pollutant concentrations) applicable to all land areas of the United States. On November 27, 1974, the U.S. Environmental Protection Agency issued a regulation which prohibits significant deterioration of air quality in areas with air cleaner than the standards at the time of issuance of the regulation. The significant deterioration regulation applies only to the particulate and sulfur dioxide pollutant classes and establishes the following area classifications and limits for concentrations of these pollutants, expressed in terms of the annual allowable increase over existing ambient measurements:

Area Classification	Particulate Increase	Sulfur Dioxide Increase
I	5 micrograms per cubic meter, annual geometric mean	2 micrograms per cubic meter, annual arithmetic mean
	10 micrograms per cubic meter, maximum 24-hour concentration	5 micrograms per cubic meter, maximum 24-hour concentration
		25 micrograms per cubic meter, maximum 3-hour concentration
II	10 micrograms per cubic meter, annual geometric mean	15 micrograms per cubic meter, annual arithmetic mean
	30 micrograms per cubic meter, maximum 24-hour concentration	100 micrograms per cubic meter, maximum 24-hour concentration
		700 micrograms per cubic meter, maximum 3-hour concentration
III	Increase limited to ambient air quality standards	

All areas with air quality meeting the standards have been designated as Class II areas by the regulation. A state is free to re-designate any area within its boundaries as a Class I or Class III area in accordance with the desires of the local populace. Designation as a Class I area would prevent extensive land development, whereas designation as a Class III area would allow substantial development and the attendant deterioration of air quality to the levels specified by the secondary air quality standards.

The EPA Administrator also has issued standards for the control of pollutant emissions from certain types of sources. As of this time, standards have been issued for mobile sources, including automobiles, trucks, and aircraft, and for stationary sources, including steam generating plants and a variety of industrial processes. These standards prescribe maximum allowable emission rates of specific pollutants from these sources and times for the implementation of the standards.

The Clean Air Act also requires each state to institute an air quality control program and to issue a State Implementation Plan defining measures to be taken by the state to achieve the ambient air quality standards within the state. These measures include monitoring of air quality within the state, maintaining inventories of emission sources within the state, and prescribing emission control measures, in addition to the federal controls, which are necessary to achieve air quality levels which meet the standards.

(v) Analysis Procedures

An Air Force facility located in an urban area is a complex source of air pollutants. Individual sources on the base include mobile sources consisting of aircraft and ground vehicles and stationary sources consisting of heating plants, fuel storage facilities, and aircraft maintenance facilities. These sources emit pollutants in five of the six classes for which federal air quality standards have been established:

- Carbon monoxide (CO)
- Hydrocarbons (HC)
- Nitrogen oxides (NO_x)
- Sulfur oxides (SO_x)
- Particulates (Part)

Photochemical oxidants are not emitted directly, but are converted by the action of sunlight on other pollutants, primarily HC and NO_x. Some of the emissions from air base activities are emitted directly into the urban atmosphere by aircraft flight operations. The remainder of the air base emissions are produced within the confines of the base and enter the urban atmosphere through the meteorological dispersion processes of wind and turbulence. Thus, the base has an impact on the quality of the overall urban atmosphere, which is termed the "area impact" of the base. However, because the base is a localized source of emissions, it has a more pronounced effect on the air quality within the base property and in its immediate vicinity. This effect is termed the "local impact" of the base. Both the area and local impacts of the base are of interest from the standpoint of public health.

The impact of a specific facility on urban air quality cannot be determined directly by measurements of pollutant concentrations because the pollutants originating on the base cannot be distinguished from pollutants from other sources. The total pollutant concentration at any particular location in an urban area is the total of contributions from all sources affecting the location. The impact of a facility can be determined indirectly by means of an analytical procedure involving four steps:

- An inventory of emissions from the facility.
- An inventory of emissions from the facility environs.
- A qualitative impact analysis based on the emission inventories.
- A quantitative impact analysis involving an analysis of the dispersion of pollutants from the facility and its environs.

It should be noted that air quality measurement is not one of the steps of the analysis procedure. Air quality data which exist at the time the analysis is conducted may be useful in establishing the present impact of the facility. However, if such data do not already exist, it is not likely meaningful data could be obtained in time to be used in the analysis. Establishment of air quality monitoring facilities is a time-consuming and costly task, and after the facilities are established, air quality data must be taken over a prolonged period--at least several months--to fully characterize the air quality at the facility. Furthermore, air quality data do not indicate the sources from which the measured pollutants are emitted, nor do the data provide any insight into the probable impact of new or modified sources. Consequently, the air quality analysis procedures are limited to analytical methods utilizing existing data.

The first step in the procedure, which consists of an inventory of emissions from the facility, involves identification, evaluation, and summation of emissions from all individual sources associated with the facility. The inventory of emissions from surrounding areas or environs is a similar summation of emissions from sources located within the base environs. The extent of the area regarded as the base environs is somewhat arbitrary but should be selected as an area which is likely to be impacted by emissions from the base and, in turn, impacts the base with its own emissions. Since the actual area of impact is difficult to determine by inspection, the base environs, for purposes of an impact analysis, often are designated arbitrarily according to existing political boundaries surrounding the base, and by the existence of emission inventories for political subdivisions in the base environs.

The qualitative impact analysis entails comparison of the total emissions from the base with total emissions from the environs to determine the contribution of the base to the total air pollution burden of the area. This comparison provides a qualitative measure of the area impact of the base. Similarly, the density of emissions at the base can be compared with emission densities in the environs to obtain a qualitative measure of the local impact of the base.

The emission density comparison is enhanced if air quality data are available for the environs. In many instances, these qualitative impact analyses are sufficient to establish that the impact of the base on local and area air quality is not significant. However, if the qualitative analysis is not sufficient or if the analysis indicates the possibility of a significant impact, the final analysis step involving a dispersion analysis is required.

The dispersion analysis involves the determination of the distribution of pollutants from the source throughout the atmosphere. The analysis requires an evaluation of the effects of meteorological dispersion processes on the transport of pollutants from all sources. The results of the analysis include predictions of the pollutant concentrations caused by the emissions from the base, and the analysis results can include measures of both local and area impact of the base. The accuracy and detail provided by the predictions are dependent upon the accuracy and complexity of the analysis procedure.

The contribution of an airport or air base to the total pollutant burden of the area in which it is located generally is found to be small (References 19 and 20). Similarly, the impact of airport emissions on local air quality also is found to be small except for commercial airports with high traffic levels located in congested metropolitan areas (References 20 and 21). Air Force bases, in general, do not fit this latter description in that their traffic levels are only a fraction of the levels at major commercial airports, and Air Force bases are located either in isolated areas or on the fringes of metropolitan areas. Consequently, it is reasonable to expect at the outset of an air quality impact analysis for an Air Force base that the impact will not be significant and that a qualitative impact analysis will be sufficient to establish this conclusion.

(b) Emission Inventory: On Base

An emission inventory is the first step in every air quality impact assessment. The inventory provides a foundation for the study of not only the present air quality impact of the sources but also the impact of proposed changes which could alter, increase, or decrease the type and/or number of pollutant emission sources. Air quality

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19 Bastress, E. K., "Nature and Control of Aircraft Engine Exhaust Emissions," 62nd Annual Meeting of the Air Pollution Control Association (APCA Paper No. 69-190), June 1969.

20 U.S. Environmental Protection Agency, "Aircraft Emissions: Impact on Air Quality and Feasibility of Control," February 1972.

21 Bastress, E. K., "Impact of Aircraft Pollutant Emissions at Airports," Environmental Science & Technology, September 1973.

impact is directly related to the rates of pollutant emissions from each source and local meteorology. Thus, an emission inventory and local climatological data can be used to assess the impact of the sources on the air quality in a particular locale.

Very simply, an emission inventory is a cataloging of the magnitude and location of each individual emission source in an area. Certain operating parameters describing each source are obtained in the cataloging process. These parameters are combined with emission indices (generalized pollutant emission rates typical of sources similar to those cataloged) to determine the mass of each pollutant being emitted into the local environment over a specific time period. (Sometimes specific pollutant emission measurements will have been made on some particular sources and, of course, this information would be used in lieu of the generalized emission indices.) The information needed for each source is dependent upon the source and the emission indices to be utilized in calculating emission rates.

The sources of air pollutants on a United States Air Force Base range from the obvious--aircraft and automobiles--to the obscure--paint shops and degreasing tanks. An inventory should list the magnitude of each of the following major source categories:

- Aircraft
- Test Cells and Run Up Stands
- Aerospace Ground Equipment (AGE)
- Motor Vehicles (Military and Civilian)
- Heating Units, Incinerators, and Boilers
- Fuel and Volatile Liquid Storage and Distribution
- Diesel Equipment such as Locomotives, Stationary Engines, and Construction Equipment
- Training Fires
- Fuel Spills
- Industrial Processes
- Training Ranges and Test Operations

The information to be obtained for each source, the probable sources of the information, and the use of emission indices from various sources are described in Appendix A.

(c) Emission Inventory: Off Base

Each state is generally divided into several air quality control regions. An air quality control region usually consists of three or more counties and is under the supervision of the State Department of Health, Air Pollution Control Division. The Health Department is designated the administrative agency for enforcing the State Clean Air Act. The department's function is to prepare and develop a general plan for proper air quality management in the state in accordance with the act.

The Department of Health of each state is also responsible for maintaining a comprehensive record of the emissions of all pollutants by each industry in the regions in tons per year. In early 1970, each state was made responsible for assessing the air quality of every region within its borders. A document prepared by the state, referred to as the "State Implementation Plan," contains an emission inventory of all sources within each region. The emissions inventory includes all possible source categories and generally is broken down into groups such as:

I. Transportation and Road Vehicles

II. Fuel Combustion Stationary Sources

- A. Industrial
- B. Residential
- C. Commercial/Institutional
- D. Steam-Electric Power

III. Incineration

IV. Processes

V. Evaporation

The pollutants usually considered are:

- Carbon monoxide
- Non-methane hydrocarbons
- Nitrogen oxides
- Sulfur oxides
- Suspended particulates

The most complete emissions inventory for each region is contained in the State Implementation Plan. However, the data in the plan are usually 1970 or 1971 information, and may not indicate actual emissions at the time an air quality analysis is being made. The values may be too high for industrial or transportation sources if pollution controls have been installed since 1970, or the values in the State Implementation Plan may be too low if new industrial sources have been constructed or traffic flow has increased.

In most states, current records are kept only of sources generating 100 tons/year or more of uncontrolled pollutants, and a majority of the small industrial operations are not included. Therefore, the most recent emissions inventory is not complete and does not represent the total emissions of the area. However, for regions where large industrial complexes predominate, a considerable fraction of the total emissions are included in the 100-ton/year or

greater inventory, and this most recent inventory can thus be used to characterize the total emissions for the area. Because most Air Force facilities are not located in heavily industrialized areas, the most accurate emissions inventory for a region would be that included in the State Implementation Plan and should be used to characterize the area.

For impact statement purposes, emission densities in the area surrounding the facility must be determined. Since the emission density of a region is not uniform, the density in the vicinity of the base must be determined by incorporating an emission distribution. This emission distribution can be obtained directly if comprehensive information is available from the state on locations of all emissions in the region. Emission densities for separate areas of the region can then be determined.

If no information is readily available on the distribution of emission sources in a region, an approximate model of this distribution can be developed by assuming a direct relationship of population distribution with emission distribution. This is a reasonable assumption for areas not containing highly concentrated zones of heavy industries. In regions of small industries, automobiles are the principal sources of two important emission classes, CO and HC. Since autombile travel is distributed to some degree in a manner similar to population, it is reasonable to expect the emission densities of these two major pollutants will be directly related to population density.

For example, if a region has an urban portion in which 60 percent of the population is distributed over 40 percent of the land area, the approximate emission density for a given pollutant in the urban area would be: (Total Emissions of Region x 0.6)/(0.4 x Total Area of Region). By using these emission distribution corrections, more realistic emission densities are obtained for areas surrounding the Air Force facility.

The results of the off-base emission inventory should be documented in a manner similar to that used with the on-base emission inventory. The results should include a map of the facility environs which clearly identifies the boundaries of the facility and the boundaries of areas around the facility for which emission inventories have been conducted. The emission inventories should be presented in tabular form indicating the emission density of each pollutant in each of the areas around the facility. The units used to express emission densities should be consistent with the units used in the on-base emission inventory.

(d) Qualitative Impact Analysis

(i) Nature of Analysis Method

A qualitative analysis of air quality impact involves a deductive reasoning procedure utilizing the results of the emission inventories for the facility and its environs and any air quality data which may exist for these areas. The purpose of the analysis is to determine whether the air quality impact of the facility can be shown to be non-adverse without conducting a quantitative air quality analysis. In many instances, the inventory and air quality data are sufficient to establish that air pollutant emissions from a facility do not cause excessive exposures to these pollutants and do not contribute substantially to the air pollution control problem of the facility environs.

In assessing the air quality impact of an air base, two categories of impact need to be considered and it is important to understand the distinction between these impact categories. Pollutant emissions from sources within the boundaries of the facility, including aircraft ground operations, have an impact which is felt primarily in and around the facility and hence is called the "local impact" of the facility. Pollutant emissions from low-level aircraft flight operations combined with the emissions from the facility have a broader impact on the areas surrounding the facility which is called the "area impact" of the facility. The quantities of emissions responsible for these impacts are different and the methods of analysis of these impacts also are different. Consequently, the analysis consists of two separate impact analyses.

(ii) Area Impact

The first requirement in analyzing area impact is to define the area which is impacted by the emissions from the facility. The area defined must also be one for which an emission inventory is available. An option which is nearly always available is the designation of the air quality control region in which the facility is located as the impacted area. The air quality control region generally will be very large compared to the area over which low-level aircraft flights occur. Therefore, the use of the region as a reference area will have the effect of reducing the apparent impact of the facility. If an emission inventory exists for an area which more closely conforms with the low-level flight operations area, then this smaller area should be used for analysis.

The area impact of the facility is evaluated simply by determining the ratio of the total emission rate of each pollutant from the facility to the emission rate of the same pollutant from all sources within the reference area. An example of results from such an analysis is shown in Table 3. Note that in this example the

TABLE 3. CURRENT CONTRIBUTION OF LANGLEY AIR FORCE BASE TO HAMPTON-NEWPORT NEWS AREA AIR POLLUTANT EMISSIONS

Source	CO	HC	NO_x	SO_x	Part.
Emissions from all sources in Hampton and Newport News 1970 (10^6 kg/yr)	131	25.5	11.8	4.41	4.37
Total emissions from Langley AFB - 1974* (10^6 kg/yr)	3.06	.850	.537	0.153	0.149
Langley AFB emissions as percent of area total	2.3	3.3	4.5	3.5	3.4

* Includes aircraft flight operations below 3,000 feet altitude.

contributions of this base to the total pollutant emissions in the reference area are represented by percentages ranging between 2 and 5. In this case, the reference area consisted only of two cities located adjacent to the base and the area is much smaller than the air quality control region. Thus, the percentage contributions from the base are realistic representations of the actual area impact of the base. The percentage contributions also are typical of the values which are found generally for major air bases or airports located in urban areas.

The significance of a specific value of emission contribution is a matter of judgment and debate depending on the point of view of the individual making the judgment. The significance of the contribution also depends upon the severity of the air quality control problem in the area impacted by the facility. If the contribution of the facility is small--let us say under 10 percent--and there is no air quality problem in the area, then it is fair to judge the impact of the facility as small. If the area is experiencing a marginal or acute air quality problem, the Air Force facility contribution would have to be very small--perhaps less than 2 percent--to be considered insignificant. In any event, it is best for the investigator to limit his judgments to the minimum necessary to place the results of the analysis in perspective. If possible, the investigator should review his results with a representative of the regional air pollution control agency to obtain an authoritative and objective judgment on the significance of the facility impact.

(iii) Local Impact

Analysis of the local impact of emissions from the facility makes use of the emission densities obtained from the emission inventories and any air quality data which may exist for the facility. If sufficient air quality data exist to demonstrate pollutant concentrations in and around the facility are within the limits set by regulations applicable to the quality control region, then it can be concluded that present operations at the facility do not have an adverse impact on air quality. In this case, the emission inventory results can be used to confirm or support the conclusion drawn from the air quality data.

At most Air Force facilities, sufficient air quality data do not exist at the present time to establish the impact of emissions from the facility. Also, air quality data cannot be used alone to indicate the future impact resulting from a change in the sources of emission at the facility. In these cases, the air quality impact assessment must be based primarily on the emission data derived from the inventory tasks.

The use of emission density data to assess the air quality in the area where the emissions occur is based on the observation that air quality in a particular area is affected most strongly by the emissions which occur within that area (Reference 22). The relationship between air quality and emission density in an area is a function of the meteorological conditions which affect the dispersion of pollutants in that area. If two adjoining areas have similar meteorological conditions, then the air quality-emission density relationship will be the same for the two areas, or, in other words, the pollutant concentrations in adjoining geographical areas vary approximately in proportion to the densities of emissions in those areas. These observations form the basis for conducting a qualitative analysis of air quality impact of an area source such as an Air Force base using emission inventory data and air quality data for the base and its environs.

The analysis is conducted by comparing the densities of emissions at the facility with emission densities determined for adjoining geographical areas. An example of such a comparison is shown in Table 4. In this example, emission densities for Langley AFB are compared with average densities for two adjacent cities and also with two zones within those cities for which an emission density distribution was estimated by the method described previously. Zone I in the example includes the more congested portions of the reference area and Zone II includes the less congested portions. In this case, emission densities at the base were found to be comparable to the densities in the less congested portions of the reference area (Zone II) and less than the densities in the congested portions (Zone I). Furthermore, in this case, air quality data indicated excessive pollutant concentrations did not exist generally in the reference area. Hence, it was deduced the air quality at the base was also within the applicable regulations. It happened that a limited amount of air quality data had been taken at the base which confirmed this deduction. However, the results of the emission density comparison alone are convincing evidence the base does not have an adverse impact on air quality in its immediate locality.

As described, the analysis method consists primarily of a comparison of emission densities at the facility and in adjoining areas. If the emission density at the base is less, than it can be stated that the average air quality at the base is better than that in the reference area. If air quality data exist for the reference area, these data provide a framework for the comparison. If, on the other hand, emission densities at the base are found to be higher than those in adjacent areas, the results of the analysis must be regarded as inconclusive. In this event, a quantitative analysis of air quality impact is necessary to determine whether the local impact of the base is adverse.

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22 Hanna, S. R., "A Simple Method of Calculating Dispersion from Urban Sources," Journal of the Air Pollution Control Association, December 1971.

TABLE 4. CURRENT EMISSION DENSITIES AT LANGLEY AIR FORCE BASE AND IN THE HAMPTON-NEWPORT NEWS AREA

Zone	Area (Km^2)	Emission Density (10^3 kg/km^2 - yr) CO	HC	NO_x	SO_x	Part
Langley AFB* (1974)	14	131	48	31	10.5	9.1
Zone I (1970)	100	784	153	71	26.5	26.2
Zone II (1970)	220	238	46	22	8.0	7.9
Zones I and II	320	408	80	37	13.8	13.7

* Based on emissions from ground operations only.

Any conclusions on local air quality impact derived by the emission density comparison method pertain only to average air quality at the facility. The method will not identify situations where Air Force personnel or members of the public are exposed to excessive pollutant concentrations from major pollutant sources which are near areas that are accessible to these personnel. If excessive exposures are suspected because of close proximity of personnel to sources such as runways, taxiways, aprons, maintenance areas, or fuel storage facilities, these exposures must be evaluated by means of a quantitative impact analysis or by air quality measurements conducted in the exposed areas.

(iv) Other Impacts

Other manifestations of Air Force activities may also have an impact on persons residing in the vicinity of the facility where the activities occur. The most common of these is the development of visible smoke plumes by military aircraft which may give rise to complaints from nearby residents. Smoke plumes constitute an aesthetic problem and new engines are being designed to operate with exhaust plumes which are less visible than those from current engines. In assessing the current impact of a facility where smoke plumes are emitted, the only available action is to acknowledge the problem and state that it is purely one of aesthetics. The physical impact of the emissions which cause the smoke is included in the air quality impact analysis.

(e) Quantitative Impact Analysis

A quantitative analysis of air quality impact involves the use of an atmospheric dispersion model either alone or in conjunction with air quality measurements. An atmospheric dispersion model is a mathematical procedure for predicting the distribution of pollutant concentrations resulting from a specified set of emission sources operating in a specified meteorological environment. The model or prediction procedure uses mathematical formulas which represent in a simplified manner the distribution of pollutants in space due to meteorological dispersion processes. Some dispersion models are simple and require only hand or desk calculator operations, while other models are more complex and require computer facilities of greater speed and capacity.

Air quality measurements may be conducted in conjunction with dispersion modeling to confirm the results of the modeling or to evaluate air quality in a physically complex environment which cannot be represented accurately in the model. For example, the influence of structures or geographical discontinuities such as shorelines are difficult to predict reliably, and air quality measurements are helpful in establishing that a dispersion model is accounting for these effects. Air quality measurements also can be used to adjust or calibrate a dispersion model so that its predictions are more accurate.

The Environics Branch of the Air Force Civil Engineering Center has sponsored the development of an atmospheric dispersion model designed specifically for analyzing the impact of pollutant emissions from Air Force flight facilities. This model can be used by preparing the necessary input data and submitting the data to AFCEC for analysis. Data requirements and formats for use with the model are described in the user's manual for the model. The input data requirements are generally the same as the requirements for the emission inventories described in the previous sections. However, more detailed information on source locations is required by the dispersion model.

If a requirement for dispersion modeling is anticipated at the outset of the air quality impact analysis, the emission inventories should be conducted in accordance with the requirements of the model to be used. If the Air Force model will be used, the input data requirements should be reviewed and the procedures to be followed in the analysis should be discussed with personnel of the Environics Branch.

(3) Radiation

Radiation is the process in which energy is emitted as particles or waves. The energy is emitted by one body, transmitted through an intervening medium or space, and absorbed by another body. Although some forms of radiation can pass through solid bodies, most of the radiation of concern to the preparation of environmental statements is normally associated with passage through the air, and for this reason the discussion of radiation has been included as part of the atmospheric regime.

Radiation can come from two general sources: radioactive elements, such as uranium, and from electromagnetic generators. Radioactive elements can transmit particles (alpha, or helium nuclei; and beta, or electrons) and gamma rays. Electromagnetic radiation can come from electrical transmission lines, radio transmitters, radar antennas, infrared sources, visible light, ultraviolet sources, and X-ray sources.

A full technical discussion of these forms of radiation is beyond the scope of the report. It is seldom that ionizing radiation impacts are involved in proposed actions, but non-ionizing radiation may be involved. Some knowledge of radiation is essential if only to alert the preparer of statements to a potential problem and to enable him to obtain assistance from persons qualified in the field. The Air Force Environmental Protection Manual should be reviewed for a general discussion of radiation sources and standards.

- Radioactive Materials

Aside from nuclear weapons and atomic power plants, radioactive materials can be found at hospitals and research laboratories. The use of radioactive materials at such facilities does not normally constitute a potential impact, but the transportation of the materials to the facilities and the subsequent disposal of used radioactive materials should be described if they are involved in the proposed action. Natural sources of radiation may present problems at times, e.g., the use of tailings from a uranium mine as landfill for construction of residential buildings.

- Power Line Radiation

Radiation losses from 60 cycle AC are too small to be significant, but consideration should be given to their possible interfering with the receiving of radio or TV signals. Direct current lines are sometimes used for railroad or trolley lines. This can cause corrosion in buried pipelines which cross the tracks or even those which are parallel to it at some distance away. This effect depends on soil conditions, and it is difficult to predict. A cathodic protection specialist should be consulted.

- Radio and Television

Licenses to broadcast and the assignment of frequencies are handled by the Federal Communications Commission (FCC). It can be assumed that if the proposed action involves new radio transmission and this is approved by the FCC, there will be no significant adverse impacts. However, attention should be given to mobile transmitters (vehicles or aircraft) in the vicinity of heavy construction involving blasting, since broadcasting can induce a voltage in blasting wires sufficient to detonate an electric blasting cap.

- Radar

The radar beam from powerful sets may exceed the limitations for personnel of 10 milliwatts per square centimeter, particularly at roof levels of nearby structures. For actions involving the construction or continued operation of high-powered transmitters, the extent of the 10 mw/sq cm field should be determined and checked for potential presence of personnel. The area should also be checked to preclude the presence of metallic elements (which could have induced sparks) in a potentially explosive or combustible environment, e.g., vapors from fuel tanks, or photographic flash bulbs. Large metal surfaces can reflect the radar beam similar to light being reflected from a mirror, and such areas should also be checked. Conversely, the construction of new buildings may have the effect of blocking or reflecting existing radar beams, thereby impacting the use of the radar. Field measurements can be made to determine the intensity level, or the beam intensity can be calculated as a function of distance. Specialists will be required to perform this analysis.

- Infrared Radiation

This is heat radiation, as produced from a warm room radiator or the glowing coals in the fireplace (or, technically, any warm body). Infrared radiation is seldom a factor in proposed actions, but it should be considered in any comprehensive review of radiation impacts since it does constitute a part of the electromagnetic spectrum.

- Visible Light

This can definitely be a factor in many environmental studies, primarily as a result of creating unwanted light at night. This can affect people who dislike light from external sources coming through bedroom windows. Complaints generally come from residential neighborhoods when a new well-lighted activity is constructed (e.g., a parking lot for a shopping center), or in some cases, simply adding street lighting to a formerly unlighted street. Another effect is the general sky-glow, which can have an adverse effect on the operation of astronomical observatories.

Conversely, inadequate light can also have an adverse impact. This applies to highway interchanges and to residential areas to the extent that night-lighting discourages crime.

Light emitted from lasers can be harmful due to their intensity. If laser operations are involved in an action, a determination should be made of the safety to personnel.

- Ultraviolet

The principal source is sunlight, and a well-known effect on humans is sunburn. Another source is arc-welding, and any shops or open areas where welding is performed should be designed to protect the public from seeing the ultraviolet light.

- X-Rays

X-rays and the more powerful gamma rays are at the very short wavelength end of the electro-magnetic spectrum. These rays have sufficient energy to cause ionization, and they are so classified as opposed to the other non-ionizing (longer wavelength) portions of the spectrum.

X-rays occur whenever high voltages are used, starting at about 20,000 volts. (Color television sets generate soft X-rays, as an example.) If high-voltage equipment is involved in an action, a specialist should be consulted to prepare a report section concerning X-ray impacts.

c. Hydrologic Regime (Water)

The hydrologic regime is represented by the movement of water through the hydrologic cycle. The water starts as precipitation, passes through surface and groundwater flow, eventually reaches the ocean, is then evaporated and condensed again as precipitation. It is important to understand the hydrologic cycle so that it can be described and the impacts to the regime, if any, can be evaluated. The hydrologic regime is discussed below under five subset categories: (1) the hydrologic cycle, (2) water uses, (3) water laws and regulations, (4) hydrologic regime as it relates to Air Force actions, and (5) data and information sources.

(1) The Hydrologic Cycle

Precipitation is the water which falls on the earth, either as rain or snow. A small amount is intercepted by the leaves of plants and trees and evaporated. The portion which falls on the ground will partially infiltrate into the soil; the remainder runs off into ditches, streams and rivers. This leads to two major subsets of the hydrologic cycle, surface flows and groundwater.

The water which infiltrates the ground exists in two zones: the upper zone of aeration in which the water is present as moisture, and the lower zone of saturation which is termed groundwater. The top of the saturated zone is the water table. Some soils are pervious (e.g., sand, gravel) and permit a ready flow of groundwater--these are known as aquifers. Impervious soils, such as clay, may contain water but cannot transmit it readily--these soils are known as aquicludes.

The roots of plants draw moisture from the ground and release it through their leaves by the process of transpiration. This loss, together with evaporation from the surface of the soil, is known as evapo-transpiration.

The flow of water in streams and rivers is the result of surface runoff and bank seepage. The latter is simply groundwater flowing from adjacent high ground into the stream. Such streams are designated as effluent streams to reflect their being fed partially by groundwater seepage. Smaller streams, known as influent streams, may lose part of their flows to groundwater. Streams not flowing year-round are called intermittent streams.

Surface flows will be modified by storage in swamps, ponds and lakes, and man-made reservoirs. Reservoirs may be non-regulated (e.g., small flood control dams and reservoirs) or regulated (e.g., large reservoirs for flood control or hydro-electric power). Surface flows are also affected by land forms, principally the slope and the use. Thus a sloping roof or pavement has a higher runoff coefficient than a level field or sandy area.

The surface flows from rivers enter the ocean through a zone that is influenced by the tides and saline waters. The interface, known as an estuary, forms an area having unique ecological characteristics. Wide river mouths form bays, while deposits of silt form deltas.

With the exception of a few inland lakes having no outlets (e.g., the Great Salt Lake), the ultimate destination of all water is the ocean. Its principal descriptors are tides, currents, temperature and salinity.

The flow of water at various locations within the hydrologic cycle is measured and reported in the form of various parameters and statistics. These can be arranged as probability distributions, mean annual flows, mean monthly flows, record high flows (floods), and record low flows (droughts). Precipitation can be reported in a similar manner. While such statistics can be expected to reflect long-term future trends, it should be noted that the short-term future events cannot be predicted beyond a few days' time.

(2) Water Uses

Water is used by all living things to sustain life. Man uses water for numerous other applications which affect his mode of living, generally with positive effects but often with undesirable secondary impacts. Both the uses and the effects of using water must be understood in order to describe the impacts from actions which involve the hydrologic regime.

The usefulness of water depends on the volume available (both physically and legally), the location of the supply relative to the use, and the quality of the water. All of these parameters can be reflected in terms of the cost to supply the water. If the water is of inadequate quality, it can be treated or even distilled. If it is not physically available, it can be transported to the point of use by canals, conduits, or even tank cars. If it is not available uniformly throughout the year (e.g., as river flow), it can be stored in reservoirs for later release. Water for hydro-electric energy has value in terms of elevation differences; similarly, surface water is more valuable than groundwater since the latter must be pumped from a well.

Water is used in two general locations: (1) in-place (e.g., navigation in a river), and (2) after withdrawal from its normal path in the hydrologic cycle (e.g., for irrigation). These can be termed in-situ and ex-situ uses, respectively. A list of specific water uses is shown in Table 5.

Each use of water may involve an evaporative loss, a loss in quality as the result of the addition of a pollutant, and/or a change in the normal time and location of the water within the hydrologic cycle. Water which is withdrawn, either from a surface supply or from groundwater, must be returned to the system either as an effluent discharge to a stream, or as recharge to the groundwater, or as evaporation.

There are as many measures of water quality as there are potential pollutants. The principal parameters are dissolved oxygen, sludge or other solids, oil, grease or scum, color and turbidity, taste and odor, coliform bacteria, pH, hardness, salinity, and other chemical constituents, temperature and radioactivity.

(3) Water Laws and Regulations

There is a vast body of federal and state legislation dealing with water use and water quality. Three categories are of particular concern to impact analysis: water law, stream standards, and wastewater discharge permits.

Western law, the doctrine of prior appropriation for beneficial use, is recognized in the 17 western states. In essence, it is based on the concept that the first user has the first right. Thus in times of shortage, the last users loose their right of withdrawal in favor of the first users, i.e., the available supply is not apportioned among all users. Eastern law, the doctrine of riparian rights, provides that the owner of land adjacent to a stream is entitled to receive the full natural flow of the stream without change in quality or quantity and is permitted reasonable use of such water.

Groundwater law is less specific than surface water law, since the mechanics of groundwater flow is not as well understood nor readily quantifiable. The law varies by states, and if groundwater is an issue it is advisable to obtain qualified legal assistance in this regard.

The federal government has authority over navigable waters and tributaries thereto. As a result of this authority, legislation was passed which provided for the maintenance and enhancement of surface water quality by the establishment of water quality standards by each state. The standards involve the classification of stream reaches, or lengths, according to designated uses. These vary from state to

TABLE 5. EXAMPLES OF WATER USES

In situ Uses

Navigation
Fish and Wildlife Habitat
Recreation - Body Contact
Recreation - Boating
Flood Control
Waste Control
Waste Transport
Hydro Power
Aesthetic

Ex situ Uses

Municipal Supply
Industrial - Process
Industrial - Cooling
Irrigation
Rural and Farm
Fire Protection
Power Plants - Cooling
Street Cleaning

state but, in general, they are as shown in Figure 10. Each classification has criteria which must be met for that classification (e.g., levels of dissolved oxygen). Salt water bodies and estuaries are classified in a similar manner and have criteria applicable to salt water regimes. The last part of the water quality standard is the plan for achieving the designated classification for each stream reach, including timetables.

The obvious way to achieve clean water is to eliminate polluting discharges. A major effort for doing so has been initiated as a result of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The law provides that all industries discharging into navigable waters must apply the best practical control technology by July 1, 1977, and the best available technology by July 1, 1983. The law also has a goal of no discharge by 1985. The definitions of what constitutes the best practical and available technologies are being established on an industry basis by the EPA.

(4) Hydrologic Regime as it Relates to Air Force Actions

The extent to which the hydrologic regime should be described depends on the nature of the proposed action and the potential impacts. The key questions are:

- Will the action change the characteristics of the hydrologic cycle? For example, will new runways in lieu of fields contribute to greater runoff, less infiltration to groundwater?

- Will the action change water use volumes? For example, will additional reservoir storage or wells be needed to serve a greater population? Will new water supply mains be required, or will existing users suffer pressure drops?

- Will water quality be affected? Consider storm water runoff which may carry oil spills and other surface contaminants to streams. Will additional personnel create an overload to the sewer system and waste treatment plant?

- How will the action affect water laws and regulations? Will added waste require a new discharge permit, or a modification to an existing permit?

If it appears the hydrologic regime will or could be impacted by the action, it should be described according to the procedures given below, to the extent that they apply.

Class A

Fit to Drink

Waters designated for use as public water supplies. Character uniformly excellent.

Class B

Fit to Swim In

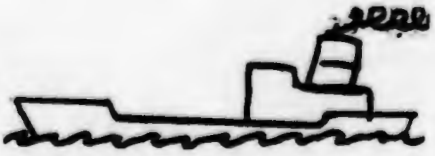
Suitable for bathing and recreational purposes including water contact sports. Acceptable for public water supply with appropriate treatment. Suitable for agricultural and certain industrial cooling and process uses. Fish and wildlife habitat. Aesthetic value.

Class C

OK for Boating and Fishing

Suitable for recreational boating, habitat for common food and game fish, certain industrial cooling and process uses. Suitable for irrigation of crops used for consumption after cooking. Aesthetic value.

Class D



Navigation

Suitable for aesthetic enjoyment, power navigation, and certain industrial cooling and process uses.

Class E

Sewer

Existing waters which fail to meet lowest assigned classification.

Figure 10. Water Quality Classifications

The description of the hydrologic regime should include a table showing mean monthly precipitation and runoff, both expressed in inches of precipitation. If there is snow during the winter, the mean seasonal snowfall in inches should also be given. Note that the snowfall will also be included as precipitation, although for the latter it is expressed in equivalent liquid form. If runoff data are not directly available, they can be calculated by taking the mean monthly discharges for a nearby stream and dividing by the drainage area. The runoff should be less than the precipitation except during spring snow melt.

The description should also include the general drainage characteristics of the land in the vicinity of the proposed action, and a description of the surface water bodies (streams, rivers, lakes, ocean) into which the drainage flows. The classification of these water bodies should be given, and a listing of the state criteria for the classifications. Results of water sampling tests for the water bodies should also be given.

If groundwater is involved, the depth to the water table and the yields and water quality from existing wells should be given. Long-term changes in the water table, if any, should be noted to determine whether the groundwater is being withdrawn faster than it is being recharged (a situation termed "mining" of the groundwater). Also, changes in salinity (i.e., becoming more brackish) should also be noted.

The water supply system should be described. If water is obtained from a municipal system, indicate the percent of the total system used by the Air Force activity, as well as the total annual consumption by the activity. If possible, indicate percent consumption as a function of water use, i.e., domestic, power plants, etc.

Describe both the wastewater and storm drainage systems, methods of treating the water before it is released, and locations, quantity and quality of discharged water. Be sure to include oil and grease skimmers and traps.

If there are any water bodies used for recreation (swimming, boating, fishing), or that contribute aesthetically to the area, describe the water bodies and their uses. Also describe the marine life (fish, waterfowl) native to these waters. Wetlands, swamps, and marshes should also be included.

If the action occurs on and/or could affect a flood plain or if it could affect the normal flow of surface or groundwater, describe the existing conditions.

Finally, describe any laws and regulations applicable to the hydrologic regime in the area where the action will take place. Be sure to include any local regulations on water use; such as restrictions on lawn watering during the dry season or restrictions on digging of clams due to polluted water.

(5) Data and Information Sources

There are several units commonly used for water data, and care must be taken when converting from one to another. Precipitation and runoff are expressed in terms of inches of depth over the drainage area, per month or year. Streamflow (or discharge) is measured as a depth or stage, which is then converted to cubic feet per second. However, water in a reservoir is expressed volumetrically as either acre-feet (one acre at one foot deep) or in millions of gallons. Municipal supply is in millions of gallons per day or gallons per capita per day. Flow in pipes and effluent discharges are expressed in gallons per minute. Occasionally, special units are used for convenience, such as the second-foot-day, which means the volume represented by a flow of one cubic foot per second for one day. Metric units are simpler--they generally involve only the cubic meter per second or per day and the liter.

Data about the climate and precipitation can be obtained from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, Asheville, North Carolina 28801. Data may also be available at local airports where weather stations are operated.

Topographic maps, also called quadrangle sheets, can be obtained from the U.S. Geological Survey, Department of the Interior. Maps covering eastern states can be obtained at 1200 South Eads Street, Arlington, Virginia 22202; maps for western states at Denver Federal Center, Building 41, Denver, Colorado 80225. These maps include rivers, streams and other water bodies; and because land contours are shown, it is possible to trace the outline of drainage basins. Navigation charts issued by the Coast and Geodetic Survey, Department of Commerce are useful for actions involving coastal regions and large rivers.

Data about streamflow can be obtained from annual Water Resource Data reports published by the U.S. Geological Survey. These reports include daily streamflow at gauging stations and statistical values. Both surface water records and water quality records are published. Water quality records can also be obtained from the EPA and state water quality agencies. Other water data can be obtained from numerous agencies; the Corps of Engineers, the Soil Conservation Service, the Office of Water Data Coordination, the Water Resources Council, and inter-state agencies and universities, to name only a few. The specific sources will vary from region to region and from state to state. The simplest approach to obtaining the data is to call one nearby agency such as the U.S. Geological Survey Office at the state capitol, explain your needs and ask for names of other agencies they know of in your region that have the data you seek.

Data about water supply, use and discharge at the activity can generally be obtained from the Base Civil Engineers Office, or they can direct you to likely sources.

3. BIOTIC ENVIRONMENT

Among the most vocal guardians of the environment have been conservationists, and conservationists have been largely concerned with wildlife. Thus, while ecological disruption may not endanger human health directly in the sense that air and water pollution can, careful consideration of biota is an essential part of the evaluation of environmental impact.

a. Populations and Species Including Rare and/or Endangered Species

In describing the biotic environment the first task is to give a general characterization of the biota in the area impacted by the action(s). If the action impacts a large area which includes different biotic environments, then each of these environments should be described in general terms and some indication given as to their relative size as well as their location within the total impacted area. Reference might be made at this point to the maps, charts, or photographs mentioned earlier. Do not forget to describe biota in both terrestrial and aquatic regimes. Terrestrial regime types include forests, grasslands, swamps, deserts, etc. If the biotic regime is largely man-made rather than natural, this should be noted. Agricultural land is an example of a man-made biotic regime, but so too is any other regime in other than its unspoiled state. For example, such a regime might be covered with brush and scrub as a consequence of previous cutting of forests and large trees, or it might be a site of former construction and demolition, overgrown with weeds.

The abundance as well as nature of the species present is important. The most numerous plant species whether ragweed, sagebrush, or pine trees should be noted. How varied are the plants present, or does one species pretty much dominate? Is the area rich in animal life? Are insects or birds very much in evidence or are they relatively rare? Are there any large wild animals in the area? In some cases a population count of some species may actually have been made, and if endangered species are involved and such information is not already available, a count may be desirable.

Unless the biotic regime of the impacted area is a particularly rich one, mention of about a half dozen birds and animals respectively (common names are adequate) may be a sufficient general description, for example:

> "The target range consists largely of poverty grass interspersed with clumps of immature scrub oak and patches of juniper, sweet fern, and a few young white pine. The most conspicuous wild flowers are daisy, milkweed, and goldenrod. Field mice and rabbits are plentiful. Tracks and droppings indicate the area is sometimes visited by deer. Blackbrids, crows, and sparrows are common; quail and pheasants are sometimes seen."

The second task is to enumerate species of flora and fauna which are rare or endangered. There are a number of factors which singly or combined may place a species or organism in this special category. It may be that the species is simply relatively rare in the region, although plentiful in other regions and thus not threatened with extinction. Or the species may be rare on the global scale, and threatened with extinction as a result of the intrusion of man's activities into its few natural habitats. The identification of rare and endangered species is difficult unless one has been trained in biology, and it is best to contact someone from the State Department of Conservation or Wildlife Management Agency. They will know the current wildlife species which have been listed under the Endangered Species Conservation Act of 1969 and which may be indigenous to the area of the action. They may also have supplemented the list, including rare and endangered flora. However, unless they are familiar with the area of the action, it will be necessary to conduct a field survey to determine whether any of the species are, in fact, present. If there are no rare or endangered species present, this fact should be reported.

If there is present human use of wildlife and plants, this should be duly noted. Such uses might include hunting, fishing, shell-fishing, berry and nut gathering, lumbering, etc.

Also, many organisms are especially vulnerable at some particular phase of their life cycle and attention should be paid to this aspect of the problem. Nesting and breeding sites are important. So too are areas where one or more organism tend to concentrate in their highly vulnerable juvenile states. Human disruption of nesting and breeding does not consist simply of the damage or removal of habitat shelter. The mere presence of noise and other human activity can make many organisms so ill-at-ease that breeding is reduced. If the disturbance is sufficiently threatening, adults will abandon eggs and young.

Some animals have periods of dormancy and cannot protect themselves. All of these phases tend to be seasonally dependent and as a consequence, the potential environmental damage of an action can be highly seasonally dependent. In many instances, if the action is a one-shot or intermittent one, damage to the biosphere can be significantly reduced by proper choice of action time.

Are the organisms permanent or transient residents of the impacted area? Migratory habits should be examined in detail. In the aquatic biotic regime, a number of species migrate to spawning grounds. Impoundments and divertiments can stop or confuse such migratory behavior. Fortunately it is often possible to mitigate such impacts fairly easily by fish wiers or ladders, but not all species will avail themselves of this convenience. If the action

will involve the erection of fences or other types of physical barriers this could interfere and should be mentioned. Clearing vegetation for roads, fire breaks, etc. can also affect animal movement as well as plant populations. Deer, for example, show little hesitancy in crossing such open spaces and, in fact, take advantage of them for feeding and movement.

Undesirable, from the human standpoint, as well as desirable species should be described. An action may have the beneficial effect of reducing such species, for example, wetland drainage may reduce mosquitoes, but it could also have a deleterious impact by encouraging the population growth of undesirable organisms. As examples, an impoundment might encourage mosquitoes, water pollution might encourage the algae growth leading to eutrophication, etc.

b. Habitats and Ecological Relations

In addition to the nature and population of wildlife, their present relation to the environment, that is to say to their habitats, should be described. Human activity tends to affect organisms largely through alteration of the organism's habitat rather than directly. The habitat of a given organism includes the physical environment, particularly the terrestrial and hydrologic (or aquatic) regimes, but of equal, if not even greater, importance is the biotic regime just described. An organism relates to one or, if it migrates, more habitats, and it relates to the other organisms which comprise these habitats.

The relationships among organisms comprising an ecosystem are very many and very complex. However, apart from some important exceptions, such as symbiosis, they tend to fall into two major categories: succession and predation. Just as an individual organism has a life cycle, the flora of a given region commonly has a definite pattern of population composition that varies with time. For example, an abandoned field in New England will begin to grow in with junipers, briars, blueberry bushes, and other low brush. Then young birches will appear and a scattering of white pine seedlings. Fast growing hardwood trees will tend to dominate and cut off sunlight to other seedlings. But hemlocks, which grow well in shade, may eventually succeed the hardwoods. Identify at which point in succession characterizes the area in question. Since this is not always apparent to the layman, you may need professional help on this point. Human intervention commonly sets the flora back in the succession sequence. If the area is unspoiled and represents climax vegetation--that is to say, the final and most mature stage of succession, it is essential that this be stated for such unspoiled environments are increasingly rare, a fast diminishing resource, and the potential for environmental damage is at its greatest.

Predation, or which organisms feed on which, is more familiar than succession and for purposes of your general description of the existing environment, you can probably identify major food chains or predation webs yourself with perhaps a little help from a knowledgeable local sportsman. Figure 11 represents a familiar and typical food chain while Figure 12 shows an aquatic predation web terminating in such large predators as hawks, fish-eating mammals, and man. It is significant to note that if we discount insects, man is top predator on this planet and many predation webs end with him.

If some food resource (including water) in the predation web is largely restricted to the environment in question, then impacting this area can have a disproportionately large effect upon the biotic regime, and it is important to deal with this particular aspect in somewhat greater detail in environmental statements. For example, wildfowl may be highly dependent on a given stand of wild rice; in an arid area disappearance of a water source will be highly injurious to animals over a wide area.

Finally, bear in mind that the time scale of succession and predation are quite different. Some steps in predation are very fast; a mayfly may be devoured minutes after it is hatched. The longest, except for very large animals, such as elephants, or very large, successful predators, such as tigers, alligators, and man, rarely exceeds more than a few years. Succession is slow even in tropical ecosystems and gets even slower in temperate and artic or high altitude climates. Succession steps commonly take 20 to 60 years and may even take many centuries. The destruction of an adult rabbit takes a year or two to repair; the destruction of an adult redwood takes thousands of years. Predation thus re-establishes itself much more rapidly than succession; there can even be relatively rapid re-population from adjoining areas following a total kill. The destruction of climax vegetation is, for all practical purposes, final within the time scale of our life spans.

4. HUMAN ENVIRONMENT

The human or cultural environment is usually less easily defined and described than the natural environment, and characteristics of the human environment are always more difficult to quantify. Many actions taken by the Air Force can have secondary or indirect (and less obvious) consequences for the environment, by altering patterns of social and economic activity. "Such secondary effects, either through their impacts on existing community facilities and activities or through changes in natural conditions, may often be more substantial than the primary effects of the original action itself. For example, the effects of the proposed action on population and growth impacts, employment, and general economic trends should be estimated if expected to be significant, and an evaluation made of the effect of any possible change in population patterns or growth upon the resource base, including land use, water, and public services of the area in question." (AFR 19-2).

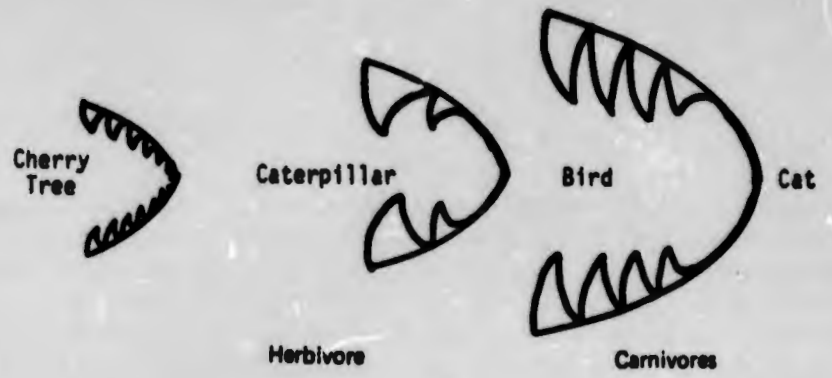


Figure 11. A Terrestrial Food Chain

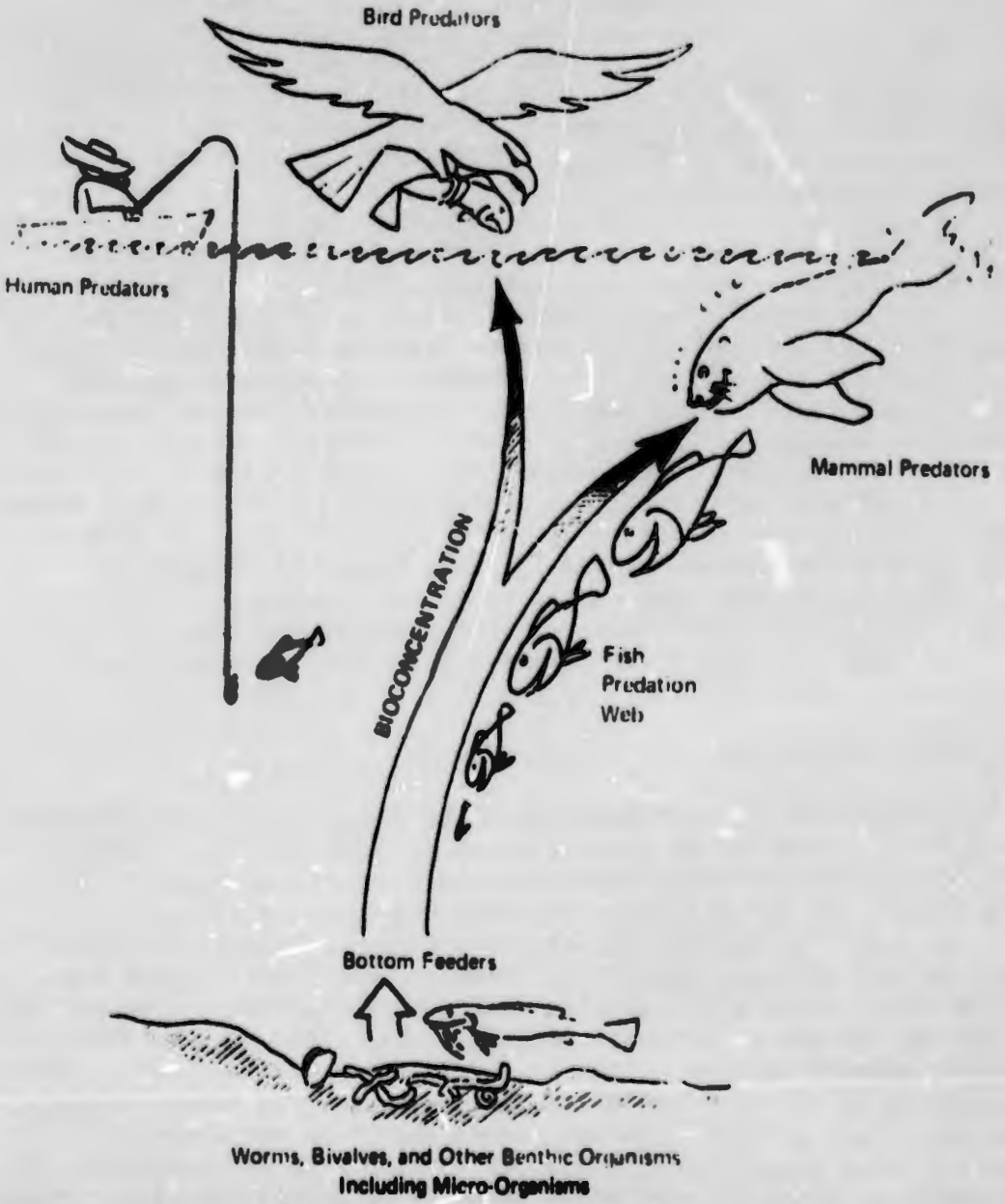


Figure 12. Movement of a Pollutant in a Food Chain or Predation Web

Such an analysis involves a comprehensive examination of the whole range of human activities--both current and historical. Before any conclusions are possible as to the nature and degree of all effects on the environment, all possible social and economic consequences of the action must be considered. Depending on the nature of the proposed activity, certain social and economic impacts may be more significant than others, particularly in view of the present role of an Air Force base in its environs. For example, if the Air Force is the single largest employer in the community, any proposal that would decrease USAF employment must be examined in terms of direct impacts such as decrease in payroll and possible increase in area unemployment. Indirect or secondary effects might include a ripple effect throughout the local economy and ultimately a long-lasting shift in the population and economic growth of the area.

Thus, in every environmental analysis concerning these social and economic variables, the most difficult task is focusing on the major issues. In addition to acquiring a general understanding of the existing human environment, the analyst must isolate those characteristics of the action that will influence or alter this environment. Table 6 gives likely scope of social and economic impact for five general categories of actions. Note that some impact areas are only possibly relevant depending on the nature of the action. For a hypothetical mission change, Table 7 demonstrates the kinds of impacts to be considered for each of the three major components of the mission change.

Before any study of the present human environment is begun, this kind of analysis should define the pertinent issues as well as the scope and depth of the study.

a. Demographic and Political Setting

Any assessment of the human environment begins with characteristics of an area's populations and the political jurisdictions into which it is divided.

(1) Geographic and Political Setting

The site of the action should have been shown in the section "Description of the Proposed Action," and appropriate cross references can be used here to identify these maps. If these maps do not adequately define the geographical and political setting, additional maps can be included here. The following criteria should be applied.

TABLE 6. PROBABLE SCOPE OF SOCIAL AND ECONOMIC CONSIDERATIONS FOR A RANGE OF USAF BASE-LEVEL ACTIONS

Type of Proposed Action	Possible Scope of Social and Economic Impact											
	Economy				Services and Facilities							Cultural Resources
	Employment	USAF expenditures	Indirect	Land Use	Transportation	Utilities	Public Safety	Housing	Schools	Hospitals	Recreation	
Real estate acquisition, disposal, outgrant	P	P	X	X	P	P	P	P	P	P	P	X
Construction of facilities (including family housing), roads transmission lines, pipelines	X	X	X	X	P	P	X	P	P	P	P	X
Establishment of new base or closing of existing base	X	X	X	X	X	X	X	X	X	X	X	P
Mission change	X	X	X	P	P	P	P	X	X	P	P	P
Operation of a Training Range	X	X	X	X	P	P	X	P	P	P	P	P

X = Likely impact area to be considered

P = Possible impact area, depending on exact characteristics of the proposed action.

TABLE 7. SOCIAL AND ECONOMIC CONSIDERATIONS FOR A HYPOTHETICAL MISSION CHANGE INVOLVING A MAJOR CONSTRUCTION PROGRAM, A LARGE NET INCREASE IN BASE PERSONNEL AND AN INCREASE IN AND CHANGE IN AIRCRAFT CHARACTERISTICS OF OPERATIONS

haracteristic of the Proposed	Economy	Land Use	Services and Facilities	Cultural Resources
lajor construction rogram in support f mission	• Jobs • USAF expenditures in local economy through contracts	• Consistency of use of land for this purpose with land use planning and controls	• New facilities for USAF? • Increased demand on water supply, schools, etc., because of constructed facilities?	• Any historic resources to be affected
arge net increase n personnel military and ivilian)	• Increased USAF payroll • Increased expenditures by USAF and by USAF employees as a stimulus to local economy • Possible economic consequences of increased demand on facilities (schools, etc.) and services (utilities, water supply)	• New or changed development pressures both near the base (housing, commercial development) and in the area or region	• Availability of housing, medical care, schools, etc. for USAF employees and their dependents	----------
ncrease in and hange in operational haracteristics of ircraft activities	• Change in land values and economic development potential of land areas exposed to aircraft noise and accident hazard	• Change in land area exposed to noise and change in land uses (particularly residential) exposed to noise, both compatible according to AICUZ criteria	• Compatibility of existing schools, housing, recreation areas in noise and accident potential from aircraft operation	• Location of known or suspected cultural resources in relation to noise (including sonic booms) and accident hazard of aircraft operations

The site of the action should be located on one or more figures giving state/county/city boundaries as appropriate. Often two figures are required, one showing location within a state (see Figure 13) and another showing the immediate vicinity or environs. Major topographical features such as rivers and mountain ranges should be shown or mentioned in the text.

The political setting is simply stated, county and city/town in which the action is to occur. Regional planning jurisdictions or designated statistical units (Standard Metropolitan Statistical Areas) are important to mention as well. A description of the political setting should not only locate the action within recognized political units but also define a reasonable study area, such as a metropolitan area, a city, or even a county. Since many Air Force actions have effects beyond the immediate environs, it is important to state (at the outset) a reasonably chosen limit on the area of study. Political jurisdictions identified here will also be the major sources of basic information concerning the study area.

(2) Population Growth and Characteristics

Since vast quantities of population data are collected, tabulated, and analyzed by planners both in government and in the private sector, this information is generally readily available. Major sources of population data are generally government agencies ranging from national, state and regional to local.

The Bureau of Census of the U.S. Department of Commerce is the primary source of both raw data and analysis. A national census undertaken every ten years is the basis for a series of documents providing data for Standard Metropolitan Statistical Areas (SMSA's), counties, and states. For smaller areas, raw data is also published for individual census tracts; this kind of information is invaluable for determining population figures for areas exposed to noise as part of the AICUZ methodology. Four major series of publications by the U.S. Bureau of the Census are listed in Table 8.

The "OBERS Projections" by the Bureau of Economic Analysis, U.S. Department of Commerce, are another source of population and economic data and growth forecasts. The geographical areas covered are larger (i.e., multi-county areas) than those used by the Bureau of the Census or local and regional planning agencies. The projections are useful, however, as a measure of anticipated area-wide growth.

An index to all government publications is provided in the December Monthly Catalog and Annual Index of U.S. Government Publications available from U.S. Government Printing Office, Washington, D. C., each year. This should be consulted for other sources dealing with a specific state, county, or metropolitan area.

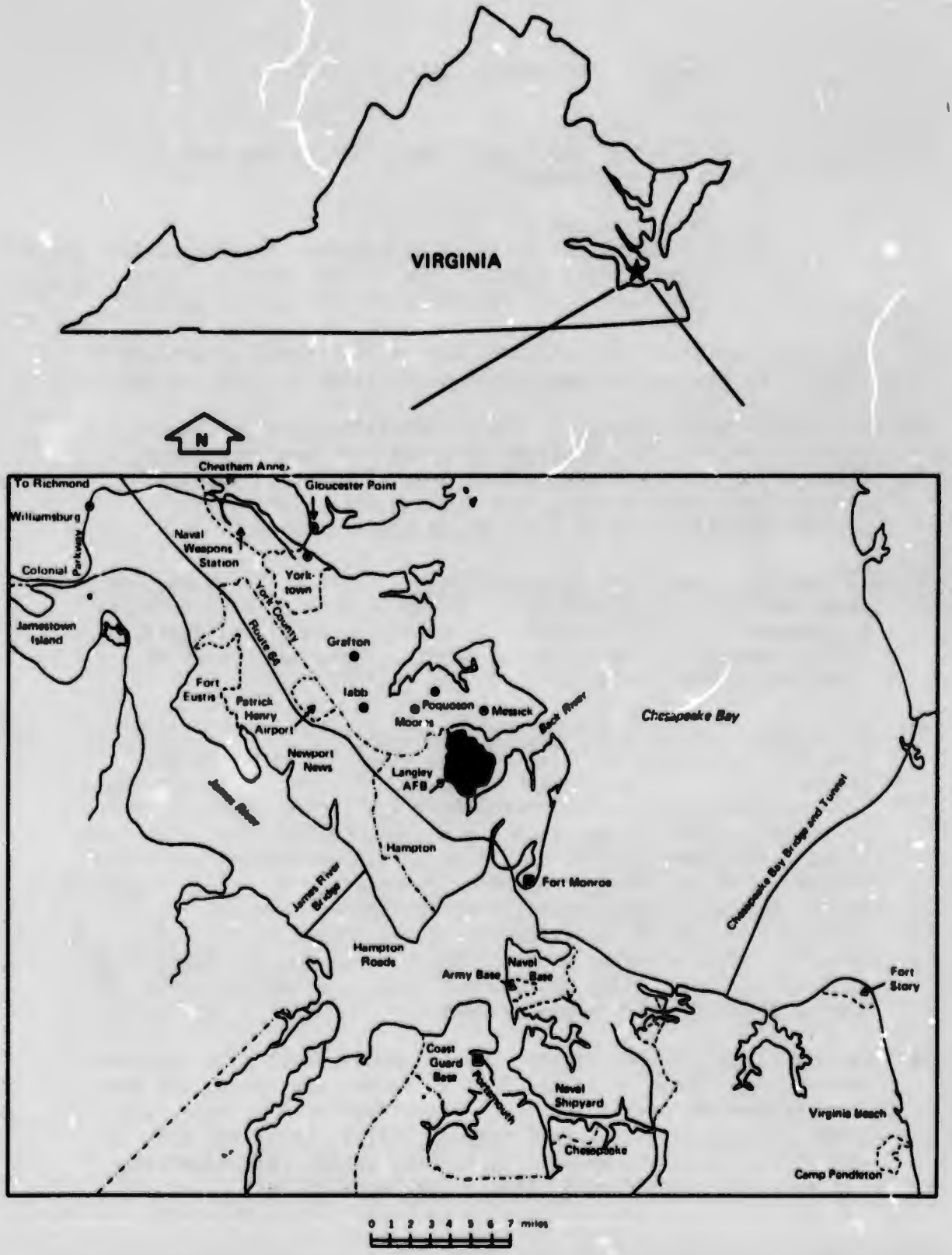


Figure 13. Area Map

TABLE 8. POPULATION CENSUS REPORTS

Volume I Characteristics of the Population. This volume consists of 58 parts, numbered as follows:

1	United States
2-52	50 states and District of Columbia in alphabetical order
53-58	Puerto Rico, Guam, Virgin Island, American Samoa, Canal Zone, and Trust Territory of the Pacific Island

Each part contains four chapters A-D in individual paperbound reports in four series designated as PC(1)-A, B, C, D, respectively.

PC(1)-A Number of Inhabitants. Final official population counts are presented for states, counties by urban and rural residence, standard metropolitan statistical areas (SMSA's), urbanized areas, county subdividions, all incorporated places, and unincorporated places of 1,000 inhabitants or more.

PC(1)-B General Population Characteristics. Statistics on age, sex, race, marital status, and relationship to head of household are presented for states, counties by urban and rural residence, SMSA's, urbanized areas, county subdivisions, and places of 1,000 inhabitants or more.

PC(1)-C General Social and Economic Characteristics. Statistics are presented on nativity and parentage, state or county of birth, Spanish origin, mother tongue, residence 5 years ago, year moved into present house, school enrollment (public or private), years of school completed, vocational training, number of children ever born, family composition, disability, veteran status, employment status, place of work, means of transportation to work, occupation group, industry group, class of worker, and income (by type) in 1969 of families and individuals. Each subject is shown for some or all of the following areas: states, counties (by urban rural-nonfarm, and rural-farm residence), SMSA's, urbanized areas, and places of 2,500 inhabitants or more.

PC(1)-D Detailed Characteristics. These reports will cover most of the subjects shown in Series PC(1)-C above, presenting the data in considerable detail and cross-classified by age, race, and other characteristics. Each subject will be shown for some or all of the following areas: states (by urban, rural-nonfarm, and rural-farm residence), SMSA's and large cities.

Note: These reports are available from the Government Printing Office, Washington, D. C. 20402 or any U.S. Department of Commerce Field Office.

Other important sources are state, regional, county, or local planning documents. Regional transportation planning agencies often develop population data and projections for planning units called traffic zones, which are generally smaller in area than census tracts. Other groups such as Chambers of Commerce, banks, and newspapers provide both projections for and analysis of populations and area growth, sometimes in periodical format.

A general discussion of population growth and characteristics should present enough historical data to indicate trends, past stimuli for growth or decline in population, and projections for the future. Tables and graphs can be used to great advantage in presenting and summarizing trends. (An example is given in Table 9.) The role of the Air Force and/or the military--both historical and projected--should be spelled out as specifically as possible. Comparison of past and future trends with those in other states or metropolitan areas are often useful. Density and distribution of population in the study area should be considered, particularly in the immediate environs of the air base or other site of the proposed action. Social and economic characterizations of the population are also useful background data; this can include age distribution, employment/unemployment data, education level attained, and median family income.

b. Land Use

Probably the most controversial impact of Air Force actions upon the human environment is in the area of land use. Installations influence land use in a number of ways which are often conflicting. Air bases induce development in adjacent areas. For example, civilian and military personnel employed by the base often wish to live near the base, and housing developments and trailer parks may be established in the vicinity of the base to meet this demand. Personal business establishments such as beauty parlors, gas stations, real estate firms and other service industries will seek to locate near the installation, particularly if it employs a large number of persons. Public services such as roads, schools, churches, and community facilities may be necessary to serve employees living on and off the base and the business establishments serving this population. Thus installations may serve as a stimulus to development of public services and residential and commercial land use in its environs.

However, the primary function of most Air Force installations, to maintain flying skills and to train pilots, can place constraints on the use of land areas exposed to the noise and accident hazard of aircraft activities. Air Force guidelines (AICUZ) and sometimes local zoning codes restrict land use falling within accident hazard and noise exposure zones. Land use within the approach zones is most severely restricted because within this area structures are

TABLE 9. EXAMPLE OF POPULATION GROWTH

Population Growth in Major Virginia Metropolitan Areas, 1940-1970

Urban Areas	Year				Percent Change 1940-1970	Percent Change 1960-1970
	1940	1950	1960	1970		
Va. Sector, Washington, D.C.	169,521	347,087	601,811	921,237	+443.4	+53.1
Norfolk-Portsmouth	258,927	446,200	578,507	680,600	+162.8	+17.6
Richmond	266,185	328,050	408,494	518,319	+ 94.7	+26.9
Newport News-Hampton	93,353	154,977	224,503	292,159	+213.0	+30.1
Roanoke	112,184	133,407	158,803	181,436	+ 61.7	+14.3
Lynchburg	90,862	96,936	110,701	123,474	+ 35.9	+11.5

Source: Newport News Community Development Program. General Population Characteristics of the Newport News Community Development Program. Newport News, Virginia: By the Program, 1971.

limited both in height and intended use. Because the presence of an air base within a community simultaneously stimulates and restricts development, air base actions affecting land use may inherently result in controversy.

Because of the likelihood of controversy, it is advisable for the environmental staff to devote considerable effort to ascertaining all of the various impacts an air base might have upon a community and thoroughly investigating means whereby adverse impacts might be mitigated. Environmental staff should be aware that the most opportune point of lessening adverse impacts lies not in the preparation of environmental statements but in the planning process where land use plans and zoning ordinances are formulated. Close cooperation with local planning and zoning officials responsible for land use regulations will ensure land use planning and regulations reflect the air base's presence and its mission in accordance with AICUZ policy. The AICUZ concept was described previously.

Data requirements for the land use section and AICUZ are similar and, when actions involving shifts in aircraft activity are involved, may be duplicative. Preparation of these sections should be undertaken concurrently. AICUZ focuses primarily upon land use and population density in areas close to the air base while the land use section encompasses a regional view of land use, development pressures and land use controls as well as land values and ownership patterns in areas near the installation.

A first step in assessing the kinds of information to be included in the background section is to hypothesize upon the nature of impacts resulting from the proposed action. Table 10 presents a listing of possible actions, their impacts and the kinds of information to be included in the background discussion of land use. Other aspects of land use may be relevant depending upon the nature of the specific action and the air base. On-going contact with local planning officials and an awareness of development trends, land use regulations land use plans in conformance with AICUZ policy will enable the environmental officer to identify the possible impact areas.

If land use is of concern, the background section should present existing land uses, land use planning and controls, and development trends within the study area, specifying those governing bodies within the counties or municipalities that have jurisdiction to mandate local land use controls. The Air Force has no legal authority to mandate local land use, and in some instances the installation may be situated in a rural area or community in which land use regulations through such mechanisms as zoning may not have been established. In such cases, it is extremely important to specify development trends.

TABLE 10. PROPOSED ACTIONS, POTENTIAL IMPACTS, AND INFORMATION NEEDS

ACTION	PRIMARY IMPACTS	SECONDARY IMPACTS	INFORMATION TO BE DISCUSSED IN BACKGROUND
Acquisition of land	Less land availability for other uses	Decrease in land available for local taxation	Land use in area to be purchased and contiguous parcels; general land availability to meet community, industrial, residential, commercial and other needs.
	Compatability of proposed AF use with nearby properties and land use regulations		Land ownership in areas to be purchased Property values Property taxes Development trends
Extension of runways	Change in land area exposed to aircraft noise and accidents	Alteration of land uses Decreased marketability of impacted areas with decrease in land values	Existing and proposed land use Development trends Property values AICUZ information if applicable
Increase in base personnel	None	Increased competition for land resources, housing, open space, etc.	Existing and proposed land use in vicinity of air base.
		Increased traffic on local roadway resulting in need for new access roads Increased commercial development established near air base	Availability of existing housing stock to serve personnel; Capacity of public services in vicinity of base; General inventory of personal services currently serving base
		Increased demand for public services General acceleration of development in local community	Development trends
Decrease in base personnel	None	Decreased demand for land, housing resources Possible decline in rate of community's development	Rate of community's development and the extent to which the air base has historically influenced the community's rate of development

TABLE 10 (Concluded). PROPOSED ACTIONS, POTENTIAL IMPACTS, AND INFORMATION NEEDS

ACTION	PRIMARY IMPACTS	SECONDARY IMPACTS	INFORMATION TO BE DISCUSSED IN BACKGROUND
Mission Change	Change in the land area exposed to aircraft noise	Alteration of land uses	
	Expand accident potential zones	Decreased marketability of impacted areas	Similar to extension of runways
		Decrease in land values	
Increase or change in Training Activity at a Range	Personnel and facilities change	Increased development and requirement for public services	Location of population centers and other activites relative to range.
	Change in area exposed to noise and aircraft accidents	Affects on land values	General land use characteristics and development history of area

General information on existing land use within the area by broad categories should be discussed. Table 11 presents summary land use for four jurisdictions surrounding Langley Air Force Base. A more detailed discussion of land uses near the air base should be undertaken, using maps if necessary. Depending upon the nature of the action, the types of information which might be included in this section are: existing land use; proposed land use, through zoning or community plans; property values and marketability; development pressures; land ownership patterns; and significant geographical and other features that affect land use such as extensive marsh, limited accessability, lack of water and sewer facilities and high demand for housing. In those sections dealing with both the larger study area and the area near the installation, the extent to which the Air Force has historically influenced development trends should be discussed.

Information sources useful in preparing the background section are listed in Table 12. In a metropolitan area there may be an abundance of data available from regional planning agencies, city planners, and developers. In this instance, it is advisable for the environmental officer to obtain qualitative information such as marketability of property, development trends, scarcity of land resources, and land values from a number of sources if these are issues. For example, regional planning agencies and realtors are both knowledgeable sources of information on development trends and future land use. However, planners and realtors may have a very different perspective upon marketability of property within various communities, and it is useful for the environmental staff to compare their opinions. The perspective of both planners and realtors may be presented or judgments based upon an analysis of the different perspectives.

In a rural community surrounding a remote installation such as a training range, the environmental staff may have difficulty obtaining both quantitative and qualitative information. The best source of information in such situations may be a state agency such as state planning agencies or departments of community affairs. Property values may in some cases be obtained from the Assessor's Office or from deed transactions on file in the municipal/county registry of deeds.

c. Plans for Future Land Use and Development

It is critical to assess not only the impact of Air Force actions upon existing land use but also future land use. In situations in which the action may affect the uses for which lands are best suited, i.e., altering the land area within noise and hazard zones, affecting the rate of land development through an increase or decrease in personnel or the provision of substantial on-base housing, the impact of Air Force actions is extremely critical. In addition to reviewing the local plans for future land

TABLE 11. LAND USE IN HAMPTON, NEWPORT NEWS, POQUOSON, AND YORK COUNTY, 1970

Land Use Category	No. Acres	Percent of Total
Developed		
Residential (single-family and duplex)	19,006	12%
Residential (multi-family)	1,115	1%
Residential (group quarters)	275	<1%
Industrial	1,924	1%
Miscellaneous	11,098	7%
Commercial	2,423	2%
Public and semi-public	59,699	37%
TOTAL DEVELOPED	96,759	60%
Undeveloped		
Water areas	1,599	1%
Vacant land	63,349	39%
TOTAL AREA	160,488	100%

Source: Peninsula Planning District Commission. Projections for the Peninsula Study Area, 1970-1995. Hampton, Virginia: By the Commission, January 1974.

TABLE 12. POSSIBLE DATA SOURCES

	Information Needed	Sources
(1)	Existing Land Uses	City/County Planners and Zoning Boards
		Regional Planning Agencies
		Other Planning Bodies; i.e., Industrial Districts, Transportation Authorities, etc.
(2)	Development Trends	Projected land developers, city planners, realtors and RPA's
	Housing Starts	Developers and local building inspector's office responsible for issuing housing permits
	Projections in migration; births and new households	Regional Planning Agencies City Planners
(3)	Local Property Taxes and Assessment Practices	
	City County School	City Assessor's Office County Assessor's Office
(4)	Land Use Regulations	Zoning Ordinances, Municipal Charters
(5)	Property Values	Realtors, Assessors, Deed Transfers
(6)	Ownership Patterns	Realtors, Assessors, Deed Transfers

use, the environmental officer should evaluate the assumptions upon which these plans have been based. For example, land use plans may assume the construction of public services and facilities on a particular schedule or on assumption the Air Force will continue to employ a constant number of persons. Elements of future land use plans and development should be included in this section and may include the following kinds of information:

- A review of zoning ordinances to determine proposed land use.
- A review of the zoning board's action over previous years to determine whether requests for zoning variances have been granted in areas near the air base.
- A review of land capabilities and proposed uses, as indicated by community development plans. These may be prepared by cities, counties or regional planning agencies.
- An assessment of the realistic expansion of municipal services to undeveloped areas.
- Plans for designation of open space or recreation in land areas near the base.
- An assessment of geographical characteristics such as wetlands which may influence growth.
- A review of general growth determinants which will influence an area's growth such as the area's economic development, completion of proposed highways, and the area's general marketability.

d. Economy

(1) Characteristics of Local Economy

Directly and indirectly, an Air Force Base influences the local economy. Essential to an understanding of this relationship is an assessment of the activity segments, present and historical, that comprise the economy of the area. Many sources of this information are available, including:

- Federal. U.S. Department of Commerce (including OBERS projections), U.S. Department of Labor, U.S. Department of Agriculture

- State. Division of State Planning (Economic Development), Division of State Employment Security

- Region. Regional Planning Agency, Regional Transportation Planning Authority

- County/City/Town. Planning Departments

- Other. Chamber of Commerce, Banks and Newspapers

The economic base of an area is usually analyzed in terms of basic and supporting activities. Basic economic activities are those serving external markets and are sources of growth for the local economy. As might be expected, the supporting or non-basic activities are responses to local economic needs, including those of the basic activities. Contract construction, local wholesale and retail trade, and local government are considered supporting activities, whereas activities such as agriculture, manufacturing, and the federal government are classified as basic activities.

In an analysis of the characteristics of the local economy, employment distribution, both basic and supporting, must be described in terms of major activity segments and growth areas. A table such as Table 13 is very useful for this purpose. Traditional major activities and past high-growth periods should also be described. Not every source listing federal government employment includes military personnel, and care must be taken that whatever figures are given are identified properly.

(2) Area Economic Trends

Projections of future economic activity and, in particular, anticipated shifts are also important background information. Of special interest, of course, is the projected position of federal employment relative to the other basic employment sectors.

Sources of economic projections are essentially the same as those listed above, with the Division of State Planning and local planning departments and Chambers of Commerce the most likely. Once again a summary table can be used to great advantage; the sample table given previously combined current and historical base analysis with projections.

(3) The Air Force Base in the Local Economy

Both through its payroll and through its purchase of goods and services, an Air Force base contributes directly to the local economy. The Base Comptroller or the Information Office can provide current employment figures, both for numbers of employees--military and civilian--and for total payroll dollars. The Base

TABLE 13. SAMPLE ECONOMIC BASE ANALYSIS

	Values in March				Average Annual Rate		Range (%)
	1950	1960	1970	1980	1950-1960	1961-1970	1971-1980
Labor Force	74,128	103,193	146,812	189,500	3.3	3.3	2.8
Employment	67,040	99,473	142,206	183,700	4.0	3.3	2.8
Basic employment	38,024	59,041	74,793	87,700	4.4	2.1	1.7
Agriculture	1,000	770	565	485	-2.5	-1.9	-1.7
Federal government	19,926	28,357	36,957	30,800	3.5	2.4	-1.8
Military	13,271	17,479	23,796	18,400	2.7	2.8	-2.7
Civilian	6,655	10,878	13,161	12,400	5.0	1.7	-0.6
Fisheries	753	768	1,165	930	0.1	3.8	-2.4
Higher education	843	1,082	1,714	1,860	2.5	4.2	0.9
Medical-institutional	1,401	1,928	2,260	2,460	3.2	1.4	0.9
Port and port-related activity	2,163	2,293	1,814	2,000	0.5	-2.1	1.0
Research and development	---	44	518	450	---	>10.0	-1.5
Travel trade	1,305	2,520	4,254	8,540	6.8	4.8	8.0
Manufacturing	10,633	21,279	25,546	40,175	7.1	1.6	5.1
Supporting employment*	29,016	40,432	67,413	96,000	3.3	4.7	4.0
% of total employment basic	56.7	59.4	52.6	47.7	---	---	---
% of total employment federal government	29.7	28.5	25.9	16.7	---	---	---
% of total employment manufacturing	15.8	21.4	17.9	21.8	---	---	---

*Contract construction; transportation; public utilities; local wholesale and retail trade; finance, insurance, and real estate; local government; and services.

Source: Division of State and Planning and Community Affairs. The Virginia Peninsula, Projections and Economic Base. Richmond, Virginia: By the Division, 1973.

Procurement Office has figures for contracts for goods and services let to local firms. For many contracts let to non-local firms, subcontracting to local firms and hiring of local labor brings a substantial portion of the actual expeditures back to the local economy. Although the Base Procurement Office is not involved in this subcontracting, it can often approximate the dollar volume involved. Direct contributions of the base to the economy should be summarized as shown in Tables 14 and 15. Note that regional and local expenditures are estimated. When the information is available, it is helpful to indicate what kinds of goods and services are purchased by the base, particularly for local expenditures.

The presence of an Air Force base creates a myriad of secondary or indirect influences on the local economy. In many cases, these secondary influences are difficult to identify. For example, local expenditures by the Air Force to operate and maintain the base provide employment in the service and supply industries, and these activities, in turn, stimulate other local demands that create employment and generate income. Similarly, the population of Air Force employees and their dependents creates a need for housing, education, transportation, food and household items. The satisfying of this demand in turn stimulates local commercial and industrial development, providing once again employment and income to be invested in the local economy. This process of people filling needs and creating other demands continues throughout the intricate and interdependent community that makes up the local economy.

At some Air Force bases, surveys or studies have been made that make it possible to show estimates of indirect economic impact. In most cases, however, approximations such as the following (for Langley AFB) will suffice:

> "No data is available indicating exactly what portion of the payroll dollars from Langley are spent in the local economy, although some approximations are possible. Civilians are not eligible for the base commissary or on-base housing. When a national average of spendable income (disposable income less savings, 79.1 percent of gross income) is used as an indicator [A13], the spendable income of civilians employed at Langley totals $14,862,497 (79.1 percent of total civilian payroll). A similar calculation for the spendable income of military personnel at Langley yields a total of $6,897,782. This figure is offset by the fact that 3,360 military personnel (38 percent) reside in military housing. Other base services such as medical and dental care and the base exchange and commissary decrease the expenditures by military personnel (and their dependents) in the local economy.

TABLE 14. MILITARY AND CIVILIAN PAYROLL,
LANGLEY AIR FORCE BASE, JUNE 30, 1974

Employee Classification	Number	Annual Payroll
Military	8,728	$ 95,844,048
Civilian (USAF)	1,531	17,578,378
Base exchange personnel	235	980,759
Non-appropriated fund personnel	690	1,785,231
TOTAL	11,184	$116,188,416

TABLE 15. ANNUAL EXPENDITURES FOR GOODS AND SERVICES
LANGLEY AIR FORCE BASE

Fiscal Year	Expenditures		
	Total	Regional*	Local+
72	$25,088,595	$20,665,695	$4,422,900
73	$43,986,916	$38,671,581	$5,315,335
74≠	$51,658,676	$45,008,618	$6,650,058

* Estimated expenditures in area encompassing Richmond, Norfolk, and Hampton-Newport News Metropolitan areas.

\+ Estimated expenditures in Newport News and Hampton area.

≠ Estimate based on $25,004,788 obligated July to December 1973.

Langley military personnel residing off the base as well as civilian employees are responsible for a sizable investment--through either rental or purchase--in real estate. This investment tends to be concentrated in residential areas close to the base, such as Tidemill Farms (see 3.6.1.1). Military personnel also purchase in the surrounding community many items not available on the base, such as automobiles."

Providing services such as schools and roads for an air base also has an economic impact on the community. In the case of schools, the largest impact is felt near the air base in schools attended by dependents who live in military housing. Often the federal funding provided to the local school system does not totally cover the annual cost of educating these students. On the other hand, federal funding is also available for dependents of USAF employees (both military and civilian) who reside in the local community and contribute through their property taxes to the local school budgets. Sources of this information are discussed in subsection f. below. Certain proposed actions such as construction of new bases or expansion of family housing can have tremendous economic impact on the local school system and, ultimately, the local tax base, and this issue must be covered in detail in cases such as these.

The presence of an air base can influence land values in its environs. For example, often both residential and commercial developments occur close to the base to serve specifically the needs of the base population. Therefore, the issue of land values is particularly relevant for proposed new bases or base closings or any land acquisition or disposal. Similarly, base operations, notably aircraft activities in urban areas, can exert an economic impact, making land areas exposed to noise, for example, less desirable for certain kinds of development. One immediate effect is the unavailability of federal funding and/or mortgage guarantees for residential developments in areas exposed to noise levels that are unacceptable by standards of the U.S. Department of Housing and Urban Development (see HUD Circular 1390.2 and AICUZ section of this report). This issue must be considered or at least mentioned for any Air Force action involving current or proposed aircraft operations.

e. Housing

Not only do USAF members and civilian employees require off-base housing, but Air Force activities, notably aircraft operations, can preclude residential development in certain areas. Thus, an Air Force base and its operation can influence significantly the availability of housing.

Two major types of information are indicators of housing availability:

- Building starts
- Occupancy/vacany figures.

In most communities, building permits are required for all new construction, and the local building permit office (town, city, or county) keeps a record of both residential and commercial construction in this manner. Residential permits are usually categorized as single-family houses or multi-family developments; for the latter, it is important to note how many dwelling units were contained in each project (one building permit suffices for either a ten-unit or a 100-unit development). Data concerning occupancy or vacany of existing housing is accumulated by a variety of groups:

- Planning departments (town, city, county, region)
- Chambers of Commerce
- Associations of Realtors or Developers

Although these local sources often have the most up-to-date information on the local housing market, the U.S. Department of Commerce, Bureau of the Census, has published a series of reports based on the 1970 Census of Population and Housing; those reports dealing with housing are identified and briefly described in Table 16.

USAF information sources will provide the best indication of where Air Force employees live and what impact they have on the local housing market. Address lists and surveys, such as carpool surveys, provide accurate information as to the residences of USAF employees. Otherwise, the Housing Referral Office at the base can give a reasonable estimate. Furthermore, this office prepares every year an analysis of USAF family housing requirements and the availability of on-base and reasonably priced off-base housing.

Background information concerning housing should indicate the general availability of housing, both in the general area and within reasonable commuting distance of the base. (Most planning reports cover housing trends and will state whether housing development has kept pace with population growth.) If the presence of the base has stimulated housing development or possibly inhibited residential growth because of activities such as aircraft operations, this should be stated. Distribution of residences of base personnel throughout the community, including military housing, should be given as specifically as possible, with special emphasis on those civilian communities in which they constitute a major or significant percentage of all households. Any trends affecting future availability of housing should be identified as relevant; this might include costs, availability of land, etc. Obviously, any planned expansion of military housing is relevant as well.

TABLE 16. HOUSING CENSUS REPORTS
U.S. DEPARTMENT OF COMMERCE, BUREAU OF CENSUS

Volume I Housing Characteristics for States, Cities, and Counties

This volume consists of 58 parts numbered as follows:

1	United States
2-52	50 states and District of Columbia in alphabetical order
53-58	Puerto Rico, Guam, Virgin Islands, American Samoa, Canal Zone, and Trust Territory of the Pacific Islands.

Each part is issued as an individual paperbound report in two series, HC(1)-A and HC(1)-B.

HC(1)-A General Housing Characteristics

Statistics on tenure, kitchen facilities, plumbing facilities, number of rooms, persons per room, units in structure, mobile homes, telephone, value, contract rent, and vacancy status are presented for some or all of the following areas: states (by urban and rural residence), SMSA's urbanized areas, places of 1,000 inhabitants or more, and counties.

HC(1)-B Detailed Housing Characteristics

Statistics are presented on a more detailed basis for the subjects included in the Series HC(1)-A reports, as well as on such additional subjects as year moved into unit, year structure built, basement, heating equipment, fuels, air conditioning, water and sewage, appliances, gross rent, and ownership of second home. Each subject is shown for some or all of the following areas: states (by urban, rural-nonfarm, and rural-farm residence), SMSA's urbanized areas, places of 2,500 inhabitants or more, and counties (by rural and rural-farm residence).

Note: These reports are available from the Government Printing Office, Washington, D. C. 20402 or any U.S. Department of Commerce Field Office.

f. Public Facilities

(1) Schools

Employees at an Air Force base have a large number of dependents attending local schools. The Federal Government provides revenues to local schools in proportion to the number of dependents of federal employees and military members. The subsidy per student is more for dependents residing on federal property (and thus exempt from local property taxes) than for dependents of military members and civilian employees who live in the civilian community (Class A and B dependents, respectively).

Each year, before application for these funds is made, a survey is conducted by each school system. The business manager or superintendent of the local school system should be able to supply the results of this survey, including both the number of dependents and the level of federal funding. Depending on how the survey is conducted and the number of federal installations in the area, it may be possible to isolate the Air Force dependents from dependents of other federal employees. A summary, as shown in Table 17, should be provided.

Dependents who live on base property often represent a substantial proportion of the student enrollment in the schools they attend, whereas the dependents of military members and civilian AFB employees living in the civilian community are dispersed throughout the local school systems. Since the federal impact funds seldom cover the cost of educating these Class A dependents, the presence of these students has an economic impact on the local school system. The type of analysis in Table 18 can be developed to demonstrate this impact. The cost of educating these students is borne by the city/town, county, or state as determined by the manner in which public education is financed.

Another economic impact of Air Force bases on local school systems is the requirement for new school construction often brought about by construction of military family housing, and this should be documented. Although some federal assistance has been available during some years in the past, construction of schools is financed, for the most part, by the local community.

At many air bases, large numbers of military personnel take advantage of the educational opportunities offered under the Air Force Tuition Assistance Program or by the Veterans Administration. Enrollments in educational programs at local high schools, colleges, and universities should be documented. The Base Education Office can provide the necessary information.

TABLE 17. DEPENDENTS OF FEDERAL GOVERNMENT EMPLOYEES AND LEVEL OF FEDERAL IMPACT FUNDING IN HAMPTON, NEWPORT NEWS, AND YORK COUNTY SCHOOLS, 1973-1974

	School System		
	Hampton	Newport News	York County
Class A dependents	1,106	1,435	1,746
Langley	663	none	1,426
% Langley	60	----	82
Class B dependents	9,837	6,539	2,150
Langley	4,707	303	not known
% Langley	48	5	----
Total Federal dependents	10,943	7,974	3,896
Langley	5,370	303	not known
% Langley	49	4	----
Average total membership	31,250	30,567	8,224
% Federal dependents	35	26	47
% Langley dependents	17	less than 1	unknown
Federal Impact Funding	$1,792,000	$1,455,516	$1,131,926

Sources: Personal Communication, Mr. Christie, Hampton School Department, July 12, 1974.
Personal Communication, Mr. R. Wingfield, Newport News School Department, July 10, 1974.
Personal Communication, Mr. Pope, York County School Department, July 11, 1974.

TABLE 18. SCHOOL BUDGETS AND FEDERAL FUNDING FOR SCHOOLS ATTENDED BY DEPENDENTS OF LUKE AFB EMPLOYEES RESIDING IN BASE HOUSING

Schools and Year	ADA*	Luke Dependents % of ADA	Approximate School Budget	Federal Funding Amount	Federal Funding % of Budget
1972-1973:					
Dysart Elementary	2,824	28	$1,932,000	$326,000	17
Litchfield Elementary	1,131	29	891,000	143,000	16
Agua Fria High School	1,171	24	1,210,000	77,900	6
Dysart High School	746	26	729,000	76,600	10
1971-1972:					
Dysart Elementary	2,786	30	1,989,000	310,400	16
Litchfield Elementary	1,109	51	774,000	176,500	23
Agua Fria High School	1,033	14	1,011,000	46,600	5
Dysart High School	977	33	1,053,000	82,950	8

* Average Daily Attendance

Sources: Luke Air Force Base Economic Impact on the Greater Phoenix Area. 1973. Luke AFB Management Analysis Branch, Comptrollers Office.

Office of Maricopa County School Superintendent. Annual Statistical Report of Maricopa County Public Schools, 1972-1973.

For proposed actions involving an AICUZ analysis, any schools located within the CUD zones for current operations should be identified and attendance or enrollment figures given.

(2) Hospitals

Two aspects of the health care requirements of the base population must be considered:

- Services provided by the base hospital and clinics
- Services required of local civilian hospitals and other health care facilities.

This information, as well as opinions concerning the adequacy of available health care services, can be obtained from administrators at the base hospital and from civilian health care planners. In addition to comprehensive health planning agencies in every state capitol (A agencies), 251 local comprehensive health planning agencies (B agencies) operate under the auspices of the Health Resources Administration of the U.S. Department of Health, Education, and Welfare (the state agency will be able to identify any local comprehensive health planning authority). Many health planning agencies publish a plan containing all of the information needed for this assessment. Otherwise interviews with state/local health planners or hospital administrators may be necessary.

A discussion of the health care facilities on base should cover both in- and out-patient facilities, their use, and the patient population served. Ever since the end of the doctor draft, the number of physicians assigned to an air base versus the number authorized has determined, in many cases, both the availability of services and the priorities in providing service to active-duty military, their dependents, retired military, etc. Therefore, the level of physician staffing at the base should be discussed. An estimate of the total patient population, perhaps based on the number of medical records, is also useful.

For the hospital, the number of beds and the average daily occupancy should be given. Services provided at the hospital (obstetric, surgical, emergency, intensive care, etc.) and those for which eligible patients are sent elsewhere should be indicated, including the extent and type of referrals to civilian hospitals, including those of military dependents under the CHAMPUS program.

Clinics--both medical and dental--operated on the base should be identified as to type, patient eligibility, use (patient visits for day, week, or month), and availability (waiting period before appointment).

In an analysis of the health care facilities of the civilian community the emphasis should be on those services required by the base population and on the availability of these services. The total bed complement in acute-care facilities, both community and private hospitals, and rate of occupancy is a good measure of this, as is the considered opinion of civilian health care planners and/or the base hospital personnel.

For purposes of AICUZ analysis, locations of hospitals, clinics, or other health care facilities (such as nursing homes) in the vicinity of the base should be known.

(3) Recreation

Both civilian and military recreation facilities available should be described briefly, including State and National Parks. The major concern is whether Air Force activities interfere with any recreational resources. If aircraft operations are or will be a part of the base activity, the location of established flight paths relative to recreational areas is of interest.

Information concerning recreational facilities on base is probably contained in any "Welcome to _____AFB" publications by the Information Office; otherwise, the Recreation Office can be consulted. State and local park and recreation departments can provide maps and descriptions of and guides to recreational areas.

g. Cultural Resources

Numerous federal statutes and executive orders as well as state statutes have been designed to ensure protection and preservation of the cultural resources of the United States. In accordance with the National Environmental Policy Act of 1969, cultural resources are an integral part of the environment and as such must be considered in any environmental impact statement.

Cultural resources include "sites, structures, objects and districts significant in history, architecture, archaeology, and culture."[23] They are encountered in many forms, as defined by the Department of the Interior, National Park Service:

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[23] U.S. Department of the Interior. Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archaeological, Architectural) Resources. National Park Service, Office of Archaeology and Historic Preservation, Washington, D. C. 20240, April 1974.

"Sites--distinguishable pieces of ground, or areas of historic, prehistoric, or symbolic importance, upon which occurred important historic or prehistoric events, or which are importantly associated with historic or prehistoric events or persons or cultures, or which were subject to sustained historic or prehistoric activity of man, sometimes featuring changes in topography produced by human activity; examples are battlefields, historic campgrounds, ancient trails or gathering places, middens, historic farms;

Structures--works of man, either prehistoric or historic, created to serve human activity, usually by nature or design immovable; examples are buildings of various kinds, dams canals, bridges, fences, military earthworks, Indian mounds, gardens, historic roads, mill races and ponds;

Objects or artifacts--material things of functional, aesthetic, cultural, symbolic, or scientific value, usually by nature or design movable;

Districts--geographically definable areas, urban or rural, possessing a significant concentration or linkage of sites, structures, or objects, unified by past events or aesthetically by plan or physical developments or by similarity of occupation." 23

Several steps are involved in ascertaining the existence of cultural resources. Most of these steps require consultation with acknowledged experts and sources. In many cases some level of study by professionals (archaeologists and historians) will be required. The intensity and extent of the investigation should be scaled to the potential impacts of the action on cultural resources. For example, a major construction effort resulting in a change in land use and character of the environs might require a more intensive survey of cultural resources than a mission change involving a different aircraft at a base already used as an active airfield. In the words of the National Park Service, "simple consultation of lists of currently identified resources seldom constitutes sufficient investigation of the affected environment." This should be the starting point, however.

Properties protected by the National Historic Preservation Act are listed in the National Register of Historic Places.[24] Additions and deletions to this listing are published in the Federal Register on the first Tuesday of each month, with a complete updated list published once a year.[25] The State Historic Preservation Office (published annually by the National Park Service in the Federal Register, usually during January or February) should be consulted for other properties eligible or nominated for listing in the National Register.

Executive Order 11593, "Protection and Enhancement of the Cultural Environment," Section 2(a) directs federal agencies to

> "no later than July 1, 1973, with the advice of the Secretary of the Interior, and in cooperation with the liaison officer for historic preservation for the state or territory involved, locate, inventory and nominate to the Secretary of the Interior all sites, buildings, districts, and objects under their jurisdictions or control that appear to qualify for listing on the National Register of Historic Places."[26]

The status of this survey for the air base should be indicated.

Many states also recognize historic sites and landmarks protected under state legislation. The State Historic Commission or the designated liaison officer (often the same) can provide assistance in identifying and locating sites, structures, and districts recognized by, or known to, both state and local historic commissions. [A useful publication in this regard is A Guide to State Programs by the National Trust for Historic Preservation (Washington, 1972).] Historical and archaeological societies and

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24 U.S. Department of the Interior, National Park Service, Office of Archaeology and Historic Preservation, The National Register of Historic Places, 1972, Washington, D. C.: Government Printing Office, 1972.

25 U.S. Department of the Interior, Notices "National Park Service--National Register of Historic Places--Advisory Council on Historic Preservation--Protection of Properties on the National Register, Procedures for Compliance." Federal Register XXXIX, No. 34, Part II, 6401-6477, February 19, 1974.

26 Executive Order 11593, "Protection and Enhancement of the Cultural Environment" May 13, 1971 (36 F.R. 8921).

college history and archaeology departments should be consulted as well. [A guide to these local groups is provided in Directory: Historical Societies and Agencies in the United States and Canada, 1973-1974 by the American Association for State and Local History (Nashville, 1972).] The Base Historian or Information Office should be able to provide historical information concerning the purchase or lease of the base by the Air Force and the previous character and use of the land. If, in the opinion of state and local archaeologists and historians, insufficient information is available to permit a reasonable assessment of the presence or absence of cultural resources below the ground surface in an area to be affected, an intensive archaeological survey by recognized authorities may be required. This process can be both time-consuming and costly and should be carried out in consultation with the state liaison officer, state archaeologist, and the National Park Service.

h. Public Works Facilities

Public works facilities which should be described and analyzed for possible impact are the following:

- Water supply
- Water pollution control (sanitary sewerage, industrial waste and spill control)
- Solid waste collection and disposal
- Energy use (natural gas, petroleum products, and utilities).

In describing the above, the general topics that should be included are:

- Source
- Location
- Rate of consumption, use, or throughput
- Ultimate disposition.

Nearly every action taken at an Air Force installation will have an effect on public works facilities. The action may also generate solid waste, require a change in the usage of water for both maintenance purposes and consumption by support personnel, and change sanitary sewerage flows.

The general philosophy which should be taken in describing existing public works facilities and the change of taxation on these facilities resulting from implementation of the proposed action is to provide the reader with enough information for him to determine the status and adequacy of existing facilities, both within the installation and those provided by adjacent communities, and understand the order of magnitude of change.

One of the most important elements of the description of existing services and facilities is the unit of measurement used. For a discussion of water and sewer use, the unit gallons per capita per day (gpcd) should be adopted. The perspective can be given by comparing this number with that of the adjacent community or that described in water and wastewater textbooks. In using this unit of measurement for on-base use, care must be taken to insure it reflects a normal 24-hour day. Although in many respects an installation is typical of a community, the community work force leaving the base in the evening will affect the rate of use of water and sewerage. Textbook or community rates of consumption are based on total daily consumption divided by the total population regardless of how that population might be distributed, the assumption being the same facilities are being used regardless.

For discussion of solid waste, natural gas, electricity, and petroleum products, common weight or volume measure per unit time should be used.

It should be kept in mind that, during the period of implementation of the proposed action, other non-related actions may be scheduled which would influence the use of public works facilities. It is necessary to consider these actions and their effect in order to arrive at a realistic net change.

(1) Water Supply

- Source: Municipal supply or U.S. government. For example, reservoir or local wells.
- Location: Location of wells, reservoirs, elevated and groundwater storage.
- Rate of Consumption: Major users of water should be identified with their percent of total demand expressed.
- Ultimate Disposition: Approximate that which enters into a sanitary sewage system.
- Other Considerations: Describe non-potable systems, its uses and limitations; water quality monitoring conducted by the Bio-Environmental Engineer; water shortages and conservation measures; historical ability of the system to supply all needs during peak consumption periods.

(2) Water Pollution Control

- General: Describe facilities which the Air Force operates to control water pollution. These should include but not be limited to sanitary sewage treatment plant, industrial waste treatment facility, and fuel and oil spill collection system. If service is provided by an adjacent community, so indicate.

- Source: Describe briefly the source and nature of sewage. What percent of the total is domestic and what percent can be classified as industrial.

- Location: Describe location of facilities or points of tie-in with a municipal system. Identify the location of the municipal system.

- Flow: Show historical (at least one year, up to five years if available) records of the installation's flow contribution to the sanitary sewage system (gallons per day). Give design flow of facility and peak daily flows.

  Describe the National Pollution Discharge Elimination System (NPDES) Permit requirement under EPA and state regulations and give the status of the facility with regard to complying with the NPDES Permit.

  If the facility does not now have an NPDES Permit, discuss its status. Also, discuss the adequacy of present treatment with regards to state and federal treatment requirements.

(3) Solid Waste Collection and Disposal

- Source: Briefly discuss the nature of solid waste generated at the facility and indicate each source as a percent of the total, i.e., industrial/operation, garbage and refuse (family housing, commissary, family services).

- Location: Describe the location of the disposal area and type of facility, i.e., dump, sanitary landfill, incinerator.

- Throughput: Give rate of throughput in cubic yards (or tons) per month collected over a one-year period of record.

- Ultimate Disposition: Indicate frequency of collection and by whom. If recycle or reclamation is practiced, so state.

(4) Energy Utilization

- General: There are three common categories of energy sources which should be discussed: natural gas, liquid petroleum products, and electricity. Consumption of petroleum products and natural gas is estimated for determination of base emissions and should also be displayed here in the context of energy use. The intent of this section will be satisfied by a tabular display of historic (one year) consumptive data. Conservation measures which have been instituted should also be discussed and the percent reduction experienced or anticipated should be indicated.

i. Transportation

Transportation is the movement of people and goods, generally involving a carrier using a pathway of some form. The components of transportation systems are as follows:

- Item Being Transported

  (1) People

    (a) Commuting
    (b) Business (i.e., office to office on-base)
    (c) Other (i.e., schools, shopping, services)

  (2) Goods

    (a) Non-bulk (i.e., boxes, packages)
    (b) Bulk (i.e., fuel oil, coal, gravel)

- Carriers

  (1) Small (i.e., walking, bicycle, car, truck)
  (2) Large (i.e., subway, train, airplane, barge, ship)
  (3) Stationary (i.e., pipeline, canal, escalator)

- Pathways

  (1) Land (i.e., path, sidewalk, street, highway, railroad track)
  (2) Water (i.e., river, ocean, canal)
  (3) Air (i.e., designated flight paths)

Transportation systems are essential to human activities; they are also complex, expensive, involve risks and inconveniences, and their operation can adversely affect the environment. Carriers must be purchased and operated; pathways must be constructed and maintained. Both involve the consumption of energy and emission of pollutants.

In describing the transportation systems for environmental statements, it is not necessary to perform a detailed technical analysis. Such studies are handled for all DOD installations by the Military Traffic Management and Terminal Service, Transportation Engineering Agency, 12388 Warwick Boulevard, P.O. Box 6276, Newport News, Virginia 23606. Reports prepared by this agency are both detailed and analytic in nature.

The description of the transportation system should emphasize those aspects which may be affected by the proposed action. Particular attention should be given to commuting problems arising as a result of changes in the base population, or in shifting of people from one location to another, including off-base housing. Will new carriers and pathways be required, and if so, will they create new problems? Potential problems are these:

- Traffic jams during commuting hours, possibly due to inadequate entrance roads and gates.
- Difficulty with on-base business travel due to dispersed buildings, including cafeterias.
- Grade crossing of busy railroad track and highway.
- Safety problems for pedestrians and children at schools and playgrounds.
- Isolation of land areas and neighborhoods because of new roads. Will fences prevent normal movement of wildlife?
- Access problems for emergency vehicles such as fire engines and ambulances.
- Transportation of hazardous or toxic materials.
- Adequate parking spaces.

The description of the transportation systems should provide an overall description of existing systems and problem areas. In view of the need to conserve energy and to avoid unnecessary air pollution, the discussion should include actions which have been taken to reduce travel, such as car pools, bus service, and bicycle paths.

Data and information regarding transportation system carriers can be obtained in conjunction with the corresponding effort for noise and air pollution data collection. This includes the number of vehicles by classes, daily trips and estimated vehicle miles traveled. A map should be included which shows major roadways, railroads, gates, parking areas, and bus routes. The map should extend far enough off-base to show how the system ties into local highway networks.

j. Public Safety (Accidents and Hazards)

Many environmental statements are limited to a description of an action as it normally occurs. However, history teaches us abnormal events do occur, and while they may have a very low frequency, they can cause very significant damage. Examples include the crash of an aircraft or the spilling of crude oil from a tanker. Accordingly, if the proposed action could involve an abnormal event, this subject should be included in the statement, including preventive and protective measures which are intended to minimize the adverse effects (see also subsection V.5). Some examples of abnormal events follow.

A record and analysis of flight accidents and hazards is a part of the Phase I data acquisition stage of the AICUZ program. Under Phase I, it is required that all local flight accidents which have occurred since 1960 be identified and analyzed and located on an accident map. The analysis summary should include as relevant, the type of aircraft, flight patterns, extent of damage, size and dimensions of impact area, and location. (The basic accident potential zones which are applied to all air installations as part of the AICUZ formulation are based upon an Air Force-wide statistical accident analysis. It can be useful, however, to have detailed accident information assembled for each air base for possible use in the development and local implementation of AICUZ land use and zoning recommendations.)

Summaries of in-flight emergencies are also assembled under Phase I of AICUZ, and reports of such incidents are presently required under AFR 127-4. These include such events as in-flight engine shutdowns, hydraulic system failures, instrument malfunctions or failures, dropped objects, bird strikes, in-flight fire or smoke, fuel leaks, loss of pressurization, etc.

The evaluation of hazards to both flight and ground operations should also be carried out. In this category should be information on bird hazards due, for example, to refuse dumps or landfills, or to seasonal migratory patterns; to electrical interference, glare, smoke, dust, steam, etc., resulting from nearby industrial activities or chronic atmospheric conditions; and of flight obstructions, such as towers, buildings, ship masts, etc.

The nature, location, and quantities of fuels and ordnance which are stored, transported, processed, or expended at the Air Force facility should be evaluated. Ideally, this evaluation should include an estimate of the risks to public safety associated with these materials. However, there is no available base of data on accidents involving ground storage and handling of fuel or ordnance which would provide a basis for estimating the level of risk associated with a particular facility or action. This lack of an accident data base is due largely to the fact that these accidents are relatively rare. Consequently, it is not possible with available information to quantitatively assess this accident risk.

Nevertheless, the potential risk of fuel and ordnance operations should not be omitted from the statement because such an omission leaves the impression of an incomplete coverage of the categories of potential impact. It is best to identify the scope of fuel and ordnance operations to the extent security restrictions will allow. To place these activities in perspective, the history of accidents at the facility involving fuels or ordnance should be described. Whatever historical information is available on this subject should be obtainable from the facility safety office. Generally, this information will reveal a low or non-existent incidence of accidents or, at least, a low incidence of injury or damage to persons or property. The description of the effects of the action on fuel and ordnance operations described along with the historical background of accidents is the best that can be done and should be sufficient to demonstrate that fuel and ordnance accidents do not represent a major impact category.

5. AIR TRAFFIC ENVIRONMENT

The flow of air traffic into and out of an air base is well defined. An incremental increase or decrease in the number and/or type of aircraft based at the installation under study will have a predictable impact upon the air traffic at the facility. To better define the impact, it is necessary to understand the spatial concept of air traffic control. The purpose of this section is to describe that concept.

Since it is current USAF policy that, insofar as practical, all flights in USAF aircraft will be conducted under Instrument Flight Rules (IFR), this section is primarily concerned with IFR flights.

Control of IFR traffic is achieved by allocation of space through which the aircraft must fly to different controlling agencies. Local control towers "own" all the space within 5 miles of each tower from ground level up to 3,000 feet above the ground. The tower may delegate responsibility of this space to another agency (particularly under IFR conditions), but the tower controller has absolute authority to permit takeoffs and landings. A description of local flight patterns is provided in subsection a, below. Approach and Departure Control "own" the air space above the tower control zone and below the high altitude air route structure. Approach and Departure Control patterns are described in subsection b, below.

An important aspect of the spatial control concept is the airway route structure. Most point-to-point traffic proceeds by means of an air route structure which crisscrosses the entire country. The route structure is keyed to radio stations that serve a location/identification function. Routes in the low altitude structure (below 18,000 feet) have "V" for Victor-numbered designations. Above 18,000 feet, the route structure carries J-numbered designations. Radar service is also keyed to the airway structure. Area control is described in subsection c, below.

a. Local Flight Patterns

Pilots flying USAF aircraft fly in prescribed flight patterns when they are in the vicinity of USAF bases. Given the IFR policy described above, Visual Flight Rule patterns are largely restricted to the following:

- Practice visual approaches conducted at the termination facility after IFR clearance has been canceled.
- Practice visual approaches conducted at some intermediate flight point under a composite flight plan.

VFR flight patterns under tower control are described below (see VFR Patterns).

When in the local area and traffic conditions permit, the pilot may be given permission to fly multiple IFR approaches. In this case each approach must be cleared separately and in the usual situation the pilot will revert from tower control to approach control after each approach. This fact is significant in accounting for tower/approach control events. Whether VFR or IFR, the aircraft will conform to flight patterns that are of a repetitive nature creating areas or zones of noise and air pollution concentration.

(1) VFR Patterns

The following is a list of typical VFR patterns:

- Closed traffic (racetrack patterns)
- 360° overhead
- 45° entry into down wind
- Straight-in approach
- Simulated flame out
- Precautionary land approach

A detailed description of many of these patterns for each aircraft type is given in the applicable USAF 51-XXX series manuals including TAC, ADC, PACAF, USAFE, and supplements thereof. The -1 operating manual for each aircraft also provides flight pattern information.

Practically, it is not possible to predict the flight path of each aircraft for each flight pattern with any degree of precision. The actual flight path is dependent upon a number of variables such as aircraft weight, meteorological conditions (crosswinds in particular), and pilot proficiency. Additionally, given perfect execution, the flight patterns for different aircraft types vary substantially.

The base operating unit and its base operation function prescribes basic procedures and specifies direction of traffic, preferential runway (if applicable), and traffic pattern altitudes. Each operating unit on the base should be queried for special procedures which may supersede some aspects of the general base operations procedure.

(2) IFR Patterns

The local tower control zone extends (typically) to 5 miles from the center of the airfield. The outer marker initiating the final glide slope is typically 5 miles distance from the approach end of each runway. Missed approach procedures typically specify an outbound radial to a holding fix. Thus, both approaches and missed approaches are typically straight flight paths within the tower control zones. IFR flight patterns are specified in the applicable high or low altitude letdown publications (FLIP).

Standard Instrument Departures (SIDs) may or may not be straight flight tracks within the tower control zone. Generally speaking, the takeoff clearance from Departure Control contains the phrase, "Maintain runway heading for vectors." Typically the first turn away from the takeoff heading will be at a distance of 4 miles. SIDs are published departure routes from the point of takeoff to some airway fix. SIDs are available through Base Operations.

(3) Traffic Density (Tower)

Both FAA-run and USAF-operated control towers keep a daily and a monthly tally on total operations; Base Operations is the reporting agency for this information on military installations.

(4) Emergency Procedures

Procedures for the jettison of external loads and fuel are posted in Base Operations. Tactical units have special procedures dealing with practice ordnance loads. Preferred bailout areas may be prescribed by the base or by the operating units.

(5) Traffic Patterns Noise

AFR 55-34, Reducing Flight Disturbances That Cause Adverse Public Reactions, specifies the circumstances under which preferential runway procedures may be used. It is the responsibility of the tower to designate the active runway at the airport. Traffic using the active is given priority. Use of the preferential runway system may be based on length differentials, existence of barriers, for noise abatement purposes or to minimize taxi time in a scramble. The following is a checklist provided in AFR 55-34 for the generation of local procedures relative to noise abatement.

Preferential Runways: Minimum requirements for the use of a preferential runway:

1. Visual Flight Rules (VFR) must be in effect.
2. The wind is within 80° of the runway heading with a velocity of 12 knots or less.
3. The wind is within 90° of the runway with a velocity of five knots or less.
4. The runway is dry and clear.
5. There are no obstructions adjacent to the runway.
6. The individual pilot concurs.

Traffic Patterns: Should be established to avoid populated areas as much as possible.

Takeoff Techniques: Establish departure procedures consistent with sound safety practices that will minimize adverse noise disturbances on the surrounding community. As a guide, procedures should require pilots of turbine-powered aircraft or a large aircraft (12,500 lb or more), to climb to an altitude of 1,500 feet above the surface as rapidly as practicable.

Landing Techniques: Aircraft flying the VFR traffic pattern should not descend below the altitude established for the traffic pattern they are flying until necessary to insure a safe landing. Aircraft making a straight-in approach should maintain at least 1,500 feet above the terrain for as long as practicable before starting a normal descent on the final approach.

Experience in preparing environmental statements suggests two areas of concern with respect to noise:

- Selection and use of preferential runway for takeoff (in particular).
- Use of precision and non-precision practice approaches over highly congested areas.

Non-precision approaches may be particularly troublesome in that pilots tend to approach minimum altitude as soon in the approach phase as permitted. Aircraft in final approach configuration normally require high power settings.

(6) Letters of Agreement

Check with operating unit and the air base unit for letters of agreement dealing with air traffic. The air traffic control tower, in particular, will have letters addressed to nearby Control Towers specifying emergency use of radar, helicopter procedures, etc.

b. Regional Traffic (Approach and Departure Control)

The function of Approach Control is to provide positive separation between IFR traffic transitioning between the airway structure and the destination airport. Approach Control also provides positive clearance for aircraft performing multiple approaches and to aircraft transiting the regional zone.

Departure Control provides the opposite transition (i.e., from the airport to the airway structure controlled by the FAA Centers). The radius and altitude limits of the regional zones vary substantially. In densely populated areas, Approach Control zones tend to be restricted in volume compared to the Approach Control zones serving less populated areas. All regional control zones keep excellent records of their respective activities, including approaches to USAF facilities. Additionally, summary type information is published annually reporting enroute traffic, terminal activity, instrument approaches, classification of aircraft using each facility, number of departures, overs, etc. The U.S. Department of Transportation's (Federal Aviation Administration) "FAA Air Traffic Activity" is available through the Information and Statistics Division Office of Management Systems.

It is possible and, in some cases, desirable to plot the tracks of IFR approaches and departures on a map showing populated areas, etc. The necessary information can be obtained from the SID plates and from the appropriate high and low altitude approach charts. While the final phase of an instrument approach will be very close to that described, the same statement cannot be made with respect to an instrument departure. Many SIDs have recently been canceled. Furthermore, it has been Air Route Traffic Control (ARTC) policy to provide radar vectors to on course to USAF pilots as a matter of course. However, this practice nullifies the ability to predict the ground track and, of course, raises questions as to responsibility with respect to the noise abatement issue if applicable.

c. Area Traffic

For turbine-powered aircraft nearly all point-to-point flights will penetrate the zone controlled by Air Route Traffic Control Centers (ARTCCs). Military traffic proceeding to special operating areas (SOAs) or special use air space may require ARTCC clearance for both.

Positive Control Airspace (PCA) exists over large areas of continental United States (CONUS). Penetration of these blocks (from 18,000 feet to 60,000 generally) requires an IFR clearance plus an operating transponder. The location and telephone numbers of the ARTC Centers are available through the local approach control facility.

d. Special Use Airspace

The Department of Defense in conjunction with FAA designates certain areas where special flight activities may be conducted. The DoD encourages and in certain circumstances, requires by regulation that the operating units use the designated space for the applicable training. Information describing these spaces is published in the Flight Planning (FLIP) document available in Base Operations. The FLIP also provides detailed information on normal times of operation, whether there is an IFR/VFR restriction and defines block altitudes encompassed by the airspace.

The FAA is the controlling agency for all special use airspace. The FAA/DOD designates a using agency for most special use space. The using agency functions as a coordinator/scheduler for those spaces where several users are involved. The FLIP document also provides the telephone number and address of the coordinator.

- Restricted Areas - An airspace of defined dimensions above the land areas or territorial waters of a state within which the flight of aircraft is restricted in accordance with certain specified conditions. All air-to-ground gunnery ranges are restricted areas. The Army has artillery ranges that are designated as restricted areas. Some military jet training areas are so designated.

- Warning Area - A specified area over international waters within or over which there may exist activities constituting a potential danger to aircraft.

Since the FAA does not own the airspace over international waters, it cannot restrict aircraft from using the space. Nonetheless, the hazard to non-alerted aircraft wandering into a warning area may be substantial. Use of warning areas is coordinated by a designated using agency.

- Low Altitude High Speed Routes - The purpose of the low-level high-speed routes is to provide navigational and dry bombing practice for tactical aircrews. Routes are laid out over sparsely populated areas away from navigational aids and clear of all aerodromes. Each route must be approved by DoD/FAA and when approved are assigned a number, an effective date, and a detailed description by grid coordinates in the FLIP. Low-level routes are further described by the following:

- Unidirection
- Airspeed restriction - 301 K to 0.99 M
- Altitude restriction - no higher than 1,500 feet above ground level (AGL)
- Hours of operation - continuous
- Avoids nuclear power plants by minimum of 5 NM
- Weather minima - 5,000 feet and 5 NM
- Use any entry point
- File flight plans with FSS

- Air-to-Air Refueling Tracks - Aerial refueling is conducted under Instrument Flight Rules along Aerial Refueling Tracks or within the Anchor Refueling Areas. A military unit may be assigned the responsibility for scheduling a particular track. The schedule is proposed to the local Air Route Traffic Control Center.

  Refueling tracks may be unidirectional or bidirectional. Specific location of the terminal points and block altitude space is provided in FLIP.

- Other Special Use Areas - Other areas designated as special use areas include:

  Alert Areas - Areas of concentrated study training activity. Flights not restricted.

  Danger Area - Flights not restricted but avoidance is advised during use.

  Prohibited Area - Flights prohibited except by special permission.

SECTION VII

PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT

1. GENERAL

In Section V, a method was outlined for describing the proposed action. Then, in Section VI, procedures were discussed for describing the existing environment. This section concerns the description of the impacts which result when the action is imposed on the environment. In simple terms, it can be viewed as a completion of a two-dimensional matrix as shown in Figure 14.

Sections V and VI represent basic data and information gathering efforts. Presumably the proposed action has been planned by someone, and a reasonably complete description should be available. Similarly, the existing environment exists as a real entity which can be seen, measured, and described.

The description of the impacts is a departure from the foregoing data and information phase of the study. For one thing, the impacts will occur in the future; thus, they cannot actually be observed and measured. Instead, it is necessary to apply experience based on the observation of similar actions in order to predict the impacts. This section of the report can therefore be considered as the analysis phase. The objective will be to identify and describe all impacts on an impartial basis, as an aid to other reviewers of the environmental statement. The section should be developed and written without any editorial comment as to the worthiness or need for the action, and without any prejudgments about the overall impacts on the environment.

Assuming the descriptions of the action and the existing environment had been prepared in a comprehensive and accurate manner, it would be expected that all reviewers, using these data and information, would reach the same conclusions regarding the potential impacts. In reality, this is seldom the case. For one thing, people have different values. For another, the environment is an extremely complex system, and it is easy to overlook some element. Finally, there is often no quantitative method of analysis which can be used to predict future conditions.

The best one can do in describing the impacts is to make an honest and reasonable effort. The draft environmental statement will be reviewed by other agencies with special expertise in the several environmental fields, and there is the opportunity for them to react to your conclusions and to submit comments and questions which will then be addressed in the final environmental statement.

Description of Existing Environment → / Description of Proposed Action ↓			PHYSICAL			BIOTIC			HUMAN	
			Land	Water	Air	Fauna	Flora	Special Factors	Social	Economic
			Topography Geology, Soils Stability	Surface Ground Quality	Climate Quality Noise	Ecosystems Inventory Importance	Ecosystems Inventory Importance	Rare Species Specimen Stands Unique Habitats	Land Use Infrastructure Recreation and Historic	Local Regional National
Primary Action	TIME	MODE								
	Construction	Normal Abnormal Controls								
	Operation	Normal Abnormal Monitoring								
	De-Activation	Normal Abnormal Maintenance								
Secondary Effects	FIELD	SUBJECT								
	Institutional	Policies Agencies Laws/Regulations								
	Related Developments	Industrial Residential Transportation								
	Economics	Costs Benefits								
	Resources	Energy Materials								

IMPACTS

Figure 14. The Impact Matrix

How can one go about describing the impacts? First, it is necessary to understand some of the characteristics of environmental systems and then the general classifications of impacts. With this background, it will be possible to examine some specific approaches.

A system can be described as a collection of objects having interactions with each other. An environmental system is simply an area and the things it contains. One of the first steps in evaluating a system is to establish or define its boundaries. At first thought, it would seem environmental systems are bound only by the earth itself, since every object is likely to affect objects adjacent to it, continuing indefinitely. In reality, the effects of an action decrease with increasing distance, until a point is reached where it is impossible to detect the original action by any type of measurement. The locus of such points form the boundary of the system relative to the action.

Environmental systems are dynamic or ever changing. The condition which a system exhibits at any time is called its state. Systems undergoing no change are in a fixed steady state; those changing at a constant rate are said to be in a changing steady state. The latter can also include periodic cycles. For example, a place on earth may undergo seasonal changes but remain essentially the same over a period of decades or centuries.

When something new happens in the system (i.e., an action), a series of perturbations will occur among the interactive objects in the system. The system will then change until it reaches a new state of equilibrium, i.e., a new steady state. The differences between the two states can be termed the impacts.

Assuming for the moment there is some way to quantitatively express the state of environmental systems, it would be possible to plot its state as a function of time, as shown by the example in Figure 15. Prior to the time of the action, the system was gradually changing at some fixed rate, and it would presumably continue at this rate if the action did not occur. After the action, there was a marked rise due to construction, then a new steady state was reached during operations. Finally, in the post-operations time period, there was a lessening of impacts until the system reached the same state it would have had if the action had not taken place.

Note that two lines are used to represent the state of the system after the action. The lower line indicates the change in state due to direct impacts only, while the upper line includes both direct and indirect impacts. In the hypothetical example, the system was shown to change in the adverse direction (both with respect to trend and action). However, it could also have changed in the downward or beneficial direction.

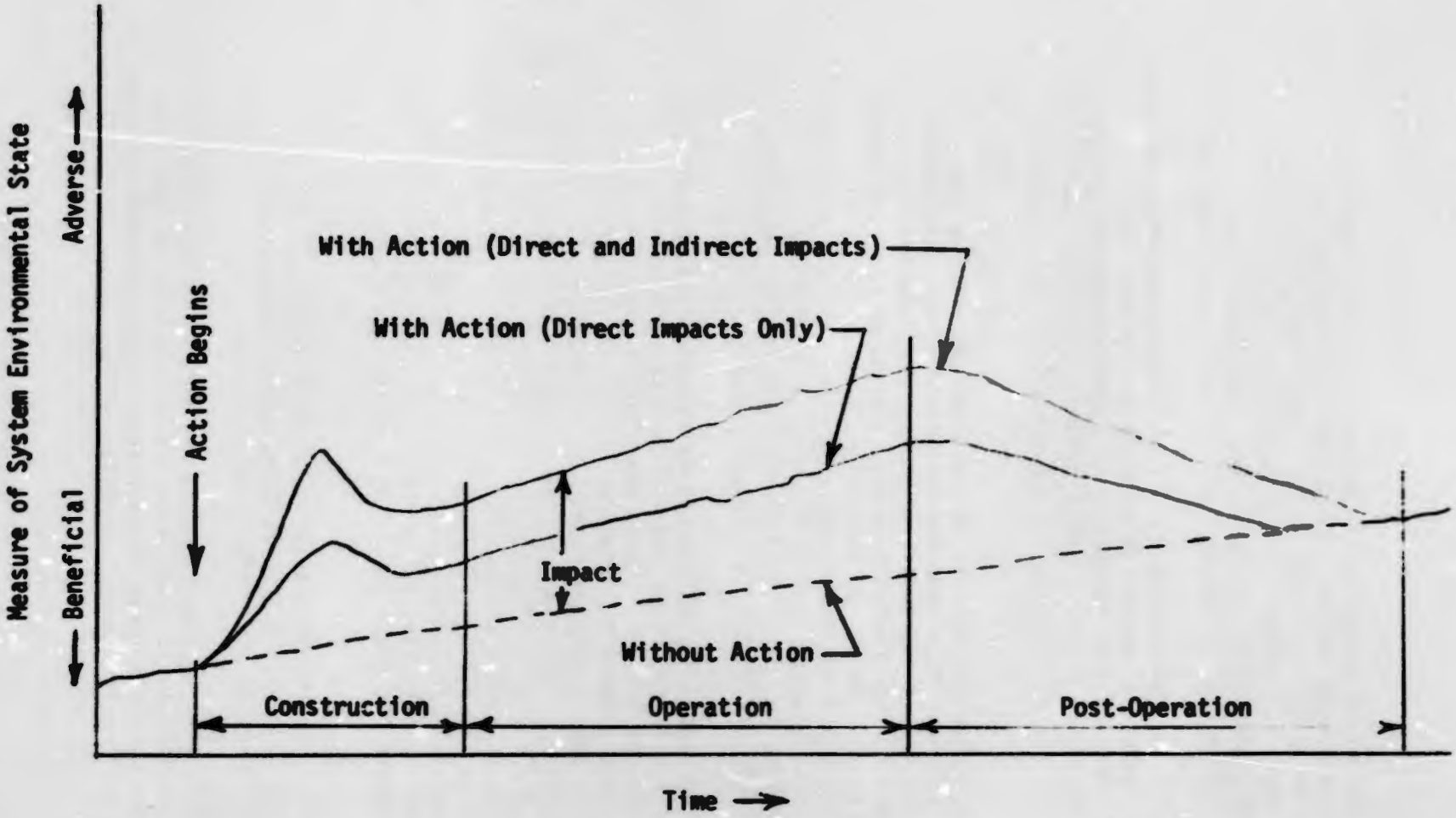

Figure 15. Change in System Environmental State as Result of Action

Another important factor in the example is the assumption the state of the system without the action could somehow be projected (as shown by the dashed line). Many things could have happened that were independent of the action and which would have changed the base-line state of the system. Sometimes these independent actions can be anticipated; at other times, they cannot.

The graph also implies that all of the subsystems which make up the total environmental system can somehow be combined into a single index. This is not feasible, since many different units of measure are involved. However, it is reasonable to plot individual parameters, such as the CO level in the atmosphere, as a function of time.

With this conceptual picture of the changing state of an environmental system, it is possible to examine some characteristics of impacts. The direct and indirect impacts were mentioned above. An example would be the construction of a new barracks. The direct impacts would be the use of the land, the construction of the building and its waste streams during use (i.e., sewage, gases from the boiler). The indirect impacts may include additional electrical power demand which, in turn, would require additional operation of a power plant with its additional effluent loads.

Another characteristic of impacts is their classification as significant or not significant, and whether they are adverse, beneficial, both, or neutral. These descriptors must be applied to the various environmental regimes or to individual objects within them. An impact is significant if it involves a noticeable or measurable change. It is adverse if it causes increased stress or strain or displeasure to the object, and beneficial if it causes decreased stress or strain or pleasure. For example, the construction of family housing may eliminate wildlife habitat and decrease groundwater infiltration (adverse to these subsystems), but at the same time it may improve the living conditions for man, and decrease travel requirements and hence the related pollution of the atmosphere.

Some impacts can be quantified while others cannot. The destruction of areas of historic or archaeological interest and the general aesthetic effect are examples of the latter.

Impacts must also be classified as avoidable or unavoidable, as to their duration, i.e., their short-term versus their long-term effects, and whether they cause irreversible or irretrievable changes. These effects will be discussed in Section VIII.

Another impact factor to consider is that an action generally requires the use of resources: energy, land or space, materials including minerals, and manpower. The use of these resources not only depletes the available supply but may preclude their use for other actions, some of which may have a higher priority.

There are several approaches to writing the section which describes the impacts of the proposed action on the environment. It is important to (1) identify all potential impacts and (2) to quantify them or otherwise describe their relative effect on the various environments. Sometimes it is impossible to say what the effect will be; in this case, be honest and simply state the effects are unknown. If the effects are uncertain, it is permissible to include a discussion of the probable range of impacts, providing there is a reasonable basis for the estimates and the level of uncertainty is stated.

The format for the section is very flexible, and the best choice will depend on the nature of the action. Basically, you can use either the description of the action or of the existing environment as the major classification, with the other being a subset classification. If the action involves a single major project (e.g., the construction of a new power plant or the extension of a runway), it is easier to describe the impacts as a function of the environmental regimes. Alternately, if the action involves many small and separated activities (e.g., modifications to all radar towers in a region), it will be easier to discuss all environmental impacts (i.e., to air, land, water, biotic, socioeconomic regimes) in integrated paragraphs as a function of each activity. This concept can be visualized by reference to Figure 14; one either uses the horizontal or the vertical vectors for primary classification, with the other as secondary classification.

In the subsections which follow, typical impacts are discussed using the same format as was used in Section VI to describe the existing environment.

2. PHYSICAL ENVIRONMENT

a. Terrestrial Regime

The impacts will generally be due to removal of surface cover (soil), and excavation and filling. This will include the site of construction and any related borrow and/or spoil areas. There may be changes in the topography, the runoff coefficient, and rainfall infiltration rate.

The major impacts often occur during construction as a result of dust, erosion, and sedimentation. Many states have regulations which require that prior to construction the owner or his contractor submit erosion control plans which specify protective measures to be taken, such as use of settling basins or bales of hay to act as filters. If such plans exist, they should be described since they serve to reduce the potential impacts. The actual impacts can seldom be quantified; at best one can only say that some erosion may occur, depending on the nature of rainfall during the construction period. Measures to be taken after construction to restore the surface of the ground, such as fertilizing and reseeding, should also be mentioned.

If the action involves solid waste landfill, the impacts can be discussed as part of the change to the terrestrial regime, or in connection with the human environment. However, the impact on land use in general (i.e., removal of farm land for a new runway) should be reserved for the section on land use.

Impacts on mineral resources should be checked. One of the most common is sand and gravel, yet suitable supplies are becoming increasingly scarce in some parts of the country, especially in the vicinity of metropolitan areas. If a single building or a pipeline or roadway crosses an area with good sand or gravel, it makes it difficult to later mine the resource. This also applies to quarrying operations.

b. Atmospheric Regime

(1) Noise

(a) Introduction

The impacts due to noise should be evaluated and reported separately for the non-aircraft noise sources and for aircraft noise using the AICUZ concept.

(b) Non-Aircraft Noise Sources

The effort, procedures, and format to be followed in writing this impact section essentially is similar to that for describing the existing noise environment except that the new conditions brought about by the proposed action are included. While the data for the existing conditions are being collected, it is important to realize that some of the elements of the data for the impacts can be collected at the same time. These elements, in general, are those parallel pieces of information that apply to the future time of the action. For example, the agency responsible for maintaining the population distribution data for the present is also concerned with estimations for growth and future populations as part of their planning function.

It is important to note that the changes enumerated or comparisons made in describing the impact must have the same basis. For instance, the number of people subjected to a given noise level as a result of the action, compared to the number of people subjected to the same noise level in the absence of the action, must be made for the popululion distribution projected for the same time period (i.e., the date of the start of the action). Thus, the comparison will exclude or separate out the growth rate effects from the impact effects--a necessary distinction in order to arrive at a fair impact assessment. Using this criteria, it may be found that the impact is due to growth only.

- Vehicular Traffic

With the new traffic data that are to be a result of the proposed action, a word description of the new traffic conditions should be presented and, if appropriate, related to another copy of the identical map shown previously. The results of calculations of the new noise levels at the same locations previously described should be shown on the map and/or in tables. In addition, a table of comparisons with present conditions should be given. Alternately, the results might be a table showing the increases in levels rather than a comparison of absolute levels. By using these tables and the appropriate criteria of References 6, 7, and/or 8, a statement of the impact can be given.

- Construction

It is necessary to describe the construction not in terms of the cost or actual structures to be built, but in terms of duration, level of activity (numbers of which pieces of equipment to be used), and the relationship, if any, to the local traffic. With this time-line description and the aid of Reference 11, the noise levels at significant locations can be calculated. The form of the presentation of these results depends upon the specific situation. Generally a table of levels versus duration for each location is sufficient. If the construction is located in a highly populated area, a map giving contour levels and number of people exposed might be required.

Because people perceive construction noises as a necessary adjunct to a new facility or activity, the noises are suffered with the knowledge the situation will soon change for the better. Such a noise description, however, has some advantages. If a particular location, such as a school or hospital, can be seriously affected according to the criteria of References 7 and 8, the result might be a purposeful rearranging of the construction schedule or a time-of-day limitation to reduce the impact to a minimum.

- Other Noise Sources

The presentation in this section follows the general treatment given for the preceding sections. Any new or more noise sources that will increase the noise levels or the increased area and population exposed to the noise levels should be described. Calculation of new noise levels compared with existing noise levels, with the change in area or people involved, should be presented in an appropriate form.

Comparisons of the results with the criteria of References 7, 8, or 9 or compliance with local noise ordinances will serve as a description of the impact.

(c) Aircraft Noise (AICUZ)

The basic methodology used to develop AICUZ information and the impact on land use categories for an existing schedule of aircraft operating in a prescribed manner has been outlined in subsection VI.2.b(1)(c). A similar process would be followed to determine the AICUZ information and the impact on various land use categories for a proposed action such as change in the mission of the air base. The significant impact of the proposed action is then determined by comparing the tabulations of the AICUZ impact measures for the existing situation and for the proposed action. If the proposed action is a significant one, in the sense, for example, that the basic mission of the air base is involved, or the number of flight operations change by a large amount, or a wing of a new type of aircraft is bedded down, then the changes in the impact measures would generally be expected to be significant.

(2) Air Quality

(a) Analysis Methodology

Analysis of the air quality impact of a proposed action at an Air Force facility involves the same procedures which were described earlier for the analysis of the present impact of the facility. The principal difference is the investigator is concerned with activities at the facility as they are expected to occur at some future time as well as current activities. The objective of his analysis is to determine the change in the air quality at the facility which will accompany the change in facility activities.

In this section the additional requirements of an air quality impact analysis for a proposed action are discussed, assuming the air quality analysis for current facility activities has already been completed or will be completed in accordance with the guidelines discussed earlier. The additional requirements discussed here are on-base emission inventory changes and impact analysis of the changed emissions.

(b) On-Base Emission Inventory Changes

• Introduction

Anything that alters, adds, or deletes an air pollutant source on the base as a result of the proposed action must be accounted for in the emission inventory. Likewise, those changes that are related with and parallel to the action (such as the change in automobile air pollutant emission indices) within the time period of interest should be included. Those changes that are simply in the wind, indefinite, or completely unrelated to the action should not be included.

The purpose of the impact statement is to evaluate the effect of the proposed action on the present environment. To include unrelated changes that are not part of the action under study would cloud the issue.

The following sections will outline those sources that are affected by changes in various base activities. The list is not intended to be complete, as a list of the different impacts of various changes would be endless. These sections are offered as a guide only. The reader is encouraged to view this as a starting point. The rigorous use of one's imagination and common sense is necessary to complete the list of sources uniquely affected by each different action.

• Aircraft Activity Change

Emission sources that vary with aircraft activity are the aircraft, the aerospace ground equipment (AGE), engine maintenance operations, aircraft refueling activities, and the vapor losses from the aircraft fuel storage tanks. AGE emissions occur as a result of the operation of the various aircraft service vehicles required to make an aircraft ready for its next flight. This includes such things as fossil fuel-powered tow trucks, air compressors, and electric generators. Engine maintenance operations include test cell and run-up stand emissions required to service the aircraft in question. Refueling activities include the net change in fuel throughput for the entire fuel system and not just the change in refueling procedures or tank truck usage. If there is a change in the number of fighter aircraft, there will be a significant change in the number of fuel spills.

- Base Work Force Change

A change in the base population, both military and civilian, will primarily affect the motor vehicle emissions and volume of fuel sold by the base exchange. A change in civilian personnel will show up as a change in traffic between the major parking areas and the main gates. A military personnel change will alter traffic between the base gates and new on-base family housing, between the base gates and work areas, and between new family housing and work areas.

If the average number of people occupying each motor vehicle is not expected to change, the annual motor vehicle mileage and base exchange fuel sales can be adequately handled by assuming that these are directly proportional to the base population.

In calculating emissions from the motor vehicles operating at the end point of the study, use the emission indices for vehicles of that time rather than for those at the beginning of the study period. The change in emission indices usually parallels and is related to the action and should be included.

- New Construction or Demolition of Existing Structures

Any change in the base facilities produces a corresponding change in the base heating and/or cooling load. If the heating and cooling systems are powered from the base as opposed to being run on purchased utilities, a net change in the pollutant emissions from these on-base sources will result.

Here a word of caution is in order. Many times the combined heating and cooling emissions are a very small percentage of the total base emissions. Further, the proposed changes are usually a very small fraction of the total heating or cooling load. It may even be the net change in load will result in a change in energy consumption that is smaller than the seasonal variations in fuel usage. Therefore, while these changes should be considered, it may be their effect will not be significant with respect to the order of magnitude of the current base heating/cooling emissions and/or the total of the base emissions. If this is the case, it should be so stated, while the estimated heating and cooling emission remains unchanged.

(c) Air Quality Impact Analysis

A qualitative analysis of the area impact of the changed emissions from the facility can be accomplished by comparing the anticipated changes in emissions from the facility with the total emissions from the surrounding area which is used as a reference area. An example of such a comparison is shown in Table 19. As indicated in the table, the anticipated changes in emissions associated with the action include increases in three pollutant emission rates and decreases in the rates of emission of two other pollutants. The most significant change is a 117 percent increase in NO_x emissions at the facility, which represents a 5.3 percent increase in NO_x emissions for reference area. If the investigator has a good appraisal of the air quality condition in the reference area, he can make a judgment as to the true impact of such an increase in emissions. For example, if recent air quality data indicate that NO_x concentrations in the reference area are approximately 50 percent of the exposure limits specified by air quality regulations, then a 5 percent increase in area NO_x emissions can be judged to be non-adverse. However, if no basis exists for assessing the area impact in some definitive manner, it is best to refrain from making any judgment or to seek an appraisal of the area impact from the regional air pollution control agency.

The local impact of the changed emissions from the base can be analyzed in exactly the same manner as described earlier for analysis of local impact of current emissions from the facility. The emission densities for the facility, as they are predicted for the period following the proposed action, can be compared with emission densities for other areas near the facility for which emission density and air quality data are available. The comparison derived in this manner for Langley AFB for an action to be completed in 1977 is shown in Table 20. As shown in the table, the emission densities at the facility after the action is completed are expected to be comparable to emission densities in the less congested portions of the surrounding cities (Zone II) except for NO_x emissions. The NO_x emission density is expected to be comparable to the density presently existing in the congested portion of the environs (Zone I). In this example, the air quality in the base environs is within existing regulations so it can be deduced that the average air quality at the base also will be within regulatory limits in 1977 when the action is completed. If the projected emission densities were found to be higher than those for the base environs, a quantitative analysis would have been required.

TABLE 19. ANTICIPATED CONTRIBUTION OF LANGLEY AFB TO HAMPTON-NEWPORT NEWS AREA AIR POLLUTANT EMISSIONS IN 1977

Source	CO	HC	NO_x	SO_x	Part
All area sources (including Langley AFB) 1974 10^6 kg/yr*	131	25.5	11.8	4.41	4.37
LAFB Emissions Percent of total 1974	2.34	3.3	4.5	3.5	3.4
LAFB Emissions Percent of total 1977	2.4	2.9	9.9	3.6	2.7
Percent change in LAFB emissions 1974-1977	+2.6	-13	+117	+3.9	-20
Percent change in area emissions 1974-1977*,**	+0.06	-0.44	+5.3	+0.14	-0.66

* Assuming 1970 area source emissions are held constant throughout the 1970-1977 period.

** Based on a record of 1970 emissions in the Hampton-Newport News area and 1974 and 1977 Langley AFB emissions and projected changes.

TABLE 20. ANTICIPATED EMISSION DENSITIES AT LANGLEY AFB AND IN THE HAMPTON-NEWPORT NEWS REGION IN 1977

Zone	Area (Km^2)	Emission Density (10^3 kg/km^2 - yr) CO	HC	NO_x	SO_x	Part
Langley AFB* (1977)	14	136	40	68	11.0	8.0
Zone I (1970)	100	784	153	71	26.5	26.2
Zone II (1970)	220	238	46	22	8.0	7.9
Zones I & II (1970)	320	408	80	37	13.8	13.7

* Based on emissions from ground operations only.

In the procedures described above, changed emissions in the facility are compared with current emissions in the facility environs. It might seem preferable to compare anticipated facility emissions with emissions anticipated for the environs during the same time period. However, emission projections for urban areas are not generally available and development of such projections is not considered to be within the scope of the requirements of the impact assessment for the facility.

(3) Radiation

If radioactive materials are among the objects included in the action, this activity should be identified as a potential impact. The effect of the radiation on the environment will probably be negligible, since the use of radioactive materials is highly regulated to prevent excess exposure. Note that some radar tubes contain radioactive materials, which present a potential solid waste disposal problem. Disposal of such tubes should be according to regulations. Nuclear physics and radiation safety are highly specialized fields, and it is recommended that a qualified radiation expert be consulted if radioactive materials are involved.

Electromagnetic radiation can produce a variety of impacts, or they may be involved in a secondary sense. Electrical equipment can cause interference to radio reception. Ground connections can cause corrosion if a cathode/anode effect is induced. Microwave beams from radar antennas may cause arcing in nearby structures, and radio transmitters can induce currents in blasting wires. X-ray machines or sources must be properly marked and shielded.

However, the most common impact is due to new sources of visible light, primarily illumination for parking lots or other areas which are well lighted for night operations. Such light radiating into residential areas may be objectionable, particularly if it continues all night. The stray light can often be reduced by proper placement and aiming of floodlights and by the use of reflectors which limit the radiation to the immediate ground areas.

The light from automobile headlights may also create an impact in some locations such as "T" intersections, depending on what is located opposite the intersecting road. If bright-colored lights are involved, they should not be located near a signal or warning lights (i.e., traffic lights) which may become less noticeable.

c. Hydrologic Regime

It is unlikely any action would cause a significant impact to precipitation in an area. However, emissions of moist air (i.e., from a cooling tower) could affect the micro-climate by creating vapor clouds. These, in turn, could create fog hazards or ice in winter.

The most likely impact on the hydrologic cycle comes from grading, filling and paving operations, with the result that surface runoff increases and the time of concentration decreases. The time of concentration is the time required for the runoff from the upper end of a small watershed to reach a discharge point. It decreases as ditches and culverts are installed, thus leading to more peaked storm hydrographs with the possibility of causing localized flooding. Grading is normally done with sloping for drainage and is always done in the case of runways, roads, parking areas, and roofs. Since these areas are impermeable, the runoff ratio increases, again contributing to localized flooding. This impact can be reduced by use of retention basins having restricted discharge openings or which contribute to infiltration to groundwater.

Paved areas are also subject to a buildup of grease and oil films and fuel oil or gasoline spills. Man-holes and catch basins can be designed with oil traps to reduce the likelihood the oil will eventually reach a stream or other surface water body. Contamination of groundwater as a result of leakage from underground or above ground storage tanks or from pipelines is also a potential impact and one which is very difficult to clean up after the leakage has occurred.

Contamination of groundwater in particular, and surface water to some extent, can occur as a result of leaching from dumps and land fills. These impacts are studied when the area is designed, and the design engineer should be consulted to obtain estimates of the impact from the leachate.

If the action involves additional water supply of any substantial amount, whether drawn from reservoirs or wells, the ability of the supply system to furnish the additional supply must be discussed. Note that the additional withdrawal may not cause a shortage during most years, but it may reduce the safe yield of the system. Thus, shortages may be experienced once in ten years instead of once in twenty years. Or the groundwater table may be lowered as a result of mining of the groundwater. This could cause other wells in the area to run dry; thus, it would require they be deepened, higher head pumps be installed, and more energy be used to pump the water. Additional withdrawals can also cause pressure drops to existing users if supply mains are of inadequate size.

The impacts as a result of additional wastewater flows must also be examined. If combined sanitary and storm sewers are involved, they should be separated for new construction if only to make a start at establishing such a system. The ability of sewage treatment plants to handle additional loads should also be discussed.

3. BIOTIC ENVIRONMENT

The potential impacts to the biotic environment can be described by noting the change in the existing physical environment as it affects the existing flora and fauna, the expected change in the habitats and ecological relations, and the estimated change in the populations of existing species in the area including any rare or endangered species.

Physical changes usually involve the construction of facilities with the result that some number of acres of fields or woods may be used. This number should be identified as a function of the land forms involved, together with an estimate of how much of similar land forms in the area the action involves. For example, removing a few acres of woods from an area that is generally forested would result in only a small percent change in this land form, and the impact on local flora and fauna would not be significant. However, removal of existing woods in an area with little forest cover could effectively eliminate any wildlife that depended on the presence of the woods.

The aquatic environment is more limited than the terrestrial environment; as a result, any changes to surface water bodies, particularly swamps and wetlands, is likely to have a significant impact. In addition to fish and animals using water bodies (i.e., beaver), surface water is used by waterfowl (ducks, geese) during migration.

Some areas may not have a large wildlife population but are nevertheless important as game trails or as waterholes. Barriers to such locations (i.e., a fence) could have significant impacts to the wildlife. Similarly, the removal of protective cover such as brush can eliminate an essential part of the habitat of many species.

It is difficult to estimate the population changes that will occur as a result of an action. This is usually estimated to vary directly with the change in land form, assuming each land form contains a standard population of wildlife it can support. Environmental biologists and fish and game wardens can be helpful in estimating standard populations in various parts of the country.

Many military installations contain unused land in the form of buffer zones that form very beneficial areas for wildlife. This is particularly true of restricted areas, such as around ammunition depots and target or test ranges. It has been observed that much wildlife adapts to new sounds, such as low flying aircraft, and seem to ignore them (yet they will fly away if an occasional vehicle passes through the area). The presence of such unused land should be listed as a beneficial impact.

Some actions can cause adverse impacts by attracting wildlife. The most common example is birds in the vicinity of runways. Seagulls can be a particular hazard. They will be attracted to food sources, such as dumps or even sanitary landfills. These areas may also sustain rat populations with the attendant risk of spreading disease.

Training operations at target ranges can cause secondary impacts to the biotic regime as a result of forest fires which may be accidentally started. If such impacts are likely, the preventive and protective measures which have been established should be described.

Of all the impacts to the biotic regime, the one of primary concern to reviewers of impact statements is the impact on rare or endangered species. If such species were identified in the description of the existing environment, a discussion must be included on the potential impact to them as a result of the action. Any special measures mitigating the impact should be described.

4. HUMAN ENVIRONMENT

This is the most likely area of impacts in connection with Air Force actions, particularly if the action is confined to an existing installation. Each of the ten potential areas of human activities which were described as part of the existing human environment should be examined and discussed. If there are no significant impacts to a particular area, this finding should also be reported.

a. Demography and Political Setting

This discussion should include any implications of the proposed action for the impacted area in terms of population and general character. Military and civilian manpower changes at the base should be discussed (including dependents), as well as other temporary or permanent population shifts that might result, such as construction personnel or other contractors to be located at the base.

Where numbers of personnel involved (either increasing or decreasing) are large relative to the present area population, consideration should be given to any possible secondary effects on the area population and growth. For example, a doubling of military and civilian personnel at an air base located in a predominantly rural area might result in a significant influx of other civilian personnel to provide commercial services and facilities (housing, schools, etc.) for the increased base population; ultimately accompanying such a population rise would be increased development in the area, representing a change from the presently rural nature of the community.

The major question to be answered in this discussion is simply whether any population changes associated with the proposed action will have any discernible or significant effects on the size, density, or characteristics of the present population of the study area.

b. Land Use

The background section on land use (subsection VI.4.b) presented the kinds of impacts which various Air Force actions might produce. It has also presented a thorough review of base line conditions existing under the current situation, and those influences which have historically affected land use and are projected to influence its future use. Within this context, the environmental officer must place the air base's proposed action. A thorough review of the base line conditions presented in the background section should enable the environmental officer to reasonably assess land use impacts. In describing impacts the officer should be as quantitative as possible. Table 21 presents a listing of the kinds of information which should be quantified. If the air base has implemented AICUZ, much of this information may be available from this process.

c. Plans for Future Land Use and Development

Assuming future land use and development plans were identified and described in subsection VI.4.c, it becomes a matter of judgment to identify possible impacts to such plans as a result of the proposed action.

Direct impacts are those which conflict with established long-range plans or zoning ordinances (i.e., if a variance is required). Indirect impacts are usually more difficult to identify, particularly if they establish a precedent. These include actions which are new or are located in an area for the first time but which may establish a trend or serve as justification for continuing the action. For example, the location of family housing units in an undeveloped area could lead to additional future units as well as supporting facilities (i.e., schools) and expanded infrastructure (i.e., roads, utilities). While the impacts from the initial action may not be significant, consideration must be given to consequential actions.

The impacts on future land use and development are most likely to occur to land located off-base, and for this reason it is essential to become familiar with municipal and state land use plans. Proposed private developments may also be affected, particularly housing developments, institutional facilities, or recreational facilities. The potential impacts can occur as a result of air traffic patterns, highway traffic from the base, or simply an expanded population living close to the base.

TABLE 21. LAND USE IMPACTS

Possible Impacts	Description of Impact
Increased land exposed to noise pollution and accidents	Total amount of acreage impacted Acreage impacted by existing land uses and proposed land use as prescribed by zoning ordinances and land use plans. Extent to which land uses in impacted areas are incompatible with increased exposure to increased noise and accidents. Possible consequences of restrictive zoning on the basis of AICUZ or lessened attractiveness of exposed areas for certain types of development. Possible consequences include: • decrease in an area's marketability • shifting patterns of community development • reduction in a community's land resources previously available for institutional, commercial and other uses • decrease in local revenues as a result of: - decrease in land development - rezoning for uses more compatible with Air Force actions, e.g., open space, recreation, agriculture or low density residences.
Base Personnel	Housing preferences of current base personnel; identify communities where base personnel may live and subsequent new demand for land resources, e.g., housing, recreational and institutional purposes. Based on the above, the increase in public services necessary to serve additional base personnel.

A substantial effort should be made when preparing the environmental statement to identify these impacts, since the adjacent land owners and users will be extremely interested in the impacts to their properties, and they are entitled to have such evaluations when they review the draft environmental statement. Failure to provide complete and fair discussion in this document can result in criticism that the draft environmental statement was incomplete, with a request for a resubmittal or extended review time. Furthermore, there has been increased legislative interest in land use planning at both the federal and state levels, and it can be expected this aspect of environmental analysis will become increasingly important in future years if and when new land use laws are passed.

d. Economy

Direct economic impacts of the proposed action are generally related to:

- Changes in military and civilian payroll at the base.
- Changes in expenditures by the base for goods and services.
- Anticipated expenditures for construction related to the action.

Insofar as is possible, these economic impacts should be presented in terms of dollar amounts (at least approximations) and employment (military, USAF civilian, and civilian jobs), with the emphasis on the anticipated increases or declines for the local economy.

Precise information concerning net base personnel changes at the base as a result of the action is usually available. If exact military rank and GS ratings of the individuals involved are known, it may be possible to calculate the exact net payroll change (excluding pay increases over an extended implementation period). In many cases, however, an approximation, as in the following example for Langley AFB, will be the best possible estimate:

> "Over the implementation period of the F-15 beddown, an estimated 9 percent reduction in personnel is projected for Langley AFB. This reduction will result in a proportionate reduction in the base payroll. The present average annual pay for military and USAF civilian personnel is $11,055; this average multiplied by the anticipated net decrease in personnel (975) yields $10,778,625. Of this decrease, approximately one-half (539 personnel, $5,958,645 payroll) is directly attributable to the proposed beddown of the F-15 TFW. The remainder, 436 personnel and payroll of $4,819,980, will result from other changes programmed for the commands at Langley. It should be noted that the 9 percent reduction in personnel is nearly three times the overall decrease (3.3 percent) in federal government employment projected for the Virginia Peninsula by 1980."

In estimating changes in expenditures by the base for goods and services, the Procurement Office may have some insight into specific types of purchases that would be increased or decreased as a result of the action. Where specific changes can be identified, the impact on the local economy should also be estimated. For example, if an overall decrease of 10 percent in base purchases is anticipated, an estimate of the decrease in local purchases can be made on the basis of current experience with procurements (i.e., the percentage of all current procurements spent in the local economy).

Similarly, estimates of construction expenditures in the local economy can be made on the basis of past experience with procurements, as in the following example:

> "The proposed beddown of the F-15 aircraft at Langley will have its greatest impact on the area economy during the related construction activity. Facilities renovation and new construction related to the F-15 will total $1,166,500 and $6,085,200, respectively. Past experience with procurements indicates that approximately 90 percent of the total ($6,526,530) will be spent in the region. Similarly, direct local contracts in Newport News and Hampton would result in estimated local expenditures of $950,000. Through subcontracts to local firms these expenditures are expected to be increased significantly."

Secondary economic effects of the action, although less easily quantified, should nevertheless be mentioned. Large base personnel changes, by influencing the expenditures by base personnel in the local economy, will impact local commercial and service activity. Similarly, increased or reduced demand for housing or schools may be significant enough to be apparent in the local housing market or school enrollments, respectively. When new or expanded requirements for community services (such as roads, sewers, water supply, schools, or hospitals) will require expenditures by the community to provide the necessary services--both to the base population itself and to the off-base population increasing directly or indirectly as a result of the action--the costs to the community and method of funding, including federal or state assistance, should be explored.

For actions involving land acquisition by the federal government, removal of large land areas from the local tax base can have significant economic consequences for the community. Another related issue concerns the economic costs and benefits to the community of land use by the Air Force versus alternative uses of the land (e.g., agricultural or development potential).

If aircraft operations are involved and the AICUZ analysis indicates a change in land area within the CUD zones, the development potential of the land may have also changed in light of the AICUZ land-use compatibility criteria. For the landowners and ultimately the community as a whole, the economic impact of the increased or decreased development possibilities can be substantial. One immediate economic effect is the unavailability of federally-insured mortgages for certain kinds of residential development in areas exposed to noise in excess of standards established by the U.S. Department of Housing and Urban Development (HUD Circular 1390.2, August 1971). Where appropriate to the proposed action, these issues should be discussed as quantitatively as possible. At the very least, they must be mentioned.

e. Housing

Most actions involving net personnel increases or decreases at an air base will affect off-base housing requirements for base personnel. Such a change should be discussed in terms of housing availability as indicated by vacancy/occupancy data, building starts, the most recent Family Housing Survey by the base Housing Referral Office, or even the opinion of the Housing Referral Officer. Consideration should also be given to current off-base residence patterns of base personnel; usually the effects of increased or decreased housing requirements will be concentrated in these areas. Obviously any additional housing under military control to be available for military personnel should be considered, whether or not the construction of the housing is directly related to the proposed action. The following paragraph concerning Langley AFB is given as an example:

> "During the implementation period for the proposed F-15 beddown, a 9 percent reduction in the work force at the base will occur. Coincidentally, the completion of 500 additional military housing units (unrelated to the F-15 beddown) will result in a reduction in off-base housing requirements for military personnel. The major impact on the community resulting from this change will be an increased concentration of Langley dependents in the York County schools; the estimated 935 dependents do represent a significant (11 percent) increase, and a new school is being planned."

Since many major actions by the Air Force involve aircraft operations, another type of impact on housing can be change in land area and housing units exposed to the noise and accident hazard of aircraft operations. Although the bulk of this analysis is given in the sections of the environmental statement devoted to AICUZ, mention should be made here of residential areas to be exposed to incompatible levels of noise and accident hazard by the proposed action.

f. Public Facilities

The effects of the proposed action on requirements for public services such as schools and hospitals should be explored. Where an increased demand will occur, the ability of existing services to absorb this increase should be assessed. (Usually the opinions of local school superintendents and health planners or the base hospital personnel are the best sources of this assessment.) If currently available services are inadequate to meet the demand, the costs to the community of expanding services should be described. A common example is the requirement for new school construction to accommodate military dependents in new or expanded on-base family housing.

If the proposed action will decrease drastically the requirement for services, schools in particular (e.g., if a base is to be closed altogether), and educational facilities built for USAF dependents could experience a drastic decline in enrollment, this could have a significant and costly impact on the affected school system.

As discussed in the previous section, public facilities such as schools and hospitals can be exposed to incompatible levels of noise and accident hazard exposure as the result of actions involving aircraft operations. Any such facilities in affected areas according to the AICUZ analysis should also be mentioned here.

g. Cultural Resources

This discussion must include both direct and indirect impacts to known cultural resources; as directed by the Department of the Interior, this analysis should be "based upon the information provided by persons professionally experienced in investigating cultural values." (Reference 27.) Conditions creating adverse impacts are not limited to direct physical alteration, but include:

- "destruction or alteration of all or part of a property
- isolation from or alteration of its surrounding environment
- introduction of physical, visual, audible, or atmospheric elements that are out of character with the resource and its setting."[27]

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27 U.S. Department of the Interior. Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archaeological, Architectural) Resources. Washington, D.C.: National Park Service, April 1974.

In assessing the possible direct impacts of construction, it is often useful to locate known historic sites and proposed areas of construction activity. All known changes in the environment (increased air pollutant emissions or noise expsoure, etc.) as developed in other sections of the environmental statement should be discussed as they might affect the cultural resources of the area. If the action involves significant changes in land use or in the social and economic character of the area, indirect influences of these changes on cultural resources should also be considered. "Adverse secondary effects, from impacts on existing community facilities and activities, from new facilities and activities, or from changes of natural conditions, may often be more substantial than the primary or direct, effects of the proposed action."[27]

Measures to minimize any adverse impacts (such as precautions taken during construction) should be developed and described. If destruction of cultural resources is unavoidable, the statement should "explain intended measures to recover archaeological, historical, architectural, ethnological, or other cultural data."[27] Any such measures should be developed in cooperation with state or designated local historic preservation officials. Further, "An environmental statement should describe any unavoidable adverse effects an undertaking may have on cultural resources. Destruction or alteration of cultural resources, and consequent reduction of opportunities for future research or preservation, constitutes an irreversible and irretrievable commitment."[27]

If a property listed in the National Register may be affected by the proposed action, special procedures must be followed (see 39 F.R. 3365, January 25, 1974). Similarly, procedures for a federally-owned property considered eligible for listing under Executive Order 11593 are contained in Section 2(b) of the Order.

If after consultation with the state liaison officer, it appears that cultural resources:

- listed or nominated for listing in the National Register
- eligible for listing following USAF survey of its federal property in compliance with Executive Order 11593
- recognized by state or local historic preservation authorities or groups

will not be affected by the action, this should be stated clearly.

h. Public Works Facilities

The impacts on public works facilities can take two forms: either existing facilities (water supply, water pollution control, solid waste collection, energy utilization) will have a changed demand level but will still be capable of providing the service; or new or additional facilities will have to be constructed. The action may include such new construction.

Adverse impacts can result if existing facilities are loaded beyond their capacity. The impacts should be reported as the total actual production of the facilities prior to the action, the estimated total production after the action, the percent increase or decrease, the design capacity of the facility, and the general effect on the facility as a result of the action. The production data should include input and output, including waste emissions to the land, air, and water regimes.

The direct demand for additional energy as a result of the action should be reported, both in terms of heat or work and in terms of fuel requirements. Indirect energy demand associated with an action is generally too complex to quantify, since it technically includes all energy associated in any way. Thus, if the action were the construction of a dormitory, one would have to consider the energy used to saw the lumber, manufacture the saw used to saw the lumber, refine the gasoline used to operate the saw, etc. However, some indirect energy impacts should be identified; for example, a dormitory using electric heat does not have its own furnace, but it does impose an additional load on the local generating plant.

If replacement public works facilities are involved in the action, there are generally several beneficial impacts since new equipment is probably more efficient and creates fewer polluting emissions. These beneficial impacts should be identified and quantified if possible.

Impacts to water supply systems and wastewater treatment systems were discussed in subsection VI.2.c, Hydrologic Regime. If they were not covered at that time, they should be discussed under this subsection.

i. Transportation

Transportation impacts are any significant changes in the demand, use or components of the transportation system as a result of the action. Because transportation systems are usually large and complex, it is assumed the potential impacts had been tentatively identified in order to describe the applicable components of the transportation system in subsection VI.4.i. The remaining problem is then to quantify the impacts in a reasonable manner.

Starting with the items being transported, the number of people-trips and/or passenger-miles can be estimated for before and after the action. This should be broken down on an origin/destination basis if possible: for commuting, business on-base, and other classifications. If this level of detail is not appropriate or simply not available, the net change in trips as a result of the action should be reported, as well as an estimate of what percent of the total such trips this represents.

Next, an estimate should be made of the types and numbers of carriers which will be involved as a result of the action. If these numbers involve any substantial increase, there may be some related secondary impacts, i.e., the need for additional gasoline stations or service centers.

Finally, identify the capacity of existing pathways to handle the increased traffic. (Air traffic is discussed separately in subsection VII.5.) Highway traffic is subject to jamming during commuter hours and at special locations, such as the gates and intersections of entrance roads to public highway systems. Increased traffic may suggest that new traffic control signals should be installed or that staggered starting and quitting times should be established. Indirect impacts could result as a result of drivers selecting new routes to avoid traffic. Thus, a quiet residential street may become a shortcut to an alternate route.

Some potential impacts are of a secondary (as opposed to indirect) nature. For example, will waiting stations at bus stops be adequate for increased patronage? Will new connecting sidewalks be constructed? Will parking racks be provided for those traveling by bicycle?

Indirect impacts are more difficult to identify. Increased noise and air pollution effects were discussed previously in connection with the impacts to the physical environment. In the transportation section, the indirect impacts to be considered include additional maintenance costs for carriers and pathways (e.g., more busses, more snowplows) and the change in energy (fuel) consumption. Note, however, if the action involves transfers of personnel, the effect on fuel consumption may not change at the national level, since the persons transferred were already using fuel at their original location.

j. Public Safety-Accident Prediction

The scope of ground and flight activities which present possible risks to public safety have been described under subsection VI.4.j. For the proposed action, an evaluation should be made of the changes in such activities associated with the proposed action, and of the associated changes in the risks to public safety presented by these changes.

New missions, for example, may well require changes in the quantities, types, or locations of fuels or ordnance. Different aircraft types or aircraft operational procedures may modify existing patterns of hazardous activities at the base. An evaluation of such changes and a comparison of the level of hazard and risks associated with them with the corresponding risks and hazard levels under the existing environment will allow an assessment of the net effects on public safety of the proposed action.

5. AIR TRAFFIC ENVIRONMENT

Each aircraft in the USAF has a prescribed training program associated with it. The program is called a syllabus until fully incorporated into the 55-XX series manuals. The program specifies the types, duration, and frequency of training missions. The impact on air traffic of adding a significant number of aircraft to a particular base can be evaluated by examining the following operations:

a. Tower Traffic

Some missions require more tower events per flight than others. For example, a tactical airlift squadron would practice a lot of VFR Touch and Goes or low landing approaches because of their requirement to fly in and out of very short landing strips.

If the tower is manned 24 hours per day, there would probably be no impact on tower personnel requirements. However, the introduction of an Air Defense Command (ADC) unit into a field that did not provide 24-hour service would increase the number of tower operating personnel required should the ADC unit have a 24-hour alert commitment. An additional impact of an ADC unit would be the increased frequency of practice IFR approaches--again because of training requirements.

Impact evaluation is assisted by breaking down tower events into categories:

- attributable to transient aircraft
- attributable to base operating units.

b. Regional and Area Traffic

The impact on required (Approach and Departure Control) and area (Air Route Traffic Control Center) traffic should be highly predictable. Since the regional and area offices keep good records of all traffic on a year-to-year basis, one needs only to obtain this information to make the predicted impact evaluation. It is important to ascertain what the traffic growth rate is and establish any potential saturation limitations. If there are other aerodromes located in the immediate vicinity or airfield under assessment, traffic patterns and procedures should be evaluated to determine compatibility with the new operation. For example, if the introduction of new or different aircraft resulted in the use of a preferential runway system, which of itself resulted in local traffic flow counter to or crossing the general area traffic, more frequent departure delays could result.

In 1963, military traffic accounted for approximately 40 percent of the total traffic handled by FAA ARTC Centers. By 1973, the proportion of military traffic to total had been reduced to approximately 15 percent. This trend is expected to continue. In any particular center area, the ratio may be considerably different. However, in general, the impact of the introduction of a wing of military aircraft into any particular area will be small when measured against air carrier, air taxi, and general aviation totals. Again the historical data on ARTCC operations is readily available.

c. Special Use Areas

The impact of the introduction of a wing of tactical aircraft on special use space may be substantial. Air-to-ground gunnery ranges are limited to certain parts of the country, and the acquisition of new ranges might prove to be very difficult. The designated using agency has the responsibility for scheduling range use. The using agency will generally have past as well as current information on use. Warning areas are used for Ground Controlled Intercepts and Air Combat Maneuvers. Where control of aircraft is maintained, as in the conduct if GCI's, the time/space availability question is of less importance than for the ACM mission where large blocks of clear space must be reserved.

Air-to-air refueling is conducted in air space which is reserved for a particular altitude/time block through FAA. Once in the block, aircraft separation is the responsibility of the military. There are a large number of tracks and orbits. There may occasionally be scheduling problems for a particular track. Space availability should not be a problem.

SECTION VIII

ALTERNATIVES TO THE PROPOSED ACTION

The alternatives section is required by regulation in any environmental statement. In many respects it is the most important part of an environmental study, and it is the only section in which alternate plans of action are examined. All other sections are oriented primarily to the planned action and its potential impacts on the environment.

Since several alternatives must be evaluated, each requiring a description of the alternate action and its impacts and cost, it is apparent each such evaluation becomes a miniature assessment in itself. The alternatives section can thus be one of the most extensive and complex sections in the entire report. It is also one which is most subject to criticism by reviewers, particularly those parties who are adversely affected by the action since they will be biased towards any alternate action which avoids impacting them or the cause they espouse.

The preparer of the alternatives section is therefore faced with a task of preparing a potentially lengthy and controversial section covering all of the environmental disciplines as well as costs and benefits, and yet keep the effort within some reasonable bounds. Furthermore, he may be writing about an action which involves high level strategic planning, the details of which he is unaware. In such cases, the selection of feasible alternatives is usually made at higher command levels, leaving only the respective impacts for preparation at field level.

In order to prepare the alternatives section, it is useful to examine the basis for actions, which is the recognition of a need or desire. The recognition may be spontaneous in someone's mind, it may be the result of a study or the evaluation of reports, or it may be that it simply supports some other more basic action. The extent to which the need is met is the benefit, which may be tangible (expressed in dollars) and/or intangible (i.e., aesthetic improvement).

Once the need has been defined, a series of steps takes place, each involving studies, reports, evaluations, approvals, and actions until the objective has been accomplished and the need has been satisfied. The steps involved are planning, design, construction or preparation and operation or execution. The planning step is of particular interest since it represents the time that environmental statements are prepared, and it is the time when alternatives are examined in detail.

Planners have traditionally been subject to three basic constraints in developing a method for meeting the need: (1) technical feasibility, (2) cost, and (3) institutional (i.e., laws and regulations). The measure of technical feasibility is performance, while dollars measure cost (both capital and operational, which can be reduced to an annual amount). The objective of planners is to maximize benefits and performance and to minimize cost and, of course, to remain within existing or anticipated institutional constraints.

Planners have also used other criteria, such as aesthetic, cultural, and environmental considerations, but until the advent of NEPA these were of secondary concern. As a result of NEPA, planners now have a fourth basic constraint which is to examine the environmental impacts of their various plans. The measure of this examination is reported in the environmental statement and particularly in the alternatives section. In essence, the law requires that when an action is planned, the environmental impacts must be weighed against benefits and costs, and that plans which cost more or provide fewer benefits may be more socially acceptable if they involve fewer adverse environmental impacts. This includes the alternative of taking no action and the alternative of postponing the action pending further study.

The first step in examining alternatives is, therefore, to examine the basic need or desire which initiated the study. Are there other ways in which this need could be met? How important is it to meet this need? For example, the action may involve the construction of a new power plant or additional generating capacity to meet the demand expected from new family housing heated by electricity. The basic need is heat. Could it be supplied by decentralized furnaces in each home burning gas or oil, could additional insulation reduce the energy required, or would the existing plant have enough capacity if other peaking demands were shifted? Could a central steam plant and distribution system be used? Or, could people use cooler homes and wear more clothing?

In many cases, there may be few if any viable alternatives for meeting the basic need; nevertheless, there should be a general discussion in which the need is identified and some possible alternatives are examined even though they are technically poor or unreasonably costly. The discussion should serve to show that the author did start his examination of alternatives at the beginning of the action producing line of events.

Once it has been shown that the proposed basic action is reasonable (e.g., providing additional electrical energy), it is necessary to examine the alternatives which are associated with the design step. Plant location, choice of fuel, cooling methods, stack emission controls, even architectural treatment, are some typical alternatives, each of which could result in different environmental impacts.

Finally, the alternatives associated with the operations step must be examined. The method of operation is an important variable in many systems, and the environmental impacts can be quite different under various operating methods. For example, the landing and take-off paths of aircraft could be changed to reduce noise impacts to residential areas surrounding an airport.

Evidently, the number of alternatives associated with an action will increase geometrically as one examines the ways in which the basic need could be met, and the designs, the locations, and the methods of operation associated with each. While all of these can be itemized in the text, only the alternatives which are technically feasible and within a reasonable cost range should be investigated in more detail. For these plans, the respective impacts should be described, particularly those impacts which differ from the proposed plan. At the same time, the difference in costs and benefits should be described and quantified to the extent it is reasonably possible. The object is to provide enough data and information for an impartial reviewer to reach his own conclusions as to the merits of the proposed plan relative to those of the alternatives. Since it must be assumed the planners incorporated environmental constraints when the proposed action was defined, the alternative section will serve to support their line of reasoning.

The alternatives of taking no action or of postponing the action must be included with the alternatives which are evaluated. Failure to do so would be an error of omission, and the report would only be returned for completion.

SECTION IX

OTHER CONTENT MATERIAL

In addition to the subjects which have been discussed in previous sections, the environmental statement must include certain additional topics as described in AFR 19-2, attachment 2. In general, these sections are not lengthy, and they reflect much of the material developed in the first part of the environmental statement. They thus serve as required discussion pieces in which selected topics can be examined and some important environmental concepts can be discussed as they relate to the proposed action. The contents of each of these sections are discussed below.

1. PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED

This subsection concerns adverse impacts which cannot be avoided should the proposal be implemented. Since all impacts, good or bad, were listed in the subsection "Probable Impact of the Proposed Action on the Environment," it would seem that this section is only a subset listing and a redundant one at that. It is, in fact, a summary of the adverse impacts, but it also comes after the section on alternatives. As such, it serves as a final declaration of the planner of the adverse impacts which he feels cannot be avoided by means of additional cost or reduction in benefits or selection of an alternative plan. The subsection thus represents the environmental cost which must be paid to satisfy the need.

In some cases, certain mitigating actions will be taken to reduce the magnitude of the adverse impacts, and these should also be described. Note that a mitigating action is one which is separate from the basic action and not simply a reduction of the basic impact. For example, the construction of a new fossil fueled power plant would add air pollutants. These may be reduced by stack emission control devices, but some effluents will still escape to the atmosphere. If it were decided to deactivate an incinerator in favor of sanitary landfill in conjunction with the power plant construction, this would serve as a mitigating action in connection with the air quality impacts.

Another example of a mitigating action would involve the taking of a playground for new construction. The original playground would be lost, but if a new one were constructed in the vicinity, it would serve to mitigate the loss of the original playground.

This section should be kept brief. Do not include pages of material which was covered in previous sections of the report.

2. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

This is another of the short discussion pieces addressing an important aspect of environmental philosophy. It applies to the principle that we, the people living today, are the custodians of the environment for future generations, and we must not destroy or use up the environment for our own benefit at the expense of future generations, nor take undue actions which foreclose future options.

The discussion in this section should show how the proposed action involves trade-offs between short-term environmental gains at the expense of long-term losses, or vice versa. For example, the disposal of hazardous or toxic wastes in landfills or shallow wells may solve an immediate disposal problem, but it may also preclude the local use of groundwater for centuries to come if it becomes contaminated.

Short-term and long-term do not refer to any specific time period, but rather to time periods which are environmentally significant in terms of the proposed action. If the action involves a one-time training exercise on a piece of land, the short-term may be a few months and the long-term may be a few years. If the action involves the construction of a new highway, the short-term impacts may occur for decades while the long-term impacts could go on for centuries since the highway may cause new businesses and communities to become established.

One way to obtain a feeling for these impacts is to examine problems of our present environment relating to actions taken many years ago. For example, we lack recreational areas near cities because suburbs simply grew, particularly along coastlines where seashore land was limited. Choice farmland was used for construction and is no longer available for crop production. Raw sewage was discharged into streams, with the result that the bottoms became filled with sludge and lakes were subject to eutrophication. Highways and streets were constructed too narrow, with the result that traffic is now jammed yet the roads cannot be widened due to buildings.

Short-term and long-term impacts can also be viewed in terms of initial construction cost versus long-term maintenance and operating costs. For example, an inexpensive foundation for a highway may reduce its initial cost and place it in operation sooner, but it may be perpetually difficult and expensive to maintain. Similarly, a building with minimal insulation will cost less to construct, but it will forever require more energy for heating and cooling.

The foreclosing of future options depends on the magnitude of the action and the cost to modify any errors. For example, the construction of a highway bridge over, or a tunnel under, a navigable river will have a long-term impact on the size of vessels which can use the river, both because of vessel height restrictions and because dredging depths will be limited. Similarly, the construction of tall buildings or towers may limit the approach path of aircraft to airports. Conversely, the location of an airport near a city may limit the height to which buildings can be constructed.

Of course, actions involving structures can be reversed or modified in the future by demolition and removal if this is deemed necessary. However, actions which involve the consumption of energy or resources, or the distribution of resources or waste products in the environment are difficult if not impossible to reverse. As a result, any measures involving energy conservation, recycling of resources, and proper treatment of waste products should be noted as actions taken to provide long-term benefits.

3. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

In order for an action to take place, a variety of resources must be committed. These resources may include the use of land, the consumption of energy, the use of vegetable and mineral materials, and the use of labor. Some of these resources may be irreversibly and irretrievably committed, and these must be described in this section of the report.

The use of land may mean existing above ground or underground features will be destroyed, including prior works of man such as historic sites or areas of cultural or archaeological interest. It may also mean that areas of natural interest may be destroyed, such as virgin forests, waterfalls, or other areas of scenic beauty.

The use of energy resources are irretrievable if they involve fossil fuels. However, energy may be used whether or not the action is implemented; that is, if it is not used in connection with the action, it may be used in other existing or continuing actions which would serve as a substitute means for meeting the need.

Material resources may be committed to an action, but not in an irreversible manner if salvage and recycling is possible. For example, the copper used in large bus bars could readily be salvaged, but that used in appliances or vehicles would not. The material resources of particular interest are those that are scarce or that may be of strategic importance.

Finally, labor should be mentioned as a resource which is committed. It is irretrievable only to the extent that it precludes using the labor for other actions.

4. CONSIDERATIONS THAT OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS

It is seldom an action has no adverse environmental impacts, whether they be of a minor or a significant nature. Furthermore, in many cases it is impossible to avoid all of the adverse environmental impacts, regardless of the alternatives used or the mitigating actions employed. These remaining adverse impacts which cannot be avoided have been described in a previous section. This section serves to describe the benefits of the proposed action, in terms of Air Force or broader national policy, which offset the unavoidable adverse impacts.

In writing this section, note that the adverse impacts and alternatives and mitigating actions have already been described. Thus, while these items may be mentioned or referenced, there should not be a complete re-description in this section. Similarly, the considerations given in this section should not have been described in detail in the previous sections.

There are generally two basic considerations which support or justify the action: (1) the need to maintain a national defense posture and (2) relative cost. If the action involves a new weapons system, the reasons can generally be taken from the literature which describes the system. If the action involves Air Force staffing, personnel, or installations, the reasons often depend on relative cost; that is, the choice of the installation where the action will be implemented is based on availability of supporting facilities and that using such facilities is least costly. However, strategic and tactical considerations may also be important factors.

If costs are a consideration, include any appropriate cost/benefit analysis of the proposed action or a summary thereof. Indicate clearly the extent to which environmental costs are reflected in such analyses.

5. DETAILS OF UNRESOLVED ISSUES

The nature of some actions is such that conflicts arise, and occasionally aggrieved parties may threaten litigation. The nature of such issues should be described in this section of the report, and the potential parties involved in the issue should be identified.

In some cases, there are unresolved issues which do not involve potential litigation but rather design decisions which have not been resolved. For example, it may be undecided whether to use scrubbers or bag filters to treat air emissions from a plant pending further study or pending receipt of bids from contractors. In these cases, give the reasons why the issue is unresolved and describe the potential impacts for both or all courses of action.

6. BIBLIOGRAPHIC REFERENCES

The final section of the environmental statement, except for appendices, is the listing of references used in the body of the report. The references should be listed numerically, giving the reference number, author, name of the article, name of the journal or book, name of the publisher, his address (city and state only), and the date. If there is no specific author, omit this and begin with the name of the publication.

In some cases, publications may have been used as background but not referenced directly. In this event, a bibliography can be included after the reference list. Entries in the bibliography should be limited to publications directly affecting the action of the area in which it will occur. It should not contain listings of general environmental publications.

REFERENCES

1. U.S. Environmental Protection Agency, "Identification of Products as Major Sources of Noise," Federal Register, Vol. 39, No. 121, pg. 22297, June 21, 1974.

2. U.S. Department of Labor, Occupational Safety and Health Administration, General Industry Standards and Interpretations, Volume 1, Section 1910.95, "Occupational Noise Exposure."

3. U.S. Environmental Protection Agency, "Public Health and Welfare Criteria for Noise," U.S. Government Printing Office, 550/9-73-002, July 27, 1973.

4. Bolt, Beranek, and Newman, Inc., "Fundamentals and Abatement of Highway Traffic Noise," Federal Highway Administration, NTIS/PB-222-703, June 1973.

5. Gordon, C. G., et al., "Highway Noise - A Design Guide for Highway Engineers," Highway Research Board, National Research Council, 1971.

6. Kugler, B. A., and A. G. Piersol, "Highway Noise - A Field Evaluation of Traffic Noise Reduction Measures," Highway Research Board, National Research Council, 1973.

7. U.S. Department of Transportation, Federal Highway Administration, PPM 90-2, "Noise Standards and Procedures," February 8, 1973.

8. U.S. Environmental Protection Agency, Office of Noise Abatement and Control, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety," March 1974.

9. U.S. Environmental Protection Agency, Office of Noise Abatement and Control, "Public Health and Welfare Criteria for Noise," July 27, 1973.

10. U.S. Department of Housing and Urban Development. Report TE/NA 171, August 1971.

11. U.S. Environmental Protection Agency, "Noise From Construction Equipment and Operations, Building Equipment and Home Appliances," December 31, 1971.

12. AICUZ, Phase One, HQ USAF, AF/PREV Planning Task Force, 27 October 1973.

13. AICUZ Information Bulletin Two, Protecting Airports and Their Neighbors Through the Environmental Land Use Planning Process, HQ USAF, AF/PREV Planning Task Force, 21 March 1973.

14. AICUZ, Information Bulletin Three, AICUZ - Economic Impact Studies, HQ USAF, AF/PREV Planning Task Force, November 1973.

15. AICUZ Information Bulletin Four, Guidance for AICUZ Phase I, HQ USAF, AF/PREV Planning Task Force, December 1973.

16. AICUZ Information Bulletin Five, Guidance for Operational Change Evaluation, HQ USAF, AF/PREV Planning Task Force, not dated.

17. AICUZ Information Bulletin Six, Guidance for Non-Operational Elements of Phase II, HQ USAF, AF/PREV Planning Task Force, April 1974.

18. AICUZ Information Bulletin Seven Guidance for Operational Review of Phase I Data, HQ USAF, AF/PREV Planning Task Force, May 1974.

19. Bastress, E. K., "Nature and Control of Aircraft Engine Exhaust Emissions," 62nd Annual Meeting of the Air Pollution Control Association (APCA Paper No. 69-190), June 1969.

20. U.S. Environmental Protection Agency, "Aircraft Emissions: Impact on Air Quality and Feasibility of Control," February 1972.

21. Bastress, E. K., "Impact of Aircraft Pollutant Emissions at Airports," Environmental Science & Technology, September 1973.

22. Hanna, S. R., "A Simple Method of Calculating Dispersion from Urban Sources," Journal of the Air Pollution Control Association, December 1971.

23. U.S. Department of the Interior. Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archaeological, Architectural) Resources. National Park Service, Office of Archaeology and Historic Preservation, Washington, D. C. 20240, April 1974.

24. U.S. Department of the Interior, National Park Service, Office of Archaeology and Historic Preservation, The National Register of Historic Places, 1972, Washington, D. C.: Government Printing Office, 1972.

25. U.S. Department of the Interior, Notices "National Park Service--National Register of Historic Places--Advisory Council on Historic Preservation--Protection of Properties on the National Register, Procedures for Compliance," Federal Register XXXIX, No. 34, Part II, 6401-6477, February 19, 1974.

26. Executive Order 11593, "Protection and Enhancement of the Cultural Environment" May 13, 1971 (36 F.R. 8921).

27. U.S. Department of the Interior. Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archaeological, Architectural) Resources. Washington, D.C.: National Park Service, April 1974.

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APPENDIX A

METHOD FOR PERFORMING ON-BASE AIR EMISSION INVENTORY AND EVALUATION

1. Emission Source Data

Aircraft emissions occurring during landing and takeoff (LTO) and touch-and-go operations below an altitude of 3,000 feet AGL (actual ground level) are of concern. This necessitates the cataloging of each different operating mode of the aircraft throughout these maneuvers. The emission indices for each operating mode of each type of aircraft engine are unique to a particular engine family in each mode. Thus, the average time each aircraft type spends in each mode must be obtained. These times vary from one air base to another due to differences in climate and topography. In addition, of course, the number of LTO and touch-and-go operations each aircraft type performs in the time period of interest must also be obtained.

To summarize, aircraft require the following information:

- Average time in each engine mode for each operation for each aircraft type
- Rate of fuel consumption for each engine in each mode
- Number of operations per year
- Number of engines used in each mode.

Example: F-15 at Luke Air Force Base

	Mode	Avg. Time in Hours	Engine Mode (1000 lb. Fuel/Hour)	Number of Engines Operating
1.	Idle at Start-up	0.167	Idle (1.06)	2
2.	Taxi before Takeoff	0.250	Idle (1.06)	1
3.	Engine Check at Runway End	0.167	Military (9.10)	2
4.	Runway Roll	0.0056	Military (9.85)	2
5.	Climbout to 3000 AGL	0.0102	Military (10.6)	2
6.	Approach from 3000 AGL	0.0434	30% (3.0)	2
7.	Landing on Runway	0.0167	Idle (1.06)	2

Example: F-15 at Luke Air Force Base (concluded)

Mode	Avg. Time in Hours	Engine Mode (1000 lbs. Fuel/Hour)	Number of Engines Operating
8. Taxi after Landing	0.208	Idle (1.06)	1
9. Idle at Shutdown	0.0167	Idle (1.06)	2

Number of LTO operations per year: 9,167

Number of touch-and-go operations per year: 3,167

Items 1 through 9 compose one LTO operation. Items 5 and 6 constitute one touch-and-go operation

Test Cell and Run-Up operations are maintenance-oriented operational checks of aircraft engines in special test rigs or installed in aircraft, respectively. They can be treated in an identical manner for an emission inventory. Data similar to that required for aircraft operations are needed. In this case, however, the data are engine specific rather than aircraft specific. In addition, the location and frequency of use of each different test cell and run up stand location should be noted for the emission density determination. Examples are shown in Table A-1.

AGE (Aerospace Ground Equipment) are used whenever aircraft are on the ground. Fueled by either JP-4, MoGas, or Diesel fuel, they provide electric power, loading/unloading services, and various other service functions to aircraft. Unlike the aircraft, however, the emission indices for AGE are fuel specific rather than equipment specific. The information required in order to determine the emissions from the AGE are simply:

- Quantity of JP-4 consumed by AGE per year
- Quantity of MoGas consumed by AGE per year
- Quantity of Diesel fuel consumed by AGE per year
- Locations of distribution points
- Locations of operations.

Motor Vehicles, both military and non-military, are a major source of air pollutants. Their emission indices are based on vehicle mileage; that is, emissions are described as so many mass units per miles driven. The data necessary for this part of the inventory is therefore the number of miles driven on the base by each vehicle type. Where the on-base traffic is composed primarily of passenger cars and light-duty trucks--less than 6,000 lbs GVW (gross vehicle weight), it is adequate to determine only the total number of vehicle miles driven on the base by all vehicles.

TABLE A-1. EXAMPLES OF DATA FOR EMISSION DENSITY DETERMINATION

Test Cell Emissions: Bldg. 3704, Base Location - Area C

		Idle	Normal	Military	Afterburner
Engine: F-100	Time (hrs)	0.16	0.083	0.083	0.083
Runs per year: 197	Fuel Flow (1000 lbs/hr)	1.179	3.0	9.722	35.06
	Total Fuel (lbs)	189	249	807	2,910
Engine: J-79	Time (hrs)	0.16	0.33	0.083	0.083
Runs per year: 324	Fuel Flow (1000 lbs/hr)	1.068	8.33	8.47	30.55
	Total Fuel (lbs)	171	2,749	703	2,536

Run-Up Stand Emissions, Stand R-1, Base Location - Area F

		Idle	Normal	Military	Afterburner
Aircraft: F-15	Time (hrs)	0.21	0.16	0.125	0.042
No. Engines: 2	Fuel Flow (1000 lbs/hr)	1.179	3.0	9.722	35.06
Runs per year: 345	Total Fuel (lbs)	248	480	1,215	1,473
Aircraft: F 104	Time (hrs)	0.25	0.083	0.25	0.16
No. Engines: 1	Fuel Flow (1000 lbs/hr)	1.068	8.33	8.47	30.55
Runs per year: 666	Total Fuel (lbs)	267	691	2,118	4,888

Heating Units, Incinerators, and Boilers are usually fired by liquid or gaseous petroleum fuels. They may be used for the generation of steam, hot water, and for heating individual or groups of buildings. Like the AGE, the emission indices are based on the quantities of fuel consumed by each unit per year. In addition to fuel consumption, size of the unit in BTU per hour, the type of burner if oil (tangential or horizontal firing), the purpose, the class of the unit (domestic heater, process boiler, etc.) and the sulfur content of the fuel must be determined. The emission indices vary with these parameters. The presence of pollution abatement equipment on this type of unit should also be taken into consideration and appropriate stack sampling data, if available, should be obtained.

Date necessary for each unit:

- Annual fuel consumption
- Fuel types
- Capacity of the unit
- Purpose (steam, heat, power generation)
- Class of unit (domestic, process boiler)
- Type of burner
- Sulfur content of the fuel
- Presence of pollution abatement equipment
- Stack sampling data (if available)--very desirable when abatement equipment is present.

Fuels and Other Volatile Liquid Storage and Distribution emissions include all those emissions (usually hydrocarbons from fossil fuels) that result from the storage and transfer of volatile liquid fuels such as for aircraft, automobiles, AGE, construction equipment, locomotives, boilers, power plants, heating units, etc. Refueling and storage tank emissions result primarily from the displacement of fuel vapors. For every gallon of volatile liquid transferred from one tank to another, a gallon of air and vapor mixture is displaced into the atmosphere. The quantity of vapor displaced into the atmosphere depends upon the vapor pressure, molecular weight and temperature of the liquid, and the method of filling the tank. These vapor displacement (working) emissions occur anytime any tank is refilled with a volatile substance. Almost all of the storage tanks on the base are subject to these working losses. Another type of loss associated with fuel storage is the so-called breathing loss. These occur from evaporation and liquid or vapor volume changes as the temperature of the tank's contents changes during daily and seasonal temperature fluctuations. These emissions are most pronounced in the common fixed-volume type of storage tank. Tanks such as main aircraft fuel storage tanks, however, are usually designed to minimize these losses. Known as floating roof tanks, they have an inner roof that floats on top of the liquid fuel surface and is sealed around the edges with a sliding type gasket. In this way, breathing losses are kept to a minimum while the working losses are reduced to negligible amounts.

Data necessary for fuel storage and distribution are:

(1) Tank data:

- Location
- Type (underground, above ground, floating roof)
- Type of fill system (splash fill, submerged, or bottom load filling systems)
- Capacity
- Type of volatile liquid (JP4, MoGas, solvent, etc.)
- Annual fuel throughput or number year
- Type of vapor recovery system, if any
- Above information for tank trucks.

(2) Fuel distribution:

- Quantity of each type of fuel distributed at each distribution point
- Quantity of fuel distributed to AGE
- Quantity of fuel sold through the base exchange
- Locations of distribution points.

Note: Fuel may be transferred from one tank to another before it is finally used. This should be included as a distribution as it usually involves filling a tank truck and transferring fuel from the truck to the second tank. This, therefore, accounts for vapor displacement in two additional tanks--the truck and the second tank.

Note also that fuel dispensed to aircraft from hydrants must be separated from that distributed by tank truck as the truck operation involved the vapor displacement emissions of the truck tank whereas hydrant distribution does not.

Locomotives, Stationary Power Plants, and Other Diesel Equipment

Emissions from these sources all result from the combustion of diesel fuel (sometimes confused with No. 2 fuel oil) in internal combustion engines. While emissions do vary somewhat with the size, age, and use of the engine, the available emission indices are established in such a way that does not now consider these variations significant. For the purpose of an emission inventory, therefore, emissions from all diesel-fueled equipment may be estimated with sufficient accuracy by simply obtaining the total quantity of diesel fuel consumed on the base (and burned in internal combustion engines) during the time period of interest.

Training Fires

As part of the normal and necessary training (both basic and proficiency), the base fire department conducts frequent and periodic drills fighting large liquid fuel fires. These fires usually constitute one of the most visible sources of air pollution on the base, although they actually contribute but a fraction of the total on-base emission inventory. The necessary information is:

- The usual, average, quantity of fuel used per fire:

  a. Estimated quantity burned.
  b. Estimated quantity left to evaporate (or soak into the ground from whence it evaporates).

- The average number of training fires in the time period of interest.

- The type of fuel(s) used for these fires.

- The average duration of each fire.

Fuel Spills

Like fuel storage and fuel distribution emissions, fuel spills constitute a source of volatile fuel evaporative emissions. They occur during start-up and shut-down when fuel lines are drained, but the largest spills usually occur from the tanks of fighter aircraft because these must always be full while the aircraft is on the ground. As the fuel warms and expands in the sun, the fuel spills out the overflow and onto the ground.

Data necessary for fuel spills are:

- The average size of each spill.
- The average number of spills during the time period of interest.

Note: If the action under study is to involve a change in the number of fighter aircraft, it would be helpful to determine the quantity of fuel spilled from the fighters now on the base separately from the rest of the aircraft in order to more accurately project the change in the quantity of fuel spilled as a result of that action.

Industrial Processes

These are those maintenance functions that are of magnitude to be considered industrial rather than repair shop operations. On most bases, the volume of paint used by the repair facilities, for instance, is so small that the magnitude of the emission that source is insignificant. On the other hand, depot maintenance operations such as those at Tinker Air Force Base are of such a magnitude that they constitute a major source of air pollutants on the base.

On each base, the capacity of the storage tanks for the volatile fluids used by the repair shops is a good indication of the magnitude of the operation. If the storage capacity is small (say 500 to 1,000 gallons) with a low turnover and the quantity of material stored in drums is negligible, this probably constitutes an insignificant source of pollution. However, if indications are that large quantities of solvents, paints, and other volatile fluids are used, the emissions from the repair areas must be included in the inventory.

Nine times out of ten, there are no cookbook emission indices for industrial operations. Each process or repair area must be inventoried using a material balance; that is, the quantity of volatile solvents each process uses and losses due to evaporation must be determined. For instance, if Stoddard Solvent is used in a cleaning tank and the tank must be topped up with 1,000 gallons of solvent every 2 weeks, it can be assumed with reasonable accuracy that the hydrocarbon emissions from the process are 500 gallons per week. The mass emission rate is then obtained by multiplying the volume loss by the density of the liquid.

Painting operations are handled in a similar manner, except, of course, that not all of the paint vaporizes. The components of each paint must be determined at least as far as the volatile portion is concerned. That portion is the part that vaporizes and makes up the air pollutants from the paint shop. For instance, if the paint is 50 percent volatile and 200 gallons a month are used, 100 gallons of volatiles per month are emitted into the air. These are normally hydrocarbons, and multiplying the volume evaporated by the densities of the various volatile liquids will yield the rate of hydrocarbon emission from these processes.

The majority of industrial emissions will be hydrocarbons from cleaning, machining, and painting operations. However, the investigator is urged to seek out other significant sources of any of the major air pollutants that are of concern in this type of study (which are carbon monoxide, hydrocarbons, nitrogen oxides, particulates, and sulfur oxides).

Training Ranges and Test Operations

These operations tend to be unique and air pollutant emissions can only be estimated by analysis of the operations that are actually conducted. Ground air emissions from bombing ranges will be minor since the practice bombs contain only a small spotting charge of powder, equivalent approximately to a 12-gauge shotgun shell. Tests of production or special ordnance items can produce CO and NOx, but the quantities will depend on the type and weight of explosive used. Tests of incendiary devices (e.g., flares) and rocket motors can also contribute as an emission source if a substantial amount of testing is performed. To determine the amount and type emissions, it is necessary to ascertain the total weight of material detonated or burned and its gaseous products of decomposition.

2. Summary, Emission Data

The data needed to conduct a typical emission inventory have been listed above. Those conducting such an inventory are urged not to stop here, however. There may be other sources which have not been mentioned here because they are rare or unusual. Make sure all ground is covered in an inventory. Remember, too, the type of data gathered is largely dependent upon the method of emission calculation. Most of the above has been based on using cookbook emission indices. However, any additional data related to a particular source that can be obtained should be obtained. In this way, a comprehensive data base will have been established so that as the methods of emission calculation become more refined, the new data necessary to use them will be readily available and old ground will not have to be recovered.

Similarly, there will undoubtedly be more and more actual effluent sampling data available as time passes, and this information should be obtained and used wherever it is available.

Now that you know what is needed, the section below will tell you where to find it.

3. Sources of Information

There is usually no single source for all of the necessary data, nor is the source for certain information apt to be the same from base to base. Furthermore, data obtained from two different sources on the same base regarding a particular operation will, for one reason or another, disagree as often as it agrees. This section should, therefore, be regarded as a guide to starting points in the search for information. In the final analysis, the investigator will have to rely on his own resources and ingenuity in finding the answers to his questions. Common sense is your best guide.

Aircraft

Aircraft activity data can be obtained from AICUZ (Air Installation) Compatible Use Zone) documents. These are a series of documents that describing the impact of aircraft noise on the areas surrounding the base and should contain up-to-date LTO and touch-and-go (or go-round) figures. They will also determine the noise impact for the study you are doing, so your figures should match. Aircraft operational information (time in mode) is best obtained from the people who fly them, the pilots. If you can locate a person who is familiar with several aircraft (e.g., at Base Operations), it may be easier to obtain most of your operational information from him. This operations person can also be a good source for the rest of the aircraft data--the number of operations (landings, takeoffs, and touch-and-go's in the time period of interest if there are no AICUZ documents for your base. Operations personnel may not be familiar with the activities of aircraft not assigned to your base, however, so you will have to seek out this data from the people who handle transient aircraft, such as Transit Alert, if you have them.

Test Cell and Run-Up Stand information is also obtained from the AICUZ documents. This will detail the activities of each cell and will tell you which engines are run for how long. They will not tell you specific fuel flow or fuel consumption figures. These can be obtained from the Directorate of Maintenance, who can also supply you with activity data if AICUZ is not available. That office will probably send you to the various units which service each aircraft and engine type, so expect to do some walking.

AGE fuel data can also be obtained from the maintenance personnel, so plan to ask for test cell, run-up stand, and AGE fuel usage data from the Directorate of Maintenance.

Motor Vehicle Mileage, especially non-military vehicles, becomes a problem at times. If you're lucky, the U.S. Army Transporation Engineering Agency, Fort Eustis, Virginia, will have conducted a traffic survey of the base some time in the recent past. A copy of this can usually be borrowed from Base Security or Civil Engineering. It will tell you how many vehicles travel over a given roadway on the average weekday. All you have to do is measure the length of each road section on a map and multiply it by the vehicle count to get total vehicle miles per day. These surveys usually cover 70 to 80 percent of the base roadways and vehicles, so multiply your total mileage by an appropriate factor to obtain an estimate for all of the base roads and vehicles.

Either you or Base Security will be able to estimate the weekend traffic volumes. The weekend traffic is best represented as some fraction of the typical weekday volume.

Annual vehicle mileage is obtained by multiplying the weekday figure by 260 weekdays and the weekend fraction of weekday miles by 105 weekend days. The sum of the two is what you are seeking (do not be surprised if it is 10 million miles or more per year).

This survey is only useful if the base traffic makeup is close to the national average vehicular makeup; that is, if most of the traffic consists of vehicles weighing less than 6,000 lbs. If it is not, or if the survey is just not available, you have some work to do.

Military vehicle mileage can be obtained from the Transportation Management Unit. They should be able to tell you the total mileage each vehicle in their jurisdiction covered each month. The only trouble is, while most of that is on base, some is off base and you must separate the two. The same people should be able to tell you the total amount of fuel issued to each vehicle and how much of that was purchased off the base. The ratio of off-base fuel purchases to total fuel used by each vehicle is a reasonable estimate of the ratio of the off-base mileage to the total mileage.

For non-military vehicles, you will have to determine the locations of the major non-military parking areas, the distance from each one to the closest base gate, and the average number of cars in each. Base Security should be able to help you conduct a vehicle count through each gate (they may already have one). The gate traffic count will tell you how many cars are on base in a given day, and the parking lot data will tell you where most of them went. You will have to make a best estimate as to the destinations of the remaining vehicles and also of intra-base errands run by non-military vehicles. Do not forget there is frequent transient traffic between the base exchange, the base gates, and family housing.

Unless you have very recent information, any vehicle data you obtain, either from the survey or vehicle counts, will have to be adjusted to present or future conditions. This is done by using a ratio of base population contemporary with the data and current and/or projected base population. Keep in mind traffic estimates are very rough and should be indicated as such.

Heating Unit, Incinerator, and Boiler data can be found in Civil Engineering. They will have descriptions of the units and the types of fuel each one uses. You may have to go to the individual operators of each unit before you obtain fuel consumption figures, but Civil Engineering is the place to start.

Fuel and Volatile Liquid Storage and Distribution data is usually spread out over many different units. Civil Engineering is a good place to start for a description of the storage facilities. In all probability, however, you will end up going around to each fuel or volatile liquid user to obtain information on the tanks he uses. You will also have to go to these some fuel users to find out how much fuel they consume. This is because the POL and Fuel Quality Control will probably not be able to breakdown their distribution in a manner useful to you. Don't forget to go to them, too, however, because they will be able to help you with the overall fuel picture and much, if not all, of the JP-4 distribution. Remember, what you need is a description of each tank and the fuel throughput for each tank.

Training Fires are, of course, conducted by the Fire Department, and they can tell you all you will need to know about them.

Fuel Spills are washed down and supervised by the Fire Department and they should also be able to help you here, although Civil Engineering may have a complete compilation of Fire Department records in this area.

Industrial Process data can be supplied by either the Directorate of Maintenance, the Logistic Command, or Base Supply. You will probably end up going to all of them, the first two for usage information and the last one for material specifications.

Other Information Sources to be considered are the base Bio-Environmental Engineer and local, state, or Federal air quality boards. The office of the Bio-Environmental Engineer can undoubtedly help you with emission sources relating to occupational safety and health, which may give you a clue as to emission rates for various industrial type sources. He may, in fact, already have a partial or even a complete emission inventory. State and Federal air quality offices near the base at one time or another may have inventoried the base and are usually more than happy to help, especially with unusual emission sources. They may also be able to help you estimate emission rates from unknown sources.

Figure A-1 summarizes this section with a flow chart of the data needs and sources.

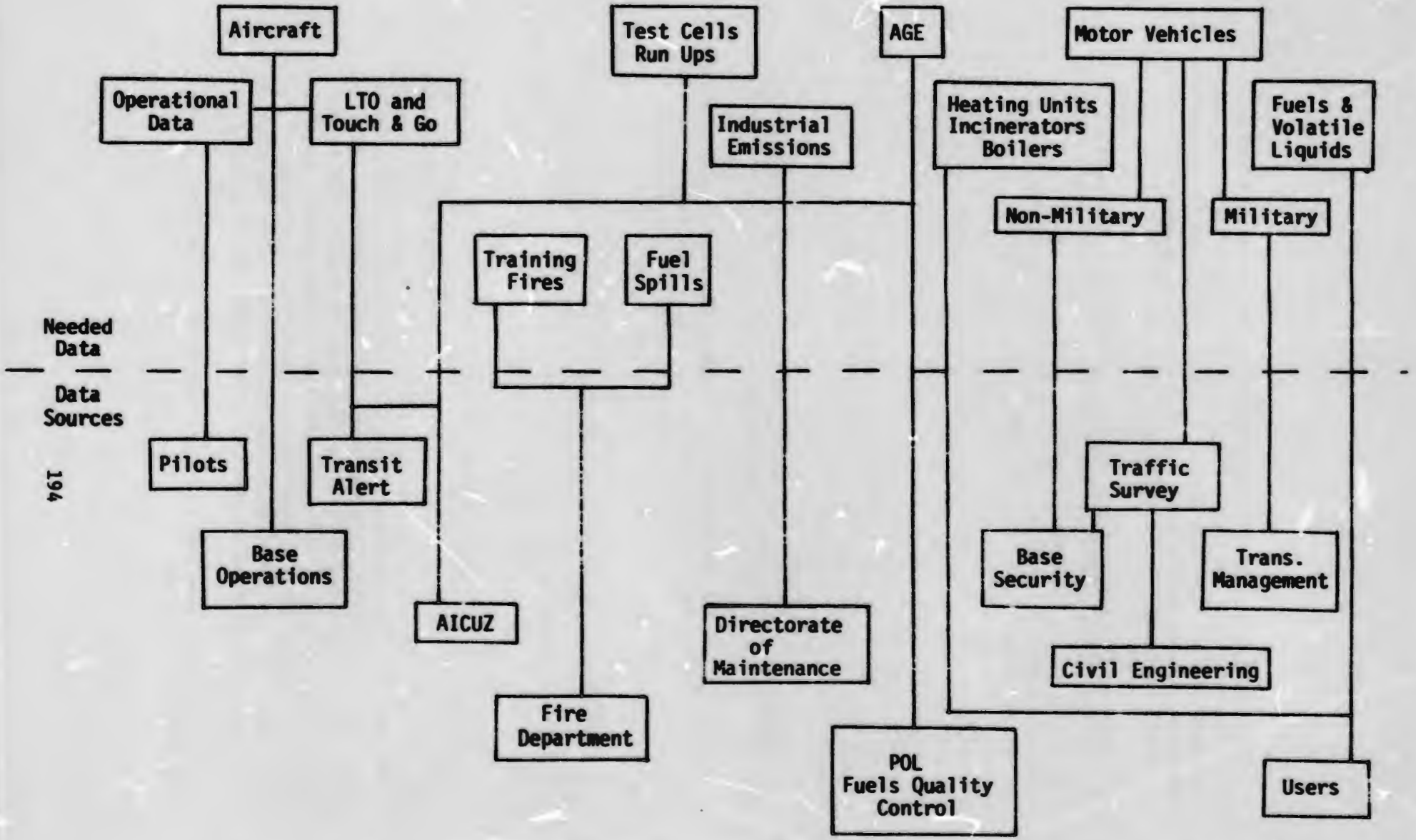

Figure A-1. Emission Inventory Information Chart

4. Emission Indices

Now that you have all of this information, what do you do with it? Emission indices must be used to estimate the emission rates of each major pollutant from each of the emission sources. Each index is based upon typical emission characteristics of each type of source. Emission rates are calculated by multiplying the appropriate source parameters by the proper emission index for each source.

Most of the required indices can be found in:

> Compilation of Air Pollutant Emission Factors, Second Edition, U.S. Environmental Protection Agency, Publication AP-42.

and its supplements. The aircraft data in this publication is primarily based on commercial aircraft operating at large municipal airports. A more appropriate source for military aircraft engines is:

> United States Air Force Aircraft Pollution Emissions, Dennis F. Naugle, Capt., USAF BSC; Bernard T. Delaney, Air Force Weapons Laboratory, AFWL-TR-73-199.

These emissions indices are engine specific rather than aircraft specific and should also be used to calculate emissions from test cells and run-up stands.

Emission indices for AGE and JP-4 training fires have been developed by the Air Force Weapon Laboratory and are as follows:

AGE Emission Indices

Pounds per 1000 pounds Fuel

Pollutants	JP-4	MoGas
Particulates	20	6.4
Nitrogen Oxides	4	2.4
Carbon Monoxide	20	6.4
Hydrocarbons	2	54
Sulfur Oxide	0.4	0.6

JP-4 Training Fire Emissions

Particulates	128	lbs. per 1,000 lbs. JP-4
Nitrogen Oxides	4.15	lbs. per 1,000 lbs. JP-4
Carbon Monoxide	560	lbs. per 1,000 lbs. JP-4
Hydrocarbons	320	lbs. per 1,000 lbs. JP-4
Sulfur Oxides	0.4	lbs. per 1,000 lbs. JP-4

There will be times when there are no indices available for a particular source. In that case, you will have to use indices for sources similar to the one you have. This is quite legitimate in that most generalized indices are accurate to only their order of magnitude. With a little thought, the indices you pick for sources without specific published indices can be within the limits of accuracy of the rest of the inventory and will be equally valid.

Further information and data can be obtained from the Air Force Environmental Protection Manual. The list of references and information sources at the end of that chapter is particularly helpful.

A review of previous impact statements for other bases and actions may also prove to be rewarding.

5. Presentation

In presenting the emission inventory, it is best to denote the location of each source by both building number and base area. This is to give the reader the most rapid reference should he wish to find a particular source location. It is also best to present the raw data, the appropriate emission indices, and the estimated emission rates in order to give the maximum credibility to the inventory.

A format that has been found useful in the past is to present a summary of the emission inventory in the main body of the text and relegate the background data to an appendix. The summary should include, in tabular form, a brief description of the source, its locations by number and base area, and the estimated emission rates. The background information should also include the source description and location, the pertinent source parameters used in the emission estimate calculations, the emission indices (and their sources), as well as the final emission estimate for each emission source. You may want to add some finishing touches such as showing the percent contribution of each source to the total base emissions.

6. Summary

The tools to complete an emission inventory on any Air Force base are now in hand. The necessary data and its sources have been outlined. The emission indices have been explained. The marriage of the data and the indices will complete the inventory.

Remember, though, the accuracy of this type of emission inventory is 10 percent at best, while the order of magnitude of some emission rates is a million pounds or more per year.

APPENDIX B

NOISE DUE TO AIRCRAFT OPERATIONS

1. Background

In the last several years, there has been a continued development of a variety of measures and criteria for environmental noise due to aircraft operations. As a result, there has developed a considerable amount of confusion relative to such noise measures and criteria, their relationship to each other, and their applicability, interpretation, and use in land use planning and environmental impact studies. To aid in the proper understanding of this situation, this appendix includes a short summary of the characteristics of several aircraft noise measures of interest and the methods currently used to evaluate the noise impact upon the surrounding area.

2. The Measures of Single Noise Events or Sources

The most basic measure of a single noise event is in terms of sound pressure level (SPL) in decibels (dB). This measure is based on equal weighting of all audible frequencies making up the noise signal. Since the ear is not equally sensitive over this audible frequency range, however, the SPL measure is not a good indicator of the subjective loudness level of a noise signal. To account for this, various modifications of the SPL, incorporating frequency weighting characteristics based on well-established criteria for subjective loudness properties of noise signals, have been developed and are widely used. The most commonly used is the so-called A-weighted sound level, expressed in dBA. A-weighted sound levels are widely applied as a measure of a variety of transportation, industrial, and community noise sources. Some typical values of sound levels in dBA are shown in Table B-1.

Psychoacoustic studies carried out in the early 1960's, particularly by Kryter[B3], concluded that the frequency weighting used for subjective loudness measures were not adequate as measures of subjective annoyance to aircraft noise. These studies, which were carried out shortly after the introduction of a jet-powered aircraft into commercial service, investigated the apparent higher level of annoyance associated with jet aircraft as compared with that of propeller-driven aircraft having the same overall SPL or the same loudness level. Kryter found that the differences in the spectral distribution of jet aircraft noise (generally more noise in the higher frequency region) relative to propeller-driven aircraft noise resulted in a higher annoyance to most of the people tested in this studies. To correlate this relationship more properly, Kryter

TABLE B-1. SOUND LEVEL AND LOUDNESS OF TYPICAL NOISES IN INDOOR AND OUTDOOR ENVIRONMENTS (Noise Levels Given in dBA)

dB(A) Ref. 0.0002 μbar	SUBJECTIVE IMPRESSION	COMMUNITY (Outdoor)	HOME OR INDUSTRY (Indoor)	RELATIVE LOUDNESS (Human Judgment of Different Sound Levels)
130		Military Jet Aircraft Take-Off With After-Burner @ 50 ft (130)	Oxygen Torch (121)	32 Times as Loud
120	Uncomfortably Loud	Turbo-Fan Aircraft @ Take-Off Power @ 200 ft (118)	Riveting Machine (110) Rock-N-Roll Band (108-114)	16 Times as Loud
110		Jet Flyover @ 1000 ft (103) Boeing 707, DC-8 @6080 ft Before Landing (106)	Pile Driver @ 50 ft (101)	8 Times as Loud
100	Very Loud	Power Mower (96) Boeing 737, DC-9 @ 6080 ft Before Landing (97), Motorcycle @ 25 ft (90)	Newspaper Press (97), Inside Subway Train - NY (95)	4 Times as Loud
90		Car Wash @ 20 ft (89), Prop. Plane Flyover @ 1000 ft.(88), Diesel Truck, 40 mph @ 30 ft (84), Diesel Train, 45 mph @ 100 ft (83)	Food Blender (88), Milling Machine (85), Garbage Disposal (80), Symphony Orchestra (Audience)(80)	2 Times as Loud
80	Moderately Loud	High Urban Ambient Sound (80), Passenger Car, 65 mph @ 25 ft (77), Freeway @ 50 ft from Pavement Edge, 10 a.m. (76 ± 6)	Living Room Music (76), TV-Audio, Vacuum Cleaner (70)	REFERENCE LOUDNESS 70 dBA
70		Air Conditioning Unit @ 100 ft.(60)	Cash Register @ 10 ft (65-70), Electric Typewriter @ 10 ft (64) Dishwasher (Rinse) @ 10 ft (60), Conversation (60)	1/2 as Loud
60	Quiet	Large Transformers @ 100 ft (50)	Typical Business Office (55)	1/4 as Loud
50		Bird Calls (44), Lower Urban Ambient Sound(40)		1/8 as Loud
40				

Source: References B1, B2

developed the concept of Perceived Noise Level (PNL), a single-number noise measure, for a prescribed noise event such as an aircraft flyover. The PNL is characterized by both the absolute sound pressure levels of the noise event, and by the spectrum (i.e., frequency content) of the noise. This information is converted into a perceived noisiness by the use of annoyance criteria which have been developed experimentally. Thus, the PNL, in terms of Perceived Noise Decibels (PNdB), is a calculated measure relating the physical levels of noise and judgments of the subjective annoyance associated with the noise.

Subsequently, a refinement of the PNL measure was introduced to include the effects of the duration of the noise (above some threshold value) and a correction for the presence of strong pure-tone components in the noise signal. The reasons for these refinements to the more basic PNL were that further experiments indicated the subjective reaction (annoyance) to aircraft noise was dependent upon both the maximum level and the duration of the single event time-history, and the pure-tone (whine) resulting from the front compressor of turbofan engines was both of high intensity and of particular annoyance. This modified measure was termed the Effective Perceived Noise Level (EPNL) and is expressed in terms of Effective Perceived Noise Decibels (EPNdB). Thus, both the PNL and EPNL measures contain objective and subjective noise factors, and both are evaluations of a single noise event.

3. Noise Environment Descriptors

In addition to the measure of the single noise event, the descriptor of the overall noise environment requires the number and distribution of these occurrences during some specified period of time. For discrete measures, such as aircraft operations, a 24-hour period is used, leading to the formulation of a daily noise environment descriptor. For general fluctuating community or environmental noise sources, such as more or less continuous lines of traffic or ambient noise levels in remote areas, a statistical descriptor would be more appropriate.

In the latter case, the distribution of source levels in dBA is obtained by recording the levels continuously over a relatively long period of time (i.e., long enough to satisfy statistical sampling considerations) and the noise environment is then described in terms of a median sound level, L_{50}, together with a standard deviation from this value; or, in terms of L_{10}, L_{50}, and L_{90}, defined as the noise level values exceeded 10, 50, and 90 percent of the time, respectively; or, in terms of the equivalent energy value, L_{eq}, which has recently been adopted by the U.S. Environmental Protection Agency as the applicable environmental noise descriptor[B4]; or, in terms of the Noise Pollution Level, defined as L_{eq} plus a factor times the standard deviation of the sound level.

Of more immediate interest are the descriptors that have been developed and used for the discrete events of aircraft operations. Many such composite descriptors of daily noise exposure levels have been developed. Two of particular interest because of their use in the United States for military applications, are the Composite Noise Rating (CNR) and the Noise Exposure Forecast (NEF), both developed by Bolt, Beranek, and Newman, Inc.[B5]. These composite noise descriptors are obtained, respectively, from the PNL and EPNL values for the individual aircraft events, and correction factors are applied for the number of such events occurring within certain specified times during a 24-hour period. Weighting factors are used for the operations occurring during time periods to account for the increased sensitivity to noise in the evening or nighttime hours.

Calculations of these composite levels in terms of the corresponding single-event measure are as follows:

$$CNR = PNL + 10 \log (N_D + 16.7\ N_N) - 13$$

$$NEF = EPNL + 10 \log (N_D + 16.7\ N_N) - 88$$

where N_D = number of flights during the day (0700 - 2200)

N_N = number of flights during the night (2200 - 0700)

The calculations are seen to be quite similar, the principal difference being the specific noise measure used for individual aircraft noise intrusions. Note also that the summation of the noise events is on a "10 log N," or energy basis. These characteristics have been suggested by evidence obtained from psychoacoustic experimental studies [B5, B6].

The Environmental Protection Agency, under authority granted by Congress under the Noise Control Act of 1972, has developed a recently published criteria and levels on environmental noise [B5]. This study by the EPA included an evaluation of the various noise exposure descriptors currently in use and subsequently the selection of an equivalent sound level, L_{eq}, and a weighted equivalent sound level, L_{dn}, as the most appropriate measures of environmental noise exposure for interference and annoyance for indoor and outdoor activities. The basic single-event noise level in these measures is also the A-weighted sound level. The descriptors L_{eq} and L_{dn} are, in fact, long-term average values of the A-weighted sound level, calculated on an energy basis.

In this case, the formulation becomes

$$L_{dn} = 10 \log \left[\frac{15}{24} \left\{ 10^{\left(\frac{L_d}{10}\right)} \right\} + \frac{9}{24} \left\{ 10^{\left(\frac{L_n+10}{10}\right)} \right\} \right]$$

where $L_d = L_{eq}$ for the daytime (0700 - 2200)

$L_n = L_{eq}$ for the nighttime (2200 - 0700)

Here, a 10-dB nighttime weighting is used on the nighttime equivalent sound level. Note that, in this formulation, the single-event measure does not appear directly but is included in the energy-summed values of L_{eq}.

The relationships between the single-event noise measures (PNL, EPNL, dBA) vary with aircraft type, type of operation, and with the measurement distance from the aircraft. As a consequence, the correlations among the noise exposure descriptors will vary with the specific airport situations. Approximate correlations can, however, be established assuming average mixes of aircraft types and operations schedules. Following such a procedure for a range of airport situations has led to the approximate equivalences shown in Table B-2.

4. Noise Exposure Calculations

The basic noise data obtained experimentally for each aircraft operation of interest is presented in terms of noise level as a function of distance from the aircraft. For most Air Force aircraft, these data are available from the Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base. Using this basic information, together with the operational information obtained during the AICUZ Phase II program, both the single-event noise measures and the overall noise exposure descriptors can be evaluated, for a given set of conditions, at any point or site of interest. Under the AICUZ Phase III program, a series of contours are developed, each delineating zones or areas around the airport which are above or below prescribed values of the noise exposure descriptor. The methodology for the development of these contours is straightforward but lengthy in cases in which there are several types of aircraft and a variety of flight paths and patterns to consider.

TABLE B-2. APPROXIMATE EQUIVALENCE OF NOISE EXPOSURE DESCRIPTORS

NEF (dB)	L_{dn} (dB)	CNR (dB)
30	65	100
40	75	115

TABLE B-3. EXPECTED RESPONSE OF RESIDENTIAL COMMUNITIES TO NOISE EXPOSURE FORECAST ZONES

Noise Exposure Forecast (dB)	Zone	Description of Expected Response
Less than 30	A	Some noise complaints are possible, and noise may interfere with some activities.
30 to 40	B	Individual reaction may include vigorous, repeated complaints, and concerted group action is also a possibility. Construction of homes, schools, churches, etc., should not be undertaken without a complete analysis of the situation.
Over 40	C	Serious noise problems are likely. No activity, nor building construction of any sort, should be carried on without a complete analysis of the situation.

As indicated in the AICUZ Information Bulletins, the noise exposure levels developed in this manner combined with the Accident Potential Zone mappings are used to guide land use planning and zoning, and to assess the environmental impact of proposed changes in the airport activities.

The depiction of noise exposure in this manner has its limitations, however, since many variable factors are inherent in the prediction of the basic single-event noise measure itself, and in the assumptions of flight profiles and meteorological conditions. On the basis of the assumption normally utilized in such forecast descriptors, noise exposure values are generally considered to have a variability of as much as $\pm$ 5 dB.

5. The Interpretation and Use of Noise Exposure Data

Empirical relationships have been developed between various levels of noise exposure and expected levels of community response. These relationships have been evolved from an accumulation of case histories involving aircraft noise complaints near civil and military airports and from psychoacoustic studies. The relationships derived for the NEF methodology are shown in Table B-3.

In addition to the assessment of community response in terms of noise exposure levels, guides for evaluating the probable impact of aircraft operations for various categories of land use have been concurrently developed for the CNR[B5] and NEF[B5] methodologies. These developments have been based upon the noise complaint case histories, together with information on speech interference criteria, subjective tests on noise acceptability, and on noise insulation provided by typical building construction methods. These guides have been expanded under the AICUZ program to include a wide category of land uses and to include compatibility requirements consistent with the accident potential zones developed under AICUZ. A complete listing of these AICUZ Land Use Compatibility Guidelines is given in Appendix C.

The land use categories encompass a rather wide range of human activities having varying sensitivities to noise intrusions. Hence, the interpretations should be taken as guides, not as absolute criteria applicable to all activities or sites falling into a given classification. In application to a specific site, some adjustments in boundaries or interpretations may be desirable. Typical influences to consider include:

- Previous community experience and previous complaint history in the immediate neighborhood.

- Influence of the existing noise environment due to industrial or surface transportation noise sources. For example, the introduction of aircraft noise in a rural area where existing background noise levels are very low would produce a much more apparent change in noise environment, and likely more pronounced reaction from residents, than would aircraft noise introduced in a dense urban area long exposed to traffic noise.

- Time period of land use activities. The basic NEF or CNR values consider both daytime and nighttime operations, with a heavy weighting factor applied for nighttime operation. Such considerations are particularly appropriate for residential land planning but may lead to overestimation of NEF noise exposure values for activities which are confined to daytime hours only, such as schools.

The noise compatibility interpretation boundaries are based upon the type of building construction which would normally be used where aircraft noise is of concern. Thus, the land use compatibility ratings for schools assume building construction involving single glazing in classrooms. Special noise abatement considerations, incorporating double glazing or elimination of windows entirely, for example, have not been considered. Obviously, for many buildings, added noise insulation can be provided during construction.

REFERENCES FOR APPENDIX B

B1. Shultz, T. J., "Noise Assessment Guidelines: Technical Background," HUD Report No. TE/NA 172.

B2. Starr, E.A., "Measuring Noise Pollution," IEEE Spectrum, June 1972.

B3. Kryter, K. E., "Scaling Human Reactions to Sound from Aircraft," J. Acoust. Soc. AM. 31, 1415-1429, 1959.

B4. "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," prepared by U.S. Environmental Protection Agency, Report No. 550/9-74-004, March 1974.

B5. Galloway, W. J. and D. E. Bishop, "Noise Exposure Forecasts: Evolution, Evaluation, Extensions, and Land Use Interpretations," Report No. FAA-NO-70-9, August 1970.

B6. "Land Use Planning Relating to Aircraft Noise," Bolt, Beranek, and Newman, Inc., October 1964.

APPENDIX C

AICUZ LAND USE COMPATIBILITY GUIDELINES

SLUCM CODE	LAND USE CATEGORY	COMPATIBLE USE DISTRICTS												
		1	2	3	4	5	6	7	8	9	10	11	12	13
		L_{dn} 85	APZ I L_{dn} 80-85	APZ I L_{dn} 75-80	APZ I L_{dn} 70-75	APZ I L_{dn} 65-70	L_{dn} 80-85	L_{dn} 75-80	APZ II L_{dn} 80-85	APZ II L_{dn} 75-80	APZ II L_{dn} 70-75	APZ II L_{dn} 65-70	L_{dn} 70-75	L_{dn} 65-70
	RESIDENTIAL													
11x	Single Family	N	N	N	N	N	N	N	N	N	$30^{1,2}$	$25^{1,2}$	30^{2}	25^{2}
11x	Two Family	N	N	N	N	N	N	N	N	N	N	N	30^{2}	25^{2}
11x	Multi-family dwelling	N	N	N	N	N	N	N	N	N	N	N	30^{2}	25^{2}
12	Group quarters	N	N	N	N	N	N	N	N	N	N	N	30^{2}	25^{2}
13	Residential hotels	N	N	N	N	N	N	N	N	N	N	N	30^{2}	25^{2}
14	Mobil homes parks or courts	N	N	N	N	N	N	N	N	N	N	N	30^{2}	25^{2}
15	Transient lodging-hotels, motels	N	N	N	N	N	N	35^{2}	N	N	N	N	30^{2}	25^{2}
19	Other residential	N	N	N	N	N	N	N	N	N	N	N	30^{2}	25^{2}
	INDUSTRIAL/MANUFACTURING[3]													
21	Food and kindred product	N	N	N	N	N	Y^{4}	Y^{5}	Y^{4}	Y^{5}	Y^{6}	Y	Y^{6}	Y
22	Textile mill product	N	N	N	N	N	Y^{4}	Y^{5}	N	N	N	N	Y^{6}	Y
23	Apparel	N	N_4	N_5	N_6	N	Y^{4}	Y^{5}	N_4	N_5	N_6	N	Y^{6}	Y
24	Lumber & wood products	N	Y^{4}	Y^{5}	Y^{6}	Y	Y^{4}	Y^{5}	Y^{4}	Y^{5}	Y^{6}	Y	Y^{6}	Y
25	Furniture & fixtures	N	Y^{4}	Y^{5}	Y^{6}	Y	Y^{4}	Y^{5}	Y^{4}	Y^{5}	Y^{6}	Y	Y^{6}	Y
26	Paper & allied products	N	Y^{4}	Y^{5}	Y^{6}	Y	Y^{4}	Y^{5}	Y^{4}	Y^{5}	Y^{6}	Y	Y^{6}	Y
27	Printing, publishing	N	Y^{4}	Y^{5}	Y^{6}	Y	Y^{4}	Y^{5}	Y^{4}	Y^{5}	Y^{6}	Y	Y^{6}	Y
28	Chemicals & allied products	N	$Y^{3,4}$	$Y^{3,5}$	$Y^{3,6}$	Y^{3}	Y^{4}	Y^{5}	$Y^{3,4}$	$Y^{3,5}$	$Y^{3,6}$	Y^{3}	Y^{6}	Y
29	Petroleum refining and related industries	N	N	N	N	N	Y^{4}	Y^{5}	N	N	N	N	Y^{6}	Y

SLUCM CODE	LAND USE CATEGORY	COMPATIBLE USE DISTRICTS												
		1	2	3	4	5	6	7	8	9	10	11	12	13
		L_{dn}	APZ	APZ	APZ	APZ	L_{dn}	L_{dn}	APZ	APZ	APZ	APZ	L_{dn}	L_{dn}
		85	I L_{dn} 80–85	I L_{dn} 75–80	I L_{dn} 70–75	I L_{dn} 65–70	80–85	75–80	II L_{dn} 80–85	II L_{dn} 75–80	II L_{dn} 70–75	II L_{dn} 65–70	70–75	65–70
	INDUSTRIAL/MANUFACUTRING[3]													
31	Rubber & misc plastic goods	N	Y[4]	Y[5]	Y[6]	Y	Y[4]	Y[5]	Y[4]	Y[5]	Y[6]	Y	Y[6]	Y
32	Stone, clay & glass products	N	Y[4]	Y[5]	Y[6]	Y	Y[4]	Y[5]	Y[4]	Y[5]	Y[6]	Y	Y[6]	Y
33	Primary metal industries	N	Y[4]	Y[5]	Y[6]	Y	Y[4]	Y[5]	Y[4]	Y[5]	Y[6]	Y	Y[6]	Y
34	Fabricated metal products	N	Y[4]	Y[5]	Y[6]	Y	Y[4]	Y[5]	Y[4]	Y[5]	Y[6]	Y	Y[6]	Y
35	Professional, scientific & controlling instru	N	N	N	N	N	N	30	N	N	N	N	25	Y
39	Misc manufacturing	N	Y[4]	Y[5]	Y[6]	Y	Y[4]	Y[5]	Y[4]	Y[5]	Y[6]	Y	Y[6]	Y
	TRANSPORTATION, COMMUN-ICATIONS & UTILITIES[7]													
41	Railroad, rapid rail transit	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
45	Highway & street ROW	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
46	Auto parking	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
47	Communications (noise sensitive)	N	N	30	25	Y	N	30	N	30	25	Y	25	Y
48	Utilities	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
42/43 44/49	Other trans, comm, & util	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

SLUCM CODE	LAND USE CATEGORY	COMPATIBLE USE DISTRICTS												
		1	2	3	4	5	6	7	8	9	10	11	12	13
		L_{dn}	APZ	APZ	APZ	APZ	L_{dn}	L_{dn}	APZ	APZ	APZ	APZ	L_{dn}	L_{dn}
		85	I	I	I	I	80-85	75-80	II	II	II	II	70-75	65-70
			L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70			L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70		
	COMMERCIAL/RETAIL TRADE													
51	Wholesale trade	N	Y^4_4	Y^5_5	Y^6_6	Y	Y^4_4	Y^5_5	Y^4_4	Y^5_5	Y^6_6	Y	Y^6_6	Y
52	Building materials-retail	N	Y^4_4	Y^5_5	Y^6_6	Y	Y^4_4	Y^5_5	Y^4_4	Y^5_5	Y^6_6	Y	Y^6_6	Y
53	General merchandise-retail	N	N	N	N	N	N	30	N	30	25	Y	25	Y
54	Food-retail	N	N	N	N	N	N	30	N	30	25	Y	25	Y
55	Automotive, marine	N	N	30	25	Y	N	30	N	30	25	Y	25	Y
56	Apparel & accessories-retail	N	N	N	N	N	N	30	N	30	25	Y	25	Y
57	Eating & drinking places	N	N	N	N	N	N	30	N	N	N	N	25	Y
58	Furniture, home furnishining retail	N	N	30	25	Y	N	30	N	30	25	Y	25	Y
59	Other retail trade	N	N	N	N	N	N	30	N	30	25	Y	25	Y
	PERSONAL & BUSINESS[8] SERVICES													
61	Finance, insurance & real estate[8]	N	N	N	N	N	N	30	N	30	25	Y	25	Y
62	Personal services	N	N	N	N	N	N	30	N	30	25	Y	25	Y
63	Business services	N	N_4	N_5	N_6	N	N_4	30	N_4	30	25	Y	25	Y
64	Repair services	N	Y^4_4	Y^5_5	Y^6_6	Y	Y^4_4	Y^5_5	Y^4_4	Y^5_5	Y^6_6	Y	Y^6_6	Y
66	Contract construction services	N	N	N	N	N	N	30	N	30	25	Y	25	Y

SLUCM CODE	LAND USE CATEGORY	COMPATIBLE USE DISTRICTS												
		1	2	3	4	5	6	7	8	9	10	11	12	13
		L_{dn}	APZ	APZ	APZ	APZ	L_{dn}	L_{dn}	APZ	APZ	APZ	APZ	L_{dn}	L_{dn}
		85	I L_{dn} 80-85	I L_{dn} 75-80	I L_{dn} 70-75	I L_{dn} 65-70	80-85	75-80	II L_{dn} 80-85	II L_{dn} 75-80	II L_{dn} 70-75	II L_{dn} 65-70	70-75	65-70
	PERSONAL & BUSINESS[8] SERVICES (Cont)													
	Indoor recreation services	N	N	N	N	N	N	30	N	30	25	Y	25	Y
69	Other services	N	N	N	N	N	N	30	N	30	25	Y	25	Y
	PUBLIC & QUASI PUBLIC SERVICES													
67	Government services	N	N	N	N	N	N	30	N	30[8]	25[8]	Y[8]	25	Y
68	Educational services	N	N	N	N	N	N	N	N	N	N	N	30	25
711	Cultural activities incl churches	N	N	N	N	N	N	N	N	N	N	N	30	25
651	Medical & other health services	N	N	N	N	N	N	N	N	N	N	N	30	25
624	Cemeteries	Y	Y[4,10]	Y[5,10]	Y[6,10]	Y[10]	Y[4]	Y[5]	Y[4,10]	Y[5,10]	Y[6,10]	Y[10]	Y[6]	Y
69x	Non profit organization	N	N	N	N	N	N	N	N	N	N	N	30	25
	Other public and quasi-public services	N	N	N	N	N	N	N	N	N	30	25	30	25
	OUTDOOR RECREATION													
751x	Playgrounds, neighborhood parks	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y
752x	Community & regional	N	N	N	Y[11]	Y[11]	N	N	N	N	Y	Y[11]	Y[11]	Y

SLUCM CODE	LAND USE CATEGORY	COMPATIBLE USE DISTRICTS												
		1	2	3	4	5	6	7	8	9	10	11	12	13
		L_{dn} 85	APZ I L_{dn} 80-85	APZ I L_{dn} 75-80	APZ I L_{dn} 70-75	APZ I L_{dn} 65-70	L_{dn} 80-85	L_{dn} 75-80	APZ II L_{dn} 80-85	APZ II L_{dn} 75-80	APZ II L_{dn} 70-75	APZ II L_{dn} 65-70	L_{dn} 70-75	L_{dn} 65-70
	OUTDOOR RECREATION (Cont)													
712	Nature exhibits	N	N	N	N	Y	N	N	N	N	N	Y	N	Y
722	Spectator sports incl arenas	N	N	N	N	N	N	N	N	N	N	N	N	Y
741x	Golf course,[12] riding stables[13]	N	N	Y[14]	Y[15]	Y	N	Y[14]	N	Y[14]	Y[15]	Y	Y[15]	Y
743/744	Water based recreational areas	N	N	Y[14]	Y[15]	Y	N	Y[14]	N	Y[14]	Y[15]	Y	Y[15]	Y
75	Resort & group camps	N	N	N	N	N	N	N	N	N	N	N	Y	Y
721x	Auditoriums, concert halls	N	N	N	N	N	N	N	N	N	N	N	N	Y
721x	Outdoor amphitheaters, music shells	N	N	N	N	N	N	N	N	N	N	N	N	N
	Other outdoor recreation	N	N	N	Y[11]	Y[11]	N	N	N	N	Y	Y	Y	Y
	RESOURCE PRODUCTION, EXTRACTION, & OPEN SPACE													
81	Agriculture(except livestock)	Y[17]	Y[17]	Y[17]	Y[18]	Y[19]	Y[17]	Y[17]	Y[17]	Y[17]	Y[18]	Y[19]	Y[18]	Y[19]
815/817	Livestock farming, animal breeding	N	N	Y[17]	Y[18]	Y[19]	N	Y[17]	N	Y[17]	Y[18]	Y[19]	Y[18]	Y[19]
83	Forestry activities	Y[17]	Y[17]	Y[17]	Y[18]	Y[19]	Y[17]	Y[17]	Y[17]	Y[17]	Y[18]	Y[19]	Y[18]	Y[19]

SLUCM		COMPATIBLE USE DISTRICTS													
		1	2	3	4	5	6	7	8	9	10	11	12	13	
		L_{dn}	APZ	APZ	APZ	APZ	L_{dn}	L_{dn}	APZ	APZ	APZ	APZ	L_{dn}	L_{dn}	
		85	I	I	I	I	80-85	75-80	II	II	II	II	70-75	65-70	
			L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70			L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70			
	RESOURCE PRODUCTION, EXTRACTION, & OPEN SPACE (Cont)														
84	Fishing activities & related services	Y	Y^{11}	Y^{11}	Y^{11}	Y^{11}	Y	Y	Y	Y	Y	Y	Y	Y	
85	Mining activities	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
91	Permanent open space	Y	Y_{11}	Y_{11}	Y_{11}	Y_{11}	Y	Y	Y_{11}	Y_{11}	Y_{11}	Y_{11}	Y	Y	
93	Water areas	Y	Y^{11}	Y^{11}	Y^{11}	Y^{11}	Y	Y	Y^{11}	Y^{11}	Y^{11}	Y^{11}	Y	Y	

NOTES

N (NO) - The land use and related structures are not compatible and should be prohibited.

Y (YES) - The land use and related structures are compatible without restriction and should be considered.

Y^{X} (YES WITH RESTRICTIONS)
- The land use and related structures are generally compatible however some special factors should be considered.

35,30 or 25
- The land use is generally compatible; however, a Noise Level Reduction of 35, 30, or 25 must be incorporated into the design and construction of the structure.

35^{X}, 30^{X} or 25^{X}
- The land use is generally compatible with NLR; however, such NLR does not necessarily solve noise difficulties and additional evaluation is warranted.

1 - Because of accident hazard potential, the residential density in these CUDs should be limited to the maximum extent possible. It is recommended that residential density not exceed one dwelling unit per acre. Such use should be permitted only following a demonstration of need to use this area for residential purposes.

2 - Although it is recognized that local conditions may require residential uses in these CUDs, this use is strongly discouraged in CUDs 10 and 12 and discouraged in CUD's 11 and 13. The absence of viable alternative development options should be determined, and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these CUDs should be constructed prior to approvals.

Where the community determines residential uses must be allowed, Noise Level Reductions (NLR) of at least 30 (CUD's 10 and 12) and 25 (CUD's 11 and 13) should be incorporated into building codes and/or individual approvals. Additional consideration should be given to modify the NLR levels based on peak noise levels and other considerations. Such criteria will not eliminate outdoor environment noise problems and, as a result, site planning and design should include measures to minimize this impact particularly where the noise is from ground level sources.

3 - Because these uses vary considerably by locality and within a general category, particular care should be taken to evaluate and modify guidelines to fit local conditions. Among factors tc be considered: labor intensity, structural coverage explosive inflammable characteristics, size of establishment, people density, and peak period (including shopper/visitors) concentrations.

4 - A NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, or where the normal noise level is low.

5 - A NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, or where the normal noise level is now.

6 - A NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, or where the normal noise level is low.

7 - No structures in Clear Zone, no passenger terminals, and no major ground transmission lines in Clear Zones or APZ I.

8 - Low intensity office uses only (limited scale of concentration of such uses). Meeting places, auditoriums, etc. not recommended.

9 - Excludes hospitals.

10 - Excludes chapels.

11 - Facilities must be low intensity.

12 - Clubhouse not recommended.

13 - Concentrated rings with large classes not recommended.

14 - A NLR of 30 must be incorporated into buildings for this use.

15 - A NLR of 25 must be incorporated into buildings for this use.

16 - No structures in Clear Zone.

17 - Residential structures not permitted.

18 - Residential buildings require a NLR of 30.

19 - Residential buildings require a NLR of 25.

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