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# ENVIRONMENTAL IMPACT ASSESSMENT

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## **ENVIRONMENTAL IMPACT ASSESSMENT**

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# Preface

The National Environmental Policy Act requires environmental impact considerations to be included in project planning along with technical and economic concerns. The action-forcing mechanism is that environmental impact statements must be prepared to describe the environmental consequences of proposed actions and various alternatives. Over 6,000 statements have been prepared since the effective date of the act, January 1, 1970, and even more will be prepared in the future.

New terminology has been developed as a result of the environmental impact statement process or components thereof. For example, environmental impact statements are also referred to as impact statements, environmental statements, and 102 statements. One component of the process is the preparation of an environmental inventory. Many agencies prepare environmental impact reports or environmental analysis reports as a prelude to the actual preparation of impact statements. A companion term is environmental impact assessment, with definitions ranging from a cursory preliminary evaluation of potential impacts of projects to the preparation of a document that is more extensive than an impact statement.

This author views the process culminating in an environmental impact statement as consisting of five components: basics, environmental setting, prediction and assessment of impacts, selection of proposed action, and preparation of impact statement in accordance with extant guidelines. This textbook is organized according to these components. Chapters 1 and 2 encompass the basic requirements and framework of the process. Chapter 3 describes environmental factors that must be considered in defining the study area environmental setting. Chapters 4 through 9 address the steps for impact prediction and assessment for the physical-chemical

(air, water, and noise), biological, cultural, and socioeconomic environments. Chapter 10 presents various impact assessment methodologies that can be utilized in evaluation of alternatives and proposed actions, and Chapter 11 describes public participation in the environmental impact assessment process, particularly as related to selection of proposed actions. Chapter 12 discusses pertinent considerations in writing environmental impact statements. Finally, Chapter 13 presents information regarding future trends and needs in the environmental impact assessment/environmental impact statement process.

This book is intended for use in upper division or graduate level courses dealing with environmental impact assessments/statements. The orientation is primarily for science and engineering majors; however, individuals trained in other disciplines such as planning can utilize this text. This book can also be used by professionals working on environmental impact studies. The attempt has been to assemble pertinent information both for the classroom and for practice. It is intended that all users gain familiarity with the following topics:

- 1 Requirements and implementation of the National Environmental Policy Act.
- 2 A conceptual framework for conducting environmental impact studies.
- 3 Approaches for defining environmental settings.
- 4 Technological methods that can be used to predict changes in environmental characteristics.
- 5 Criteria and considerations involved in interpreting significance of predicted impacts.
- 6 State of the art of environmental impact assessment methodologies.
- 7 Techniques for accomplishing public participation.
- 8 Practical considerations for writing environmental impact statements.

This book is not meant to encompass every possible consideration in the environmental impact assessment/environmental impact statement field. This is a dynamic field, and proper use of this textbook is as a reference for a point in time, with the understanding that it must be supplemented as additional information and technology become available.

The author expresses his gratitude to the College of Engineering, University of Oklahoma, for its support during the preparation of this textbook. He is also grateful to the U.S. Civil Service Commission and Mr. Marvin H. Brannon for the many opportunities afforded through conduction of workshops in this subject area. Particular thanks are due to Dr. Loren Hill and Dr. Paul Risser, University of Oklahoma, for their cooperative efforts on several environmental impact assessment studies. Appreciation is also extended to Mrs. Edna Rothchild, Mrs. Pat Huddleston, and Mrs. Darlene Scallon for their tireless typing efforts. Finally, the author thanks his wife for her encouragement in the process of developing this textbook.

**Larry W. Canter**

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# National Environmental Policy Act and Its Implementation

The past several years have been characterized by passage of major federal legislation dealing with the environment, including specific legislation on control of water and air pollution (1, 2). Perhaps the most significant legislation is the National Environmental Policy Act (NEPA) of 1969 (PL 91-190), which became effective on January 1, 1970. This act was the first signed in the 1970s (3). The thrust of this act, as well as of subsequent executive orders, Council on Environmental Quality (CEQ) guidelines, and numerous federal agency procedures, is to ensure that balanced decision making occurs in the total public interest (4). Project planning and decision making should include the integrated consideration of technical, economic, environmental, social, and other factors. Prior to NEPA, technical and economic factors dominated the decision-making process. The NEPA is reproduced in Appendix A.

## **TERMINOLOGY**

New terminology has arisen in conjunction with the process of complying with the requirements of NEPA. Three of the most significant new terms are "environmental inventory," "environmental assessment," and "environmental impact statement."

### **Environmental Inventory**

Environmental inventory is a complete description of the environment as it exists in an area where a particular proposed action is being considered. The inventory is

compiled from a checklist of descriptors for the physical, biological, and cultural environment. The physical environment includes such major areas as geology, topography, surface-water and groundwater resources, water quality, air quality, and climatology. The biological environment refers to the flora and fauna of the area, including species of trees, grasses, fish, herpetofauna, birds, and mammals. Specific reference must be made to any rare and/or endangered plant or animal species. General biological features such as species diversity and overall ecosystem stability should also be presented. Items in the cultural environment include human population trends and population distributions, historic and archeological sites, and economic indicators of human welfare.

The environmental inventory serves as the basis for evaluating the potential impacts on the environment, both beneficial and adverse, of a proposed action. It is included in an impact statement in the section referred to as "description of the existing environment" or "description of the environmental setting without the project" (5). Development of the inventory represents an initial step in the environmental impact assessment process.

### **Environmental Assessment**

The environmental assessment represents the key step in meeting the requirements of NEPA. In essence, it is an attempt to evaluate the consequences of a proposed action on each of the descriptors in the environmental inventory. The essential steps in an environmental impact assessment are

- 1 Prediction of the anticipated change in an environmental descriptor.
- 2 Determination of the magnitude or scale of the particular change.
- 3 Application of an importance or significance factor to the change.

Many of the current assessment approaches embody the steps of prediction, scaling, and significance interpretation, although the methods use many terms to describe these particular steps.

The scientific validity of the technology available for the prediction of impacts varies depending upon the particular environmental descriptor. For example, extensive research and sound scientific methods have been developed for prediction of air quality impacts (6), at least with regard to anticipated concentration levels of pollutants in the ambient air; however, impacts on flora or fauna as a result of the calculated concentration levels are less quantifiable. Thus it is possible to utilize sound technology for some impact predictions, whereas other predictions must be primarily based on professional judgment.

In order to accomplish an environmental assessment, as well as to prepare an inventory and write an impact statement, it is necessary that the approach used be interdisciplinary, systematic, and reproducible. Requirements for an interdisciplinary approach indicate that the environment must be considered in its broadest sense; thus the input of persons trained in a number of technical fields needs to be included (7). The disciplines represented in a specific environmental assessment must be oriented to the unique features of the proposed action and the environmental

setting; however, at a minimum it is necessary to have input from a physical scientist or engineer, a biologist, and a person who can address cultural and socioeconomic impacts. Requirements for a systematic and reproducible approach indicate that a degree of organization and uniformity should be utilized in the assessment process. In this regard several assessment methodologies have been developed since 1970 (8, 9), and these will be discussed in more detail later.

### Environmental Impact Statement

The environmental impact statement (EIS) is a document written in the format as specified by NEPA, CEQ guidelines, and specific agency guidelines. The EIS represents a summary of the environmental inventory and the findings of the environmental assessment. Environmental impact statements are also referred to as "environmental statements," "impact statements," "environmental impact reports," or "102 statements" (10). The term 102 statement refers to the section in NEPA that spells out the requirements for the preparation of an EIS.

There are two categories of EISs: draft statements and final statements. The draft statement is the document prepared by an agency proposing an action; it is circulated for review and comment to other federal agencies, state and local agencies, and public and private interest groups. Specific requirements with regard to timing of review are identified in the CEQ guidelines (the 1973 CEQ guidelines are included here as Appendix B). The final statement is the draft statement modified to include a discussion of problems and objections raised by reviewers. The final statement must be on file with CEQ for at least a 30-day period prior to initiation of construction on a project.

### NATIONAL ENVIRONMENTAL POLICY ACT

The act is divided into two basic parts: title I, which is a declaration of a national environmental policy, and title II, which establishes the CEQ. The national goals as specified in section 101 of the act are as follows (4):

- 1 Fulfill the responsibilities of each generation as a trustee of the environment for succeeding generations.
- 2 Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- 3 Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.
- 4 Preserve important historical, cultural, and natural aspects of our national heritage and maintain, where possible, an environment that supports diversity and variety of individual choice.
- 5 Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
- 6 Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

trustee

Section 102 of NEPA has three primary parts related to the environmental impact assessment process. Part A specifies that all agencies of the federal government shall utilize a systematic, interdisciplinary approach, which will ensure the integrated use of the natural and social sciences and environmental design arts in planning and in decision making that may have an impact on the human environment. Part B requires agencies to identify and develop methods and procedures that will ensure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations. This part has provided impetus for the development of several environmental assessment methods. Part C indicates the necessity for preparing environmental statements and identifies basic items to be included. It also indicates that agencies should include in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment a detailed statement that covers five major areas (4):

- 1 The environmental impact of the proposed action.
- 2 Any adverse environmental effects that cannot be avoided should the proposal be implemented.
- 3 Alternatives to the proposed action.
- 4 The relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity.
- 5 Any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented.

The requirement for preparing an EIS was not a part of the original proposed legislation that subsequently became NEPA (11). Detailed histories of the legislative background of NEPA have been presented by Andrews (12) and Yannacone and Cohen (13). Section 102 requirements were added late in the legislative review process, just prior to final action on the part of Congress. These particular requirements have been called the "action-forcing mechanism" of NEPA (14), indicating that agencies must prepare a draft statement, which is then subject to review and critique by other federal agencies as well as state and local governmental and private groups. It is an understatement to say that the NEPA requirements for preparing impact statements have been controversial (15, 16), and many court cases have resulted from this section of NEPA (17-20). Perhaps one of the problems with NEPA is that it does not contain a provision for ensuring compliance (21).

One section of NEPA that has received very little attention is section 103, which requires that all agencies review their present statutory authority, administrative regulations, and current policies and procedures for the purpose of determining whether there are any deficiencies or inconsistencies therein that prohibit full compliance with the purposes and provisions of NEPA. Very few written responses have been recorded with regard to action taken in conjunction with section 103 (11, 22).

## MAJOR ACTIONS SIGNIFICANTLY AFFECTING THE QUALITY OF THE HUMAN ENVIRONMENT

Section 102 of NEPA requires that environmental statements be prepared for "major Federal actions significantly affecting the quality of the human environment." The Corps of Engineers uses the acronym MASAQHE for this phrase. Definitions are not included in NEPA for what constitutes a major action or what constitutes a significant effect on the quality of the human environment. Concern with these definitions is relevant since the preparation of an EIS requires both human and economic resources (23). One of the negative results of the passage of NEPA has been the preparation of impact statements on projects that perhaps should not require much attention, such as installation of traffic control signals and minor roadway resurfacing work. On the other hand, many major actions of the federal government, such as peace-time military activities and space activities, have not had EISs filed.

To attempt to define a "major action significantly affecting the quality of the human environment" involves many quantitative and qualitative considerations. The simplest way of defining a major action is to compare a predicted impact with an environmental quality standard for a given parameter. It is possible to do this for many substances found in air and water, for example, suspended particulates in the atmosphere and dissolved oxygen in water. However, there are many environmental parameters for which only subjective standards are available, such as scenic vistas and archeological sites. Agencies can best define MASAQHE by project type, indicating that certain projects require impact statements because they are major actions, and others do not because they are minor actions. The Federal Highway Administration has developed guidelines of this type (24). Major actions include a highway section entirely or generally on a new location and major upgrading of an existing highway section that requires extensive right-of-way acquisition and construction. Highway sections that may have a significant effect on the quality of the human environment include those

1 That are likely to have a significantly adverse impact on natural ecological, cultural, or scenic resources of national, state, or local significance.

2 That are likely to be highly controversial regarding relocation housing resources.

3 That divide or disrupt an established community; disrupt orderly, planned development; are inconsistent with plans or goals that have been adopted by the community in which the project is located; or cause increased congestion.

4 That involve inconsistency with any national, state, or local standard relating to the environment; have a significantly detrimental impact on air or water quality or on ambient noise levels for adjoining areas; involve a possibility of contamination of a public water supply system; or affect groundwater, flooding, erosion, or sedimentation.

Negative declarations can be prepared on the following types of highway improvement actions since they are not likely to have significant impacts:



- 1 Signing, marking, signalization, and railroad protective devices.
- 2 Acquisition of scenic easements.
- 3 Modernization of an existing highway by resurfacing; less-than-lane-width widening; adding shoulders; auxilliary lanes for localized purposes.
- 4 Correcting substandard curves.
- 5 Reconstruction of existing stream crossings where stream channels are not affected.
- 6 Reconstruction of existing highway/highway or highway/railroad separations.
- 7 Reconstruction of existing intersections including channelization.
- 8 Reconstruction of existing roadbed, including minor widening, shoulders, and additional right-of-way.
- 9 Rural two-lane highways on new or existing location that are found to be generally environmentally acceptable to the public and local, state, and federal officials.

### BASIC CONTENTS OF AN IMPACT STATEMENT

Section 102, part C, of NEPA identifies five points that need to be adhered to in an EIS. The first one is to describe "the environmental impact of the proposed action." In the early years of the preparation of impact statements, attention was primarily focused on the negative or detrimental impacts associated with a given proposed action. To be complete both beneficial and detrimental impacts should be delineated. The basic thrust of NEPA is that it is a "full disclosure law," implying that both the positive and negative ramifications of a given proposed action should be explored in complete detail (25). In addition, attention must also be directed toward the primary and secondary impacts associated with a proposed action (5). Primary and secondary impacts are also referred to as direct and indirect consequences. Table 1-1 includes a partial listing of the direct and indirect impacts of a sewage treatment plant, with only adverse impacts being identified (26). In general, agencies have developed methods and procedures to respond in part to direct impacts, both beneficial and adverse. However, the major impact of a project is often from secondary or even tertiary effects, and these are much more difficult to assess due to the dearth of predictive techniques available.

The second item required by NEPA is an identification of "any adverse environmental effects which cannot be avoided should the proposal be implemented." If a thorough approach has been utilized in describing the environmental impact of the proposed action, this section should basically be an abstract of the negative impacts, both direct and indirect, of the proposed action. New information is not included in this section.

The third point focuses on a discussion of "alternatives to the proposed action." This section has caused a great deal of difficulty, and many court cases have resulted from inadequate treatment of this section by the proposing agency (17-20). Kennedy and Hanshaw (27) reported on an analysis of the alternatives sections of 200 randomly selected environmental statements from several agencies. Of the 127 actions that listed adverse environmental effects, a total of 214 alternatives were listed, all of which were rejected: 130 were rejected for economic