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EPA • United States Environmental Protection Agency

PRINCIPLES OF ENVIRONMENTAL IMPACT ASSESSMENT

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Principles of Environmental Impact Assessment

An International Training Course

UPDATING AND ENRICHING THIS TEXT

This text will be periodically updated to include new environmental impact assessment concepts and examples from countries around the world. Readers are encouraged to send comments and ideas for the next edition to:

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This text is one of two documents that form the basis of a training course on Principles of Environmental Impact Assessmen (EIA). The other is the Facilitator's Manual, which contains the guidance, materials, and handouts required for facilitating the course. The text and course are designed for policy makers from government, academia, public life, and environmental and industrial organizations, broadly designed for use by anyone interested in an Environmental Impact Assessment program, in any culture.

The course was prepared in 1991 by the U.S. Environmental Protection Agency (USEPA) staff in Washington, D.C. Headquarters' Office of Federal Activities and USEPA's Region III in Philadelphia, Pennsylvania, with assistance from Gannett Fleming, Inc. and EcolSciences. It is based upon internationally accepted principles and frameworks as well as 25 years of experience within USEPA implementing its EIA program, as well as the input from many colleagues around the world. It was first developed in response to a request by Poland's Ministry of Environmental Protection, Natural Resources and Forestry and subsequently revised for delivery at the request of the Secretary of Social Development of Mexico (SEDESOL) with financial support from the U.S. Agency for International Development. Modest revisions to the course materials were designed by USEPA in response to comments of course facilitators from all EPA Regions and participants from over a dozen countries over the past five years. These changes were completed with the assistance of Science Applications International Corporation under EPA Contract No. 68-W2-0026 in 1997.

PRINCIPLES OF ENVIRONMENTAL IMPACT ASSESSMENT

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1. INTRODUCTION

Many countries have taken positive actions to protect environmental resources and public health from environmental pollution and to restore and enhance the quality of their natural environments. They have developed or are developing legislative, procedural, and technical strategies for assessing the potential environmental changes caused by: 1) the development of new sites, 2) the redevelopment of existing sites, 3) the remediation of disturbed or contaminated sites, 4) use of natural resources, and/or 5)significant new government policies and programs. The common goal of these various environmental laws, procedures, and regulations is to establish a substantive environmental policy that protects natural resources, environmental quality, and public and ecological health and better integrates economic, social and environmental goals. Integral to this goal are systematic procedures for environmental impact assessment (EIA).

EIA is an early warning system and an on-going review process.

Most strategies of EIA derive from statutory requirements that must be addressed in planning for large and small projects that could, if constructed and operated, change the nature or quality of environmental resources, both natural and man-made. An EIA program converts the language and intent of fundamental environmental laws and policies into a uniform set of procedural and technical requirements that permit a systematic review of proposed actions well before those actions are implemented. In this regard, EIA is both an early warning process and a continuing review process that protects sensitive environmental resources from unwarranted or unanticipated damage.

WHAT IS THE PURPOSE OF THIS TEXT?

This text has been prepared to help individuals responsible for environmental protection and impact assessment in different countries, regions, and localities design and implement programs of EIA and to help others participate in the process as reviewers and commentors. It is intended to provide general and specific guidance in the *principles* of EIA for anyone involved in development, redevelopment, and remedial planning, including

government officials, nongovernment officials, industry and academic leaders, environmental scientists and engineers, and private citizens.

This text is *not* designed to provide comprehensive technical guidance in the use of EIA tools such as air quality modeling, water quality modeling, ecological community analysis, risk assessment, or fiscal analyses. Such methodologies are summarized in this text in terms of the types of approaches available for the assessment of environmental impacts. In addition, references to texts or manuals that discuss the specific application of such methodologies are given in Chapter 13 of this text. The focus of this text, however, is on the *internationally accepted principles* that underlie sound EIA programs rather than on the specific tools or measures of impact assessment.

This text provides the following:

- A characterization of the nature and importance of an EIA program.
- A framework for designing and developing EIA strategies and programs.
- Key considerations in the EIA process.
- A synopsis of general methods for predicting and assessing environmental impacts.
- Guidance for the preparation of environmental impact assessment (EIA) reports.
- Examples of existing EIA programs and major EIA issues.
- Options for incorporating various elements into a specific EIA program.
- A list of resources that provide further information.

The successful implementation of EIA procedures requires significant effort, forethought, and cooperation among many responsible parties. The incorporation of EIA into existing systems of land use planning, particularly incorporation at the early stages of such planning, often entails modifications of well-established procedures. Those modifications may be modest or extensive, depending on the nature of prior planning practices. Nevertheless, a reliable framework for designing and

implementing EIA programs has emerged from the experiences of several nations, including the United States, the United Kingdom, France, Germany, Italy, Greece, the Netherlands, and Canada. This text draws from those experiences and will be updated periodically to enrich the value of the guidance it provides.

EIA is a problem-solving approach to the decision-making process.

WHAT IS EIA?

EIA is both a decision making process, and a document that provides a systematic, reproducible, and interdisciplinary evaluation of the potential effects of a proposed action and its practical alternatives on the physical, biological, cultural, and socioeconomic attributes of a particular geographical area.

The EIA process should be systematic, reproducible and interdisciplinary.

EIA is often a key component in national, regional, or local facilities planning and land use planning. The purpose is to assure that important environmental resources are recognized early in the planning process and protected through proper planning and decision-making. The EIA analysis should be *systematic* to assure that all feasible alternatives that would meet the basic purpose and need of the proposal are considered and compared, that relevant environmental resources are described and evaluated, and that all measures that could protect those resources are given full consideration in the planning process. The EIA should be *reproducible* to permit independent verification of the findings and conclusions presented in the EIA document. The EIA should be *interdisciplinary* to ensure that experts in the relevant physical, biological, cultural, and socioeconomic disciplines contribute their expertise to the overall assessment so that the evaluation of resources and impacts is comprehensive and accurate.

As a decision-making process, EIA provides a means for all stakeholders in an action to be heard and to participate in the process of selection of alternatives and mitigation of adverse impacts. It also brings before decision makers more alternative courses of action that may better achieve several instead of just one set of goals. Finally, it helps to identify actions needed to prevent future environmental damage from future anticipated impacts.

The terminology used to describe the process of assessing the potential environmental impacts of human actions is somewhat variable from country to country. In this text, the following conventions have been used:

EIA is the process and the document.

- The phrase *environmental impact assessment, or EIA* denotes the process as well as referring to the document detailing the EIA process for a particular action or class of actions. Decisions include: 1) whether to evaluate impacts to the environment of a proposed action and reasonable alternatives, 2) whether to consider alternatives and mitigation of adverse environmental impacts and the results of analysis into account when deciding upon the proposed action or its reasonable alternatives, and 3) how to involve stakeholders in the process.

Initial EIA is a preliminary evaluation.

- The phrase *initial environmental impact assessment* denotes an early stage of EIA wherein a brief, preliminary evaluation of the types of impacts resulting from an action are described.

WHY IS EIA IMPORTANT?

EIA improves planning and decision-making.

An effective EIA program brings multiple benefits to society; several principal benefits are summarized in Table 1-1. First, and most important, natural resources, environmental quality, and public health are accorded appropriate degrees of protection through a substantive environmental policy and an effective EIA process. Second, the EIA document brings together in a public document all relevant information on the proposed action, the nature of the affected environment, and the types of potential environmental impacts that might result from implementation of the proposed alternatives to the action. Third, the identification of finite resources and potential environmental impacts at the earliest stages of project planning promotes the selection of the most appropriate alternatives, pollution prevention, and the use of best management practices and technologies to reduce the magnitude of those environmental impacts resulting from the action.

HOW MAY EIA PROGRAMS EVOLVE IN DIFFERENT CULTURES AND COUNTRIES?

Anyone involved in designing an EIA program will face certain fundamental issues: How should such a program be initiated? What elements should be emphasized? How can the full range of responsibilities be handled with limited program resources? How should the program evolve over time as the program moves to new stages, and as policy-makers evaluate the success of previous strategies? How can the program address technological and economic developments that require new assessment methodologies?

Each program must answer these questions based on the resources and culture in place. This text provides a broad range of possibilities for the different elements of an EIA program. Policy-makers can select from these possibilities to design or modify a program so that it best serves the desired goals within the available resources.

EIA programs should be developed from fundamental approaches and methodologies.

The resources available to implement an EIA program may limit the breadth and sophistication of the program's initial application. Ideally, agencies and individuals who are charged with preparing EIAs would be well-trained and experienced before they engage in full-scale assessments. Due to limited resources and/or program priorities, many programs rely initially, if not predominantly, on on-the-job training. The challenge for every program is to make the most effective use of the resources that are available. The approaches and methodologies discussed in this text provide a broad base from which individual EIA programs can be formulated.

National policy is an important consideration in the effectiveness of an EIA program.

Finally, the effectiveness of an EIA program depends on the degree to which environmental quality is a national, regional, and local priority. Adherence in decision-making to a program of thorough EIA may lead to difficult economic choices and environmental compromises. Public and government concern for environmental quality provide an important foundation for EIA programs as without this commitment there is no guarantee that a sound

environmental decision will result from having carried out an EIA on several alternatives.

TABLE 1-1
THE IMPORTANCE OF AN EIA PROGRAM

- **Establishment of a Substantive Environmental Policy.** An effective program of EIA expresses the intent at the national, regional, or local level to establish a sound and sustainable environmental policy for governmental and private decision-making.

- **Protection of Natural Resources, Environmental Quality, and Public Health.** An effective EIA program serves to identify, in advance, actions that could have significant adverse effects on natural resources; on the quality of local, regional, or national environment; and on human health and safety. In this regard, the EIA program is an important preventive measure that reduces potential risks to the well-being of the natural environment.

- **Full and Open Disclosure of All Environmental Consequences of a Proposed Action.** An effective program of EIA provides a standardized mechanism for documenting and disclosing the full spectrum of effects of a proposed action. This disclosure encourages a thorough examination of all actions that could affect the natural environment.

- **Objective Consideration of All Reasonable Alternatives.** The heart of the EIA process is the objective and systematic comparison of reasonable alternatives to identify the least environmentally damaging alternative that would meet the stated purpose and need of the proposed action.

- **Establishment of a Uniform and Quantitative/Qualitative Basis for the Identification and Characterization of All Relevant Environmental Impacts.** The systematic steps included in an effective EIA program provide technical guidance concerning the types of environmental effects that should be evaluated, the range of technical methodologies that might be used in those evaluations, and the types of techniques that can be used to predict potential effects resulting from a proposed action.

- **Application of Best Management Practices to Minimize Unavoidable Impacts.** Early identification of effects potentially stemming from a proposed action can promote the use of best management practices or innovative technological solutions to eliminate, reduce, or mitigate significant adverse impacts.

- **Encouragement of Public Participation Throughout the EIA Process.** Provisions for public involvement through workshops, meetings, and hearings promote an open flow of information and allow communities and citizens to make reasoned choices about the benefits and risks of proposed actions. It also helps to identify alternatives which may not have otherwise been considered which better serves to integrate economic, social and environmental concerns.

NOTES

2 BASIS FOR EIAs

2. BASIS FOR EIAs

INTRODUCTION

Although EIA laws and regulations may differ from country to country, many nations have included both formal statements of environmental policy and a set of procedures designed to integrate these policies into the planning routines of government agencies and private developers. In general, the procedures require the preparation of a formal document that evaluates a proposed action, explores a spectrum of viable alternatives, assesses the impacts of those alternatives, and identifies measures to avoid or lessen the severity of unwanted impacts. The information disclosed by the EIA process can form the basis for a decision either to approve or deny a proposed action, or to place conditions on its implementation (Environmental Law Institute, 1991).

Traditional planning approaches may need to be expanded to include all the EIA concepts.

An EIA program will often require that environmental specialists and planners consider a broader range of alternative solutions and/or locations for proposed actions than might have been considered in the absence of such a program. An EIA program may also require that potential impacts to environmental resources be evaluated in detail, and that a preferred alternative be selected on objective merits. This procedure for reviewing proposed projects before they are implemented means that traditional planning methods may have to be altered or adapted to accommodate all of the EIA program requirements.

An EIA program fosters balanced decision-making and public participation.

The aspects of traditional planning that are most likely to be affected by the adoption of formal EIA procedures are precisely those aspects that constitute the core of an effective EIA program. These aspects are 1) balanced decision-making and 2) public participation. In the absence of an EIA program, decisions on development, redevelopment, remedial actions or management of natural resources can be made unilaterally, often by individuals or organizations that have some degree of bias or preference toward how the action should be oriented in location, design, or both. Such unilateral decision-making provides minimal information

about the planning process to the concerned public, and eliminates the opportunity for public participation and comment on the proposed action. An effective EIA program, conversely, precludes unilateral decision-making by informing decision-makers and involving the public. Single focus decision making can often miss key opportunities for achieving greater benefit and avoiding unforeseen costs.

Balanced decisions consider adverse and beneficial effects.

BALANCED DECISIONS

A principal goal of the EIA process is to ensure, to the greatest degree possible, that the undesirable environmental effects of an action are kept to their practicable minimum. It should be evident, however, that virtually any new development, redevelopment, remedial action or resource use will alter some attributes of the existing environment. A primary function of EIA in the decision-making process is to ensure that decisions on proposed actions are balanced, i.e., that the environmental effects (both positive and negative) of an action are weighed against the socioeconomic results of the action. The information acquired and evaluated in the EIA process should thus be organized and presented in a manner that facilitates balancing these positive and negative factors. Moreover, the EIA process should consider in comparative fashion several reasonable alternatives that could meet the purpose and need of the proposed action. These alternatives should include the option of not carrying out an action in any way (the no-action alternative), and describe objectively the reasoning for the preference of one alternative over others.

The no-action alternative is the option of not carrying out an action in any way.

The EIA docket is a record of all the steps in the process.

The full and open disclosure goals of the EIA process apply most emphatically to the aspect of balanced decision-making. The administrative record, or docket, of the EIA process should thoroughly document the steps taken throughout the process to balance the factors incorporated into the final decision on the proposed action. This would include records of meetings, issues discussed at meetings, records of written and oral comments from cooperating agencies and interested parties, and full documentation of the various alternatives considered.

TABLE 2-1
PROCEDURES TO ENCOURAGE PUBLIC PARTICIPATION IN EIA PROGRAMS

- In the law-making and rule-making stages of EIA programs, **publicize the adoption of environmental laws and regulations.** Emphasize the provisions that promote public participation in the programs and publicize any changes to the laws and regulations.
- Incorporate a provision into EIA regulations that requires an agency or private party to publish in the public media a **notice of intent** to undertake an EIA and request for public comment.
- Invite public participation in the early planning stages of the project or program planning through the use of **scoping meetings.**
- **Solicit assistance** from the public in identifying project/program alternatives to be studied and in comparing and screening reasonable alternatives.
- Inform the public about **significant issues and changes** in proposed projects or programs as such issues or changes arise.
- Solicit assistance from the public, particularly from conservation groups and similar organizations, in **describing the ecological condition** of the environments potentially affected by the proposed project or program.
- **Anticipate potential conflicts** and encourage early discussions of differences among affected parties.
- Incorporate provisions into EIA regulations that require a sufficient time to be set aside for a period of **public review and comment** on the EIA report. Preferably, this would occur at the stages where the draft and final EIA report are released.
- Solicit comments from the public in **formal public hearings, informal workshops, or information sessions** sponsored by the agency responsible for reviewing or preparing the EIA.
- Provide for **responses to the comments** in a final EIA document or a separate document called a "responsiveness summary."
- Use **special facilitators** or environmental mediators to enhance dialogue and communications.

NOTES

3 EIA LAWS AND REQUIREMENTS

3. EIA LAWS AND REQUIREMENTS

INTRODUCTION

EIA laws should be designed to improve the quality of planning and decision-making.

The initial steps that should be taken to create an effective EIA program are the establishment of environmental policy and guidance documents followed by law-making and rule-making steps that establish the fundamental mechanisms for the EIA process. An important goal of EIA laws and regulations is to improve the quality of planning and decision-making by government agencies, private organizations, and individuals.

In this text, a law refers to a statute passed by a legislative body. A regulation, alternatively, refers to a ruling that provides more detailed direction needed to implement the law. A regulation is typically issued by a government agency.

EIA laws and regulations require that parties prepare an EIA document, follow certain procedures and consider the environmental consequences of their actions or proposed actions, and give substantive consideration to reasonable alternatives that avoid or reduce adverse environmental impacts. EIA laws and regulations are most effective when they are linked to monitoring and follow up to any agreed upon mitigation from to prevent environmental or other adverse impacts. EIA laws and regulations can have the added benefit of public participation and confidence in the decision-making process through full disclosure provisions. Finally, by setting "milestones" for various steps of EIAs, the laws and regulations encourage the timely completion of the decision-making process. Each component is discussed further below and summarized in Table 3-1. For comparative purposes, a synopsis of the United States' National Environmental Policy Act (NEPA), which is the EIA statute used in the United States, has also been added at the end of this chapter.

NEPA is the EIA statute in the United States.

TABLE 3-1
BASIC COMPONENTS OF AN EFFECTIVE EIA PROGRAM

- The establishment by law of a **substantive national environmental policy** that encompasses the concept of EIA.
- The creation of **EIA regulations and requirements** that implement environmental law in ways that are systematic, rigorous, and practical.
- The establishment of a **regulatory system** ("agencies") for preparing EIA's, or for coordinating, guiding and reviewing the preparation of EIA's by others.
- The identification and **clarification of organizational roles and responsibilities** within the general framework of EIA regulations and procedures.
- The **coordination of EIA preparation and review activities and decision-making** among government agencies, private developers, environmental consultants, and the public.
- The **ongoing evaluation of the success** of the program and holding program personnel accountable for its success.
- The encouragement of **public participation** in all aspects of the EIA process.

ENVIRONMENTAL POLICIES AND LAWS

EIA policies clarify and express the intent to protect the environment.

The establishment of a substantive environmental policy can provide a solid foundation upon which an EIA program can be built. Such a policy can express the intent and resolve of the government to protect and enhance the natural environment as a means to safeguard the human environment. An environmental policy at the national level can establish the environmental standard and promote consistency in environmental considerations at lower levels of government.

Laws formalize policies.

The environmental policy can be formalized through the adoption of laws or statutes at the national, regional, and local levels of government. These environmental laws may set forth broad general policies or may be directed at specific environmental issues and responsibilities.

EIA REGULATIONS

Regulations provide detailed requirements for implementing laws.

Following the establishment of laws, the *rule-making* process translates legislative intent into formal regulations, requirements, and procedures that are to be followed. These regulations may detail such requirements as the circumstances requiring the preparation of an EIA, the timing and content of the EIA, and reviewing and commenting procedures for the EIA. These regulations may also establish agencies with specific oversight, review, and permitting authority. The regulations may also establish requirements for the integration of public participation throughout the EIA process. Typically, the rule-making steps contain more specific information than do the laws; the rules often contain details on the technical, analytical, and procedural requirements for the program. After the laws and rules necessary and sufficient to implement an EIA program have been established, the *decision-making* process - the heart of the EIA program - can commence.

FULL DISCLOSURE

The agency responsible for conducting the EIA for a particular action should be required to maintain full

Full documentation of the EIA process is necessary.

documentation of the EIA procedures followed. This planning record, or docket, is evidence of the agency's compliance with the EIA laws and regulations. If a document is lost or was never prepared, the agency has no evidence of the efforts it took to follow the EIA procedures. Some countries have laws mandating that such planning records be made available to the public for examination upon request.

Conflicting views often surface when a draft EIA is released.

At the point where the findings of the EIA have been incorporated into a draft document, full disclosure and public comment can be encouraged by circulating copies of the draft EIA report to public institutions (e.g., libraries, local government offices) as well as to interested governmental agencies. Although procedures should be structured to encourage full disclosure and public participation throughout the EIA process, in practice, it is often the disclosure of the draft EIA document that generates the highest degree of public scrutiny and comment on the proposed action.

Did you have a sandwich for lunch?

It cannot be stressed too strongly that the EIA process for any particular project should be documented fully and carefully. This record serves as the "project memory" and is a record that can be consulted should any aspect of the EIA process be called into question. The need for such documentation can be illustrated by an example from a major highway project that was recently proposed in the northeastern United States. The EIA report was legally challenged by several citizens groups on the grounds that certain interpretations of impacts were changed between the time the draft and final EIA reports were issued and that the changes in interpretations were not fully documented. A governmental official indicated in court testimony that certain calculations had actually been performed and had been written on the wrapping paper of the official's lunchtime sandwich. The judge ordered the official to produce that wrapper and enter it into evidence. In this case, the paper actually had been kept and was duly produced and entered into the record. However, the calculations that caused the interpretations of impacts to be revised should have been formalized at the time they were performed and entered into the public record for the project.

TIMING OF EIAs

A fundamental goal of the EIA process is to incorporate environmental considerations as part of the decision-making process; therefore, agencies should integrate the EIA process with other planning processes at the earliest possible time. This will ensure that planning and decisions reflect environmental values, avoid unnecessary delays or procedural corrections later in the planning process, and minimize potential conflicts. In addition, design changes can be incorporated into the project planning to avoid or reduce environmental impacts identified by an EIA.

EIA Process
↓
Planning
↓
Design
↓
Implementation

The project proponent, agency, non-governmental organization, or team responsible for project planning should not commit resources in a way that would prejudice selection of alternatives before the EIA process is completed. For example, a developer should not financially invest in a particular action to the point that the developer considers all other alternatives impractical because of that investment. As another example, detailed planning for a facility on a specific site may be required for a feasibility study but the investment in time and money to obtain those details should not be used as a claim that other alternatives become less viable because of that investment. In this regard, the EIA process should not be used to rationalize or justify planning decisions made prior to application of the EIA process.

The EIA process should not be used to justify planning decisions!

TIME LIMITS ON THE EIA PROCESS

The implementation of a uniform process for conducting an EIA should make the preparation of the document and the decision-making process more efficient. However, projects and programs differ in their complexity and scope of potential impacts so the actual lengths of time required for the preparation and review of EIAs for these projects and programs are likely to vary. The time required

for an EIA can depend on such factors as the complexity of long-term planning details and/or the acquisition of sufficient data. Placing limits on the time allowed to prepare or review an EIA without knowledge of the actual time required can result in an inadequate or incomplete EIA process and EIA because of unrealistic deadlines. Therefore, any statutory limits placed on the length of time required to complete the preparation or review of an EIA should be based on observations of the lengths of time required to complete several actual EIAs. These EIAs should have satisfied all EIA requirements and represented the spectrum of proposed actions likely to be encountered in the future. Until statutory limits can be finalized, initial guidelines for time limits on one or more stages of the EIA process can be imposed to ensure the process progresses toward completion.

Any statutory time limits should be based on experience in completing several EIAs.

Alternatives and the no-action alternative.

ALTERNATIVES ANALYSIS

Alternatives are different means of meeting the general purpose and need of a proposed project or program. The no-action alternative is the option of not engaging in the proposed project or the other "action" alternatives.

The EIA process as a decision-making tool operates properly only if the assessment thoroughly considers a spectrum of feasible alternatives that could reasonably achieve the purposes and goals of a proposed action (Table 3-2). In this way, the least environmentally damaging alternative that still satisfies the purpose and need can be identified and selected. In the absence of such feasible alternatives, the usefulness of the EIA process is diminished greatly, yielding no more than a cataloging of the environmental impacts of a specific project in a particular location.

Structural and non-structural alternatives may meet the purpose and need of the project.

The identification and characterization of feasible alternatives should be carried out as soon as possible after the purpose and need are established; in this way, project planning does not bias the assessment toward one alternative or another. The alternatives analysis should include full consideration of non-structural and structural alternatives that would satisfy the purpose and need.

TABLE 3-2
ALTERNATIVES ANALYSIS IN THE EIA PROCESS

- An EIA for a proposed action should consider a **range of alternative means** of achieving the stated purpose and need of the action.
- The range of alternatives should include the **no-action alternative**, the option of not engaging in the proposed action or other action alternatives, or, in the case of programs or policies, of not changing existing programs or policies.
- All **reasonable alternatives** should be rigorously explored and objectively evaluated in the EIA. Reasonable alternatives should include those that are viable or feasible from a technical and economic standpoint, rather than only those desirable from the standpoint of the project sponsor.
- Alternatives can be **screened** to reduce their number so that a reasonable number of alternatives that represents the complete array of viable alternatives can be evaluated in detail.
- Where the choice of no-action would result in predictable actions by others (e.g., if not building a new roadway would create the need to redesign an existing roadway), this **consequence of the no-action alternative** should be included in the analysis.
- **Alternatives eliminated** by objective screening from detailed study should be identified, and the reasons for eliminating them should be documented.
- All alternatives should be of equal, objective detail and given **equal, objective treatment** in presentation such as displays and maps, throughout each stage of the EIA process.
- The EIA report should identify a **preferred alternative** and document the selection criteria by which that alternative came to be preferred over other alternatives.
- The decision-maker should **consider all the alternatives** discussed in an EIA report, not just the preferred alternative.

Alternatives include changes in size, location, technology, or planning.

Example:
Proposed Project:
Construction of a new drinking water supply reservoir.

Range of alternatives that may be considered:

- **No action**
- **Water conservation measures**
- **Installation of groundwater wells**
- **Construction of a desalination system**

In the identification of these alternatives, the no-action alternative, which is the option of not to engage in the proposed action or other action alternatives, should be retained as a feasible option and given serious consideration in the subsequent EIA steps. The no-action alternative serves as an objective baseline against which the other alternatives can be measured. When the environmental consequences of the other action alternatives are weighed against their projected benefits, the no-action alternative can sometimes be the preferred alternative and the one selected.

The alternatives should offer legitimate and substantive choices; siting a facility in one location or another of a large tract of land may be an appropriate approach to reducing environmental impacts, but generally constitutes only one alternative way, in the legitimate sense, of meeting the purpose and need of the proposed action. The alternatives evaluated should ideally provide the decision-makers with different geographical locations for the action and with different technical or planning solutions for achieving equivalent goals. For example, if the purpose of a proposed action is to supply potable water to a particular region, the alternatives analysis should not be limited merely to a consideration of different sites for surface water reservoirs. Rather, the alternatives analysis should also consider the adoption of water conservation measures, the use of groundwater aquifers, regional distribution systems, and desalination of marine or brackish waters. This spectrum of conceptual alternatives presents decision-makers with a balanced set of structural and non-structural options that offer much more than an alternative location for a particular type of water supply facility.

Preferred Alternative.

As the EIA process for any particular action progresses, the agency or party conducting the EIA can identify one or more "preferred alternatives." A preferred alternative is generally identified on the basis of its technical, environmental, and economic merits, relative to the other project alternatives, including the no-action alternative. A preferred alternative, once identified, becomes a focal point for commentary by other agencies and the public. The systematic comparison of alternatives, including the no-action alternative, should be carried throughout the documentation of the EIA process, treated in equivalent detail, and given equal weight, even when a agency

preferred alternative has been identified. The selected alternative is the alternative that is chosen for implementation.

THE NEPA EXAMPLE

The environmental law that stipulates the need for EIA need not necessarily be lengthy and detailed. In the United States, the National Environmental Policy Act of 1969 (NEPA), which had enormous and far-reaching influences on the way environmental impacts were evaluated, was a model of brevity at five pages in length. The major sections of NEPA encompassed the following:

A five-page document contains the statute for EIA in the United States.

The NEPA statute addressed:

- **National policy,**
- **Use of EIA in government activities,**
- **Independent review agency, and**
- **Funding.**

- A congressional declaration of national environmental policy.
- A directive to all federal agencies to use a systematic, interdisciplinary EIA approach in planning and decision-making, including the preparation of an "environmental impact statement" documenting in formalized categories the EIA process and findings.
- The creation of a Council on Environmental Quality (CEQ), an independent government agency, whose duties were to gather information concerning conditions and trends in the quality of the environment, review and appraise the various programs of the federal government, develop and recommend national environmental policies, conduct environmental investigations, and report at least once per year on the state and condition of the national environment.
- The authorization of federal funds for the conduct of the activities authorized by the Act.

The CEQ subsequently issued its NEPA guidelines implementing the federal act. These regulations are much more extensive and detailed than the act; the CEQ addressed

CEQ's regulations provided details on how to implement NEPA:

- **Agency responsibilities**
- **Format of documents**
- **Timing**
- **Review process**

agency responsibilities, the format of the EIA document (called, in the United States, an environmental impact statement or EIS), set the timing of various stages of EIA, and outlined the review and decision-making processes that would follow any assessment. The headings of the major sections of the CEQ guidelines for implementation of NEPA are listed in Table 3-3. In addition to the CEQ guidelines, federal agencies in the United States have adopted their own sets of regulations that implement NEPA and are consistent with the statute.

TABLE 3-3
IMPLEMENTATION OF NEPA BY CEQ IN THE UNITED STATES

PURPOSE, POLICY, AND MANDATE

- Purpose
- Policy
- Mandate
- Reducing Delay
- Agency Authority
- Reducing Paperwork

NEPA AND AGENCY PLANNING

- Purpose
- Apply NEPA Early in the Process
- When to Prepare an EIA Document
- Whether to Prepare an Environmental Impact Statement
- Lead Agencies
- Cooperating Agencies
- Scoping
- Time Limits

TABLE 3-3
IMPLEMENTATION OF NEPA BY CEQ IN THE UNITED STATES

ENVIRONMENTAL IMPACT STATEMENT
- Purpose
- Implementation
- Statutory Requirements of Statements
- Major Federal Actions Requiring the Preparation of Environmental Impact Statements
- Timing
- Interdisciplinary Preparation
- Page Limits
- Writing
- Draft, Final, and Supplemental Statements
- Recommended Format
- Cover Sheet
- Summary
- Purpose and Need
- Alternatives Including the Proposed Action
- Affected Environment
- Environmental Consequences
- List of Preparers
- Appendix
- Circulation of the Environmental Impact Statement
- Tiering
- Incorporation by Reference

COMMENTING
- Inviting Comments
- Duty to Comment
- Specificity of Comments
- Response to Comments

PREDECISION REFERRALS TO CEQ OF PROPOSED FEDERAL ACTIONS DETERMINED TO BE ENVIRONMENTALLY UNSATISFACTORY
- Purpose
- Criteria for Referral
- Procedure for Referral and Response

NEPA AND AGENCY DECISIONMAKING
- Agency Decisionmaking Procedures
- Record of Decision in Cases Requiring Environmental Impact Statements
- Implementing the Decision

TABLE 3-3
IMPLEMENTATION OF NEPA BY CEQ IN THE UNITED STATES

OTHER REQUIREMENTS OF NEPA
Limitations on Actions During NEPA Process
Elimination of Duplication with State and Local Procedures
Adoption
Combining Documents
Public Involvement
Further Guidance
Proposals for Legislation
Filing Requirements
Timing of Agency Action
Emergencies
Effective Date
AGENCY COMPLIANCE
Compliance
Agency Capability to Comply and Agency Procedures

NOTES

4 CIRCUMSTANCES REQUIRING EIAs

4. CIRCUMSTANCES REQUIRING EIAs

INTRODUCTION

The regulations implementing an EIA process should include a set of standard procedures for identifying the general or specific circumstances that require a full-scale EIA. Those procedures should be capable of distinguishing between proposed actions whose anticipated impacts *are not* likely to be significant and those actions whose anticipated impacts *are* likely to be significant.

Environmental impacts and significant environmental impacts.

An environmental impact is a change in the environment brought about by implementation of a proposed project, plan, program, policy or its alternative. A significant environmental impact is, in general, an impact that could alter the properties of a natural or man-made resource in a way considered important. The significance of an environmental impact is difficult to define more explicitly in the abstract; significance of impact is generally deduced or inferred from specific EIAs for specific actions.

As noted in Chapter 2, virtually every development, redevelopment, remedial action, or resource use affects the attributes of the existing environment; in fact, most actions are explicitly taken to modify certain attributes to provide particular socioeconomic benefits. However, some actions are known to have, or anticipated to have, minimal impacts on environmental resources, and subjecting such actions to the full EIA process could be a misdirection of resources or divert the attention of decision makers from more significant issues. Therefore, the EIA process generally begins with an initial consideration of whether or not the proposed action should undergo a full EIA.

An EIA may be performed on projects, policies, plans, and programs.

The actions that might be considered as subject to EIA should include not only physical projects (i.e., construction of facilities), but also administrative policies, plans, and programs that have the potential for significantly affecting the quality of the environment.

Certain general types of projects (e.g., dams, reservoirs, power plants, major roadways) can be assumed

from their nature or intent to generate significant environmental impacts. Based on a knowledge of the types of actions in the past that have required EIAs, a general framework for determining which projects require EIAs can be established under the broad categories of scope of effect, significance of their effect on the human environment, controversial status in the public view, or existing legal or financial requirements. These broad categories are discussed individually below.

SCOPE OF EFFECT

Scope of effect considers the size of the area affected and the length of time over which impacts will occur.

This characterization refers to the extent of potential impacts generated by a proposed action, mainly in the geographic land area potentially affected, and the length of time over which the impact will occur. The area also includes the watersheds, airsheds, and ecosystems within which the project is located. The defined area within which all potential effects, impacts, features, and compensation efforts related to a proposal and its alternatives would occur can be called the study area. As noted above, reservoirs, logging operations, and power plants generate effects over large geographic areas, entail major construction, and continue to affect resources during the life of their operation. Actions with similarly broad scopes of effects might include solid waste landfills, airports, major roadways or other linear facilities (electric, gas, water transmission lines), and large industrial complexes. Similarly, a government policy relevant to the construction of all solid waste landfills in a country would have a broad scope of effect. The scope of effects of these types of projects is reasonably well understood, and EIA methodologies include detailed lists itemizing the multiple impacts that such facilities might have on environmental resources.

SIGNIFICANCE OF EFFECT ON THE ENVIRONMENT

There are particular types of actions that, though of somewhat more limited scope than in the sense discussed above, have the potential to exert significant effects on the environment. These potential effects may be related to the high sensitivity of

the resources to disturbance, to the specific nature of the impacts, to the potential duration of such impacts, or to potential secondary and cumulative impacts. The principal concern in these types of actions is that the environmental effects could cause irrevocable losses of important natural resources or irreversible effects on human health.

Highly sensitive environmental resources may be certain natural environments such as major wetland complexes (either inland or coastal), the floodplains of major rivers, large tracts of prime agricultural land or forestland, habitats with threatened species, or regions with extensive and important cultural resources. In addition, highly sensitive resources may be human resources; the potential risk of an action may be a function of the number of "sensitive receptors" in the affected area (sensitive receptors here being such things as schools, potable water supplies, recreational areas, and housing for the elderly). Increased levels of air pollution, for example, are likely to be more significant if the young, the old, or the ill - the more sensitive human receptors - will be exposed.

The nature of the potential effects will affect the EIA. Discharges of natural wastes (e.g., domestic sewage) will produce undesirable changes in surface or groundwater characteristics, but these changes are qualitatively different from those potentially resulting from the release of a synthetic chemical that is both hazardous and persistent. The effects of the discharge of natural wastes are reversible, at least in part, while contamination of surface or groundwaters with hazardous and persistent chemical compounds presents a significant problem over a longer term. The significance of such effect should also be considered in terms of time period. As the length of exposure or the frequency of exposure increases, so will the likelihood of adverse impacts.

Significance of Effects

- **Sensitive resources**
- **Irreversible impacts**
- **Duration and frequency of impact**
- **Secondary and cumulative impacts**
- **Uniqueness of resources**

Public controversy over a proposed action may be the basis for deciding to proceed with an EIA.

When does public controversy arise?

PUBLIC CONTROVERSY

Public participation in the EIA process is, for most proposed actions, accompanied by some degree of public controversy - disagreement among public groups or concerned individuals about the purpose, need, location, alternatives, or impacts of the action. Such disagreement can contribute constructively to the planning process if the adversarial positions are not too extreme. Certain types of actions have historically been particularly prone to arouse public controversy. Such projects fall into the categories of major linear facilities such as roadways, railways, transmission lines; reservoirs and dams; and facilities generating, storing, handling, or processing hazardous materials. Part of the controversy over major projects such as these relates to the need for the acquisition of land from private landowners; where private landownership is a firmly established right or policy, taking land for a public facility may be vigorously resisted. Occasionally, controversy will arise if the project will cause a disruption to land use or commuting patterns. Also, when a proposed action includes the involvement of hazardous materials, particularly in populated areas, the public discussions are likely to be controversial.

LEGAL AND FINANCIAL REQUIREMENTS

EIA Process in the United States

EIA can be linked to the permitting, licensing, or financing of a proposed action.

In the United States, the passage of NEPA in 1969 mandated the EIA process for all projects involving federal actions, including the issuance of permits, licenses, and financial assistance. In the years following NEPA, a number of states enacted environmental policy acts mandating similar EIA requirements for state-level projects, and many local municipalities have followed this lead. As a result, an EIA in some form is likely to be required by statute for many development or redevelopment projects in the United States. The governmental levels administering regulations and making decisions on proposed actions may range from the level of the local to the federal government. There is also a notable trend toward project financiers requiring EIA to protect their financial investments in properties and facilities. Once the underlying EIA laws and regulations are in place, it is also entirely feasible

for those laws and regulations to require the application of the EIA process to subsequent, specifically-directed environmental regulations. For example, an EIA law could require a regulatory agency concerned with commercial fishing to examine, through EIA procedures, the potential impact of a change in the harvesting that it enforces. Likewise, an agency responsible for establishing water quality standards could be required to assess any potential impacts that would result from changing these standards. These "legislative EIAs" or "program EIAs" should address purpose and need, alternatives, affected environment, and risks and benefits -- the same issues that would be considered for a new development project.

EIA can also be linked to the land use planning process.

EIA Process in Europe

In the past several years, an increasing number of countries and multinational communities have enacted laws and directives establishing EIA requirements for project reviews. In 1985, the European Economic Community issued a directive establishing minimum requirements for EIA in all member countries. The United Nations Environment Program adopted Goals and Principles of EIA in 1987. In 1991, twenty-six nations of the United Nations Economic Commission for Europe signed a Convention on EIA in a Transboundary Context, requiring all signatory nations to establish EIA procedures for transboundary impacts. All Central and Eastern European countries except for the Czech and Slovak Federal Republic signed the convention (Environmental Law Institute, 1991).

EIA Process Internationally

Increasing emphasis on EIA is also being observed by members of the international banking community. The World Bank issued in 1989 an operational directive requiring EIAs for certain categories of projects, while multilateral development banks are working to incorporate EIA procedures into their lending practices. The European Bank for Reconstruction and Development (EBRD), created in 1990 to fund the redevelopment of Central and Eastern European economies, is likely to require EIA procedures to further its goal of promoting "environmentally sound and

sustainable development" in its economic activities (Environmental Law Institute, 1991).

These actions at the national and international level describe a clear trend in establishing a common basic requirement and framework for evaluating proposed actions and assessing environmental impacts. As international financing agreements and arrangements rise is geographical geographical scope and economic importance, it appears clear that participating nations will need a well-defined policy of EIA in order to engage fully in these agreements.

Some projects can be excluded from the EIA process because the type, or category, of activity does not have significant impacts.

CATEGORICAL EXCLUSIONS

All projects can benefit from some level of EIA, even those on the level of individual businesses or facilities. Triggering mechanisms for subjecting projects to EIA are usually defined in the laws or regulations that create the EIA process. In the United States, only those projects involving a federal action undergo an EIA under the NEPA statute. Federal actions are generally limited to project sponsors applying for federal financial assistance, permits, or licenses. Other levels of government may subject more and different kinds of projects to assessment. When an assessment is required by two different levels of government, requirements of both are usually incorporated into an assessment conducted at the level of government with the more stringent regulation.

However, some projects are so inconsequential that it would be a waste of resources to require them to undergo a full EIA. Therefore, the EIA process usually begins with a step for determining whether on not a project should undergo an assessment at all. This step requires that a project meet 2 tests before it can be categorically excluded from the EIA process:

Test 1 is based on experience and the historical record.

> **Test 1** - the project should be consistent with categories of projects that have been determined not to have, individually, cumulatively, over time, or in conjunction with other projects in the same area, a significant effect on the quality of the environment. Examples might be the minor rehabilitation of an existing facility or the

replacement of equipment. Such projects can be placed in categories of projects that can be excluded from EIA requirements if they can meet the criteria under Test 2 below.

Test 2 - a project meeting the criteria for exemption (Test 1) must not be located in or near areas that might affect the protection of sensitive natural or cultural(endangered species, historic sites, etc.). In this case, exemption from EIA requirements would not be appropriate. Similarly, a proposed program or project might be characterized by a high level of public controversy; such a project, though qualifying for an exemption under Test 1, could benefit from the full scrutiny and disclosure of the EIA process.

Categories of potentially exempted projects (Test 1) are sometimes based on public policy. More often, they result from experts' experience indicating that certain categories of projects rarely result in adverse impacts to the environment. Criteria for not granting an exclusion from EIA (Test 2) are almost always due to public policy.

The public should be notified of a categorical exclusion.

Even though a decision may be taken to exempt a project from EIA based on the tests above, good practice suggests that the affected public should be notified about these projects. The value of the notice is that local interested parties may know reasons, other than those considered by the assessment team, why a particular project should not qualify for exemption. It should also be noted that, although this categorical exclusion step occurs in the initial phases of the assessment process, in practice this step involves consideration of the same factors as those used in a full-scale EIA. Making effective determinations for categorical exclusions requires a basic understanding of the scope of the action, the sensitivity of the environment potentially affected, and the general nature and magnitude of potential environmental impacts.

Initial EIAs consider the significance of impacts.

INITIAL EIAs

For the proposed actions that are not excluded from further EIA by categorical exclusions, the majority will fall into a category of assessments whose impacts are unknown. The procedures for undertaking an EIA generally begin with an initial EIA of the proposed action. The level of detail that is required in the initial EIA must be sufficient to make one of two determinations: 1) there will be no significant impact expected to result, or 2) significant impacts are expected. If at any time during the preparation of an initial EIA, information is uncovered that would indicate the project could result in significant environmental impacts, the initial EIA can be immediately terminated (if it is a formal step in the procedure) and a full EIA begun.

As experience in EIA is gained, proposed actions that always have significant impacts associated with them in every case (power plants, reservoirs and dams) should be identified and categorized. Criteria that may be useful in identifying significant actions include when a project:

- could impact directly on air and water quality, particularly if there is a possibility that standards may be exceeded or that degradation of high quality conditions may occur;
- could adversely affect protected ecological resources such as endangered species;
- could create undesirable indirect impacts such as increased traffic or rapid urban growth;
- could cause release of toxic or hazardous materials or generation of wastes;
- could, in combination with other activities, cause adverse cumulative effects; or
- could create significant public controversy.

5 KEY CONSIDERATIONS IN THE EIA PROCESS

5. KEY CONSIDERATIONS IN THE EIA PROCESS

INTRODUCTION

When it is determined, through the EIA steps discussed in Chapter 4, that a proposed action should undergo the EIA process, it is necessary to identify the essential elements and particular issues that should be incorporated into the process. By organizing the EIA process from the start, a greater uniformity in style, content, technical rigor, and specificity can be achieved. The following considerations are key to the orderly conduct of the EIA process.

PURPOSE AND NEED

The purpose and need of a proposed project is the justification for undertaking the action. The purpose and need may originate from legislation, from administrative decisions, or from private enterprise. The need for the action may be a policy that needs to be implemented or a specific problem that needs to be addressed.

A clear description of the purpose of, and need for, a particular action provides the perspective in which the reasonableness of various alternatives can be evaluated over a specified planning period. Without a clearly justified and documented purpose and need, the project should not proceed further.

PUBLIC PARTICIPATION

Public participation in the EIA process is a critical component in achieving the open decision-making goal. Public participation should begin in the earliest phases of project planning and continue through the decision-making process. Public involvement can be formalized by scheduling public hearings and public information sessions, creating public advisory and/or liaison groups, and periodically distributing information concerning the status of project planning. Public involvement in the EIA process

gives communities and individuals a voice in issues that may bear directly on their health, welfare, and quality of life. An open flow of environmental information can foster objective consideration of the full range of issues involved in project planning and can allow communities and citizens to make reasoned choices about the benefits and risks of proposed actions.

Public participation is critical to open decision-making and should begin as early as possible in the EIA process.

The initial, day-to-day activities of an EIA are likely to be carried out by the staff of an environmental agency or other environmental specialists; the public may not be involved at this level of the EIA. There are, however, certain points in the EIA process where public participation is readily achieved and may be most effective. These points are: 1) the notification of an intent to undertake an EIA for a proposed action, 2) the scoping of the EIA process, 3) the issuance of a draft EIA report, if such a draft document is circulated for public comment, 4) the issuance of the final EIA report if circulated for comment, and 5) the decision. A growing trend is to engage the public in follow up monitoring of implementation of mitigation and post project implementation environmental monitoring.

Critical public participation stages:

- **Notice of intent**
- **Scoping**
- **Draft EIA report**
- **Final EIA report**
- **Decision**

Public participation can also be encouraged by establishing citizens' action committees that may include groups of citizens representing various civic groups, environmental interests, and business activities. These committees can serve as a focal point or channel for public participation efforts by distributing information about the project and directing public comments to designated project representatives. Ideally, the principal purpose of such committees is to facilitate the objective collection or dissemination of information relevant to the action rather than to advocate or oppose a particular action or alternative.

Citizens' action committees can facilitate collection and dissemination of information.

Individuals or groups that are likely to possess specialized knowledge about the affected environment should be strongly encouraged to participate and provide input to the EIA. Often, local conservation groups (e.g., birdwatchers, naturalists, watershed associations) have detailed information about the distribution and abundance of plant and animal species in their geographical area; such

information has greater value in project planning and comparison of alternatives if it is disclosed early in the EIA process.

Early input from local specialists may foster better decisions.

Because public participation is such an essential component of the EIA process, a public participation workplan should be prepared during initial project planning. This workplan should describe how public participation will be conducted, encouraged, and facilitated during the EIA process. The public participation workplan should include a schedule of activities, staffing arrangements, budget requirements, information distribution methods, and identification of key points in the EIA process where public participation will be emphasized. As the EIA process proceeds, full documentation of the public participation process, as well as the public's specific comments, should be maintained. Table 2-1 summarizes several procedures that can be followed to promote public participation throughout the EIA process.

What are the objectives of the proposed action?

The public participation workplan identifies tasks, schedules, staffing, budget, and methods to communicate with the public.

SCOPING

Scoping is the early, open process of considering the issues and choices of alternatives to be examined in the EIA of a particular action, policy, or program. Scoping helps insure that real problems are identified early and studied properly, that issues of no real concern do not consume undue time and effort, and that the EIA report when made public is balanced and thorough.

When a full EIA is required for a proposed action, it is essential to plan the scope of the EIA study at the beginning of the process. Many projects may involve a substantial number of feasible alternatives and a wide spectrum of potential impacts. In order to conduct the EIA in an efficient and systematic manner, the scope of the issues to be studied in detail can be derived and approved in the beginning of the process. This early planning phase of the EIA is often termed "scoping."

Scoping focuses resources and reduces paperwork.

Scoping must occur early in the EIA process.

In the United States, scoping originated in response to early applications of NEPA by federal agencies. In some early environmental impact studies, great lengths were made to study every conceivable impact, regardless of its significance, and consequently enormous EIAs were submitted in which critical issues were obscured by the volume of details. Other environmental impact studies went to the opposite extreme, presenting too little information and analysis to be of use in the environmental decision-making process. To remedy these problems, the existing EIA regulations were supplemented to include a requirement for all agencies to engage in scoping at the beginning of the EIA process (Environmental Law Institute, 1991).

Scoping is more than just public involvement.

Scoping is used to determine the breadth of issues to be addressed, to identify the significant issues related to a proposed action, and to identify and eliminate from detailed study the issues that are not significant or that have been treated in prior EIAs. During scoping, the agency or organization with principal oversight responsibilities over the EIA process should assign the responsibility for preparing the EIA to an appropriate agency or organization, and should set forth a tentative schedule for planning and decision-making.

Public participation should be initiated at the scoping stage of the EIA process. This can be accomplished through a public notice of intent to conduct an EIA for a specific action. Such a notice of intent should include a description of the proposal and describe how the public may participate in the process. Early public involvement may lead to a more detailed identification of sensitive environmental resources and disclosure of issues of significant community concern.

Scoping typically is conducted in a meeting or series of meetings involving the project proponent, the public, and

the responsible government agencies. The structure of the meetings may vary depending on the nature and complexity of the proposed action and on the number of interested participants. Small-scale scoping meetings might be conducted like business conferences, with participants contributing in informal discussions of the issues. Large-scale scoping meetings might require a more formal atmosphere, like that of a public hearing, where interested parties are afforded the opportunity to present testimony. Other types of scoping meetings could include "workshops," with participants in small work groups exploring different alternatives and designs. As is the case with all procedural and analytical stages of the EIA process, documentation of the scoping process should be systematic and thorough.

Scoping includes:

- **Participation by others**
- **Determining issues to be addressed in the EIA**
- **Eliminating insignificant issues**
- **Assigning responsibilities and requirements for preparation and review**
- **Identifying other related planning decisions**

Once the details of the EIA approach to a particular action are agreed upon, the agency or organization conducting the EIA should prepare a *work plan* that addresses key considerations in the EIA process. These key considerations are discussed individually below.

Don't forget to document the scoping process.

INTERDISCIPLINARY APPROACHES

The scope of most EIAs is sufficiently broad to require the contributions of a spectrum of technical and scientific experts; for this reason, an interdisciplinary approach will clearly provide the most valuable information for decision-making. An EIA report for a major project will commonly consider existing environmental conditions of, and potential impacts on, surface water quality and aquatic communities, groundwater quality and water supplies, terrestrial vegetation and wildlife, air quality and human health, geology (including topography and soils), infrastructure (transportation, demography, socioeconomics), and cultural resources. A detailed assessment of all of these systems requires the collaboration of experts in these several fields. In some cases, additional experts may have to be added to the interdisciplinary team as the EIA progresses. The final EIA report can be written by a smaller group of individuals having access to the findings of the technical experts.

The broad scope of the EIA process requires the use of an interdisciplinary team.

ALTERNATIVES TO THE PROPOSED ACTION

Alternatives are different means of meeting the general purpose and need of a proposed action, project, or program. The no-action alternative is the option of not engaging in the proposed action or the other action alternatives and provides the baseline against which the impacts of the action alternatives are compared.

Objectivity of the process rests on the analysis of the alternatives.

The identification, description, evaluation, and comparison of alternative ways to meet the basic purpose and need of a proposed action are crucial to the objectivity of the EIA process. In most cases, the EIA team can identify several alternatives that are reasonable, feasible, and would achieve the stated needs of the action. In the absence of an objective and thorough alternatives analysis, the EIA process tends merely to affirm a chosen action and loses power as a decision-making tool.

The thorough description of alternatives in an EIA process facilitates their side-by-side comparison in terms of their technical, environmental, and economic risks and benefits. The alternatives analysis of an EIA should discuss alternatives *to* a specific action, such as not proceeding with the action, carrying out the action in a different location or facility, or implementing a non-structural solution. It is generally not sufficient to discuss only alternatives *within* an action, such as using different designs or materials, or changing the orientation of the facility slightly within the project boundaries.

No-action alternative is the baseline for comparison.

The alternatives considered should include the "no-action" alternative the option of not carrying out any of the action alternatives. The no-action alternative represents an objective baseline against which the other alternatives can be measured and may, in the final analysis, be the alternative that is preferred.

CATEGORIZATION OF IMPACTS

Primary and Secondary Impacts

The primary impacts of an action are those effects that are caused by the action and that generally occur at the same time and place as the action. They are usually associated with the construction, operation, maintenance of a facility or activity, and are generally obvious and quantifiable.

Primary impacts are direct and occur at the same time and place.

Primary impacts can encompass such effects as:

- removal of significant amounts of prime or unique agricultural lands from productive use.
- imposition on, or destruction of sensitive ecosystems, including wetlands, forests, coastal areas, floodplains, natural habitats, and the habitats of threatened or endangered species.
- degradation of surface water quality due to erosion during construction or due to excessive contaminant loadings to surface water runoff and/or discharges.
- alteration of groundwater characteristics due to construction, dewatering activities, or significant withdrawals during operation.
- alteration or destruction of historical, archaeological, geological, cultural, or recreational areas.
- displacement of households, businesses, and services.
- generation of increased concentrations of air contaminants, and increased levels of environmental sounds or odors.
- creation or aggravation of public health problems.
- direct violation during construction or operation of national, regional, or local environmental and land use statutes or regulations and plans imposed by such statutes or regulations.

Secondary impacts are indirect and occur later in time or at a different place.

Secondary impacts of an action are indirect or induced changes in the environment, population, economic growth and land use, and other environmental effects resulting from these changes in land use, population, and economic growth. In other words, secondary impacts span the potential effects of additional changes that are likely to occur later in time or at a different place as a result of the implementation of a particular action.

Secondary impacts can include additional construction and/or development, traffic increases, increased recreational demand, and other types of off-site impacts generated by on-site activities. Such induced changes may gradually adversely affect the environment in the general vicinity of the specific action. An EIA should include an analysis of secondary impacts, and a demonstration that such impacts satisfy, to the maximum extent possible, the applicable environmental policies and standards. Secondary impact analysis must include the likely geographic extent of induced development, its relationship to the environmental master planning for the region, an assessment of likely induced point and non-point air and water quality impacts, and evaluation of the induced development in terms of all applicable resource and development policies.

Projects that expand infrastructure often induce development and have secondary impacts.

In the United States, a secondary impact analysis was mandated by regulation for certain categories of federally-funded actions. These actions are, in general, those that expand infrastructural elements that are considered to induce development: water supply systems, highways, and wastewater treatment systems. Table 5-1 lists the typical categories of potential secondary environmental impacts that should be addressed in EIAs.

Persistence and duration of impacts should be characterized.

Short and Long Term Impacts

Impacts can be short-term or long-term depending upon the persistence or duration of the impacts. Identification of short-term and long-term impacts is important because the significance of any particular impact may be related to its duration in the environment. The loss of grass or other low-

TABLE 5-1
CATEGORIES OF POTENTIAL SECONDARY IMPACTS

Environmental Media Impacts

- Surface and Groundwater Quality and Quantity
- Ambient Air Quality
- Ambient Noise Levels
- Waste Generation

Sensitive Environmental Area Impacts

- Wetlands
- Floodplains
- Coastal Zones
- Wildlife Habitats

Unique Area Impacts

- Parklands
- Wild and Scenic Rivers
- Areas of Historic, Architectural, Archaeological, or Cultural Value

Secondary Economic Impacts

- Agricultural Land Availability
- Availability or Demand for Energy
- Property Values

Source: EPA, 1978

lying herbaceous vegetation on a particular area might be considered a short-term impact because the area may be easily revegetated through seeding and mulching in a relatively short period of time. The loss of a mature forest, however, can be considered a long-term impact because of the time required to reforest the area and for the trees to reach maturity.

Positive and Negative Impacts

Environmental impacts can also be beneficial.

Information on the potential environmental impacts of a proposed action forms the technical basis for comparisons of alternatives, including the no-action alternative. All significant environmental effects, including beneficial effects, should be addressed. Although the term "environmental impact" has come to be interpreted in the negative sense, many actions have significant positive effects that should be clearly defined and discussed. This is particularly appropriate for redevelopment or remedial actions whose specific purpose and need is to remedy any undesirable condition.

Cumulative Impacts

The sum of individual non-significant impacts may be significant.

Cumulative impacts are those environmental impacts that result from the incremental impact of the proposed action on a common resource when added to other past, present, and reasonably foreseeable future actions. Cumulative environmental impacts can occur from the collective effects of individually minor actions over a period of time.

Circumstances generating cumulative impacts could include:

- water quality impacts from an effluent discharge that is combined with other point source discharges or from non-point source runoff.
- air quality impacts that result from industrial or commercial emissions operated in the same geographical region.
- loss and/or fragmentation of environmentally sensitive habitats (forests, wetlands, farmlands) resulting from

the construction of several independent residential or commercial developments.

The assessment of cumulative impacts is difficult, in part due to the speculative nature of the possible future actions, and in part due to the complex interactions that need to be evaluated when considering collective effects. The cumulative impacts may be simply additive in their effects, but could potentially interact in synergistic or antagonistic fashion. Water and air quality modeling provide a means to study effects of cumulative impacts.

Are all impacts additive?

The analysis of cumulative impacts can be particularly complex when the cause-effect relationships are not strictly additive (e.g., where the relationships are discontinuous or non-linear). For example, an action that has a small impact by itself may bring one or more key environmental attributes to a threshold of irrevocable harm, with potentially serious impacts to the affected ecosystems. A system in which an incremental impact has a greater effect than the preceding increment is non-linear. It can be important to factor this non-linear aspect into an EIA because an assumption of linearity would underestimate the real cumulative impact of an action. Similarly, cumulative impacts could be underestimated when various effects interact synergistically, that is, when the aggregate of the effects is greater than the simple sum of the effects.

SHORT-TERM USES AND LONG-TERM MAINTENANCE AND ENHANCEMENT OF THE ENVIRONMENT

Balanced decisions consider policies, goals, and needs over the long-term.

The "balanced decision" aspect of the EIA process applies not only to the evaluation of specific alternatives, but also to the more general balancing of short-term uses of environmental resources and the enhancement of such resources over the long term. For example, there may be national or regional environmental policies that set goals to improve water and air quality; to preserve wetlands, coastlines, and unfragmented forests; and to provide adequate natural open spaces for the human population to enjoy. These are broad policies directed at sustaining and enhancing environmental resources through generations. The potential

environmental impacts of a proposed action, whose benefits may address a short-term need (e.g., wastewater treatment, increased industrial capacity, more efficient roadways) should be evaluated for compliance with these long-term policies. Economic comparisons of alternatives in the context of national or regional goals can be very effective in demonstrating which alternatives are most compatible with long-term environmental goals such as levels of water or energy conservation.

MITIGATION AND COMPENSATION

Mitigation is the purposeful implementation of decisions or activities that are designed to reduce the undesirable impacts of a proposed action on the affected environment.

Mitigation reduces adverse impacts.

Mitigation is a general concept that could include: 1) avoiding impacts altogether by not taking a particular action, 2) minimizing impacts by limiting the magnitude of the action, 3) restoring or repairing particular features of the affected environment, 4) reducing impacts over time e.g. by performing maintenance activities during the life of the action, and 5) compensating for impacts by providing additions to or substitutes for the environment affected by the action (Environmental Law Institute, 1991).

Avoiding impacts is the most preferable option.

Note that these categories of mitigation approaches are arranged in a hierarchical order of their desirability (Table 5-2). In other words, it is more desirable to avoid impacts than to have to restore the environment, or provide compensation for impacts.

Mitigation can take place during planning, design, and implementation.

Undesirable environmental impacts that are identified early in the EIA process can be avoided or minimized by thoughtful modifications in the design of the proposed action. The encroachment into sensitive environmental resources such as wetlands, floodplains, or habitats for threatened and endangered species can be avoided by changing the design or layout if such resources are identified at an early stage of planning and accorded the additional degree of protection they warrant. For example, roadways that must cross wetland areas can be aligned to cross the edge of wetlands so as not to fragment them and disrupt their ecological and

hydrological exchange; roadways that must pass through wetland areas can also be designed with bridges or narrow embankments to minimize the area of wetland filled in the road crossing.

In a well-planned process, all reasonable means to avoid and minimize impacts are incorporated into the alternatives during the analysis of alternatives and project design. Compensation for the remaining impacts is the final stage of mitigation. A significant reduction in impacts can be achieved by thoughtful use of the alternatives analysis and mitigation options; it is through these means that the EIA process works to prevent significant environmental impacts from occurring.

TABLE 5-2
CATEGORIES OF MITIGATION

Avoidance:	Mitigation by **not carrying out** the proposed action. For example, if the only area available for a regional airport happens to be an area of extensive wetlands that would be filled during construction of the airport, avoidance of the action might be the only reasonable way to protect those wetlands.
Minimization:	Mitigation by **scaling-down the magnitude** of a project, **reorienting the layout** of the project, or **employing pollution prevention or cleaner production technology and procedures** that reduces the factors generating the undesirable environmental impact. For example, a wastewater treatment plant discharging to a river might be reduced in treatment capacity, be oriented to avoid disturbances of wetlands and floodplains at the facility site, and might employ advanced water quality treatment techniques. Complete recycling of waste water could prevent many of the adverse impacts due to water pollution.
Restoration:	Mitigation through the **restoration of environments** affected by the action. For example, areas cleared for the installation of linear facilities (pipelines, power lines) can be regraded after the facility is installed, and then replanted with native vegetation.
Reduction:	Mitigation by taking **control, prevention or maintenance steps** during the course of the action. For example, stormwater management systems can be designed to trap sediments carried from developed areas in stormwater runoff. Such stormwater systems are effective only if the sediment traps are periodically cleaned.
Compensation:	Mitigation through the **creation of environments** similar to those affected by an action. This step should only be considered after all steps above have been completed. As a last resort, donation of land or money for a regional program of habitat creation or enhancement could be considered. Adverse impacts on the economics of small communities can be "compensated" through special funds or payments.

6 KEY STEPS IN THE EIA PROCESS

6. KEY STEPS IN THE EIA PROCESS

INTRODUCTION

The EIA framework includes a multi-step process that is documented in the EIA report.

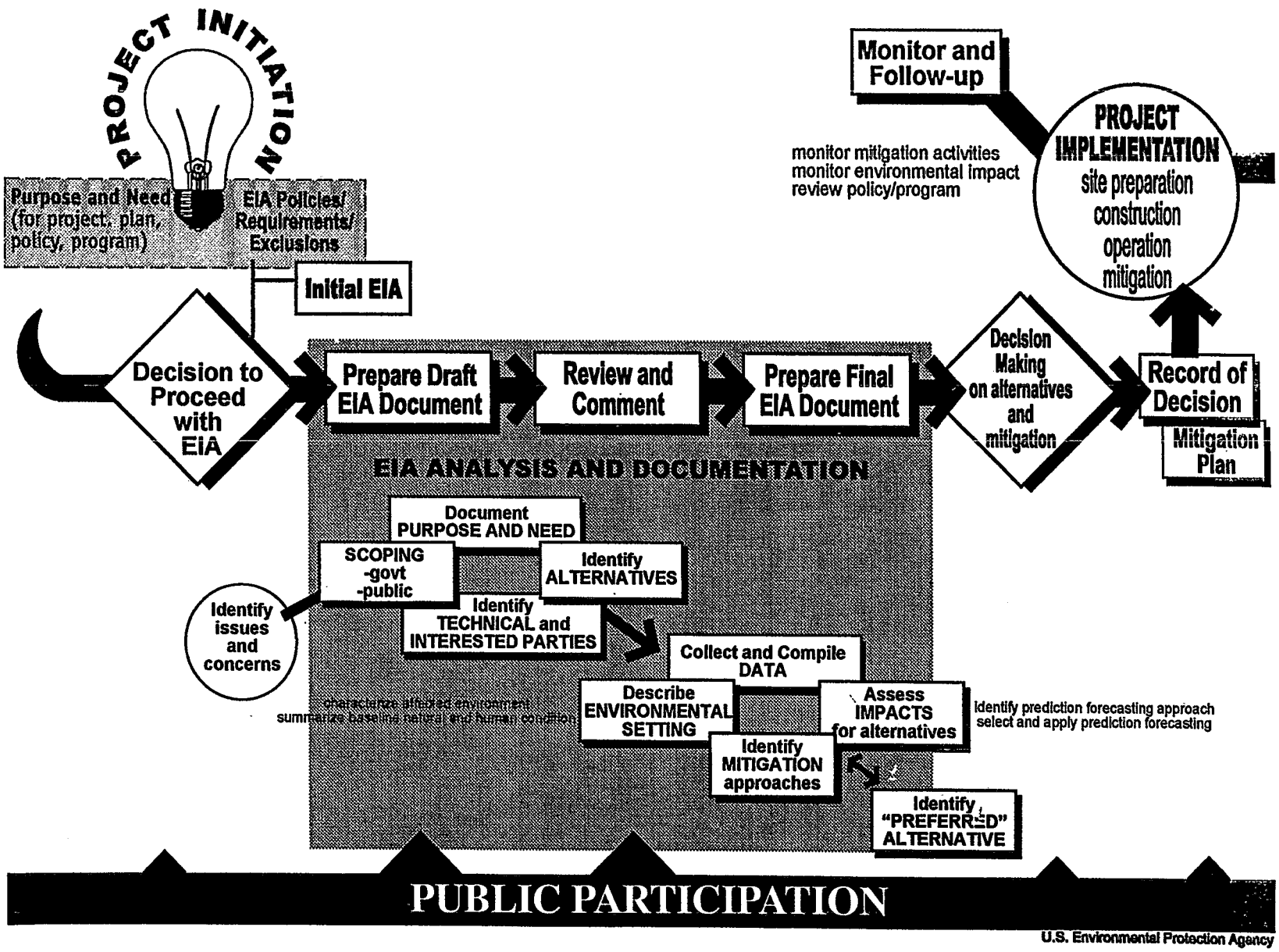
An EIA investigates, evaluates, and documents the information that allows citizens and governmental agencies to understand the risks and benefits of a proposed action and its reasonable alternatives. This information is made available to the individuals and organizations that will be involved in the action, including environmental specialists, the planners of the action, and the general public. The EIA should consider all important information about the nature of the proposed action, reasonable alternatives to the proposed action including the no-action alternative, the purpose of and need for that action, the environmental setting in which the action is proposed, and a discussion of anticipated environmental impacts. When completed, the EIA report documenting the process becomes a primary information source and a record of the EIA process. This record becomes the decision document.

EIA documents should be analytical.

Experience in the United States and other countries has shown that EIAs best serve these multiple purposes when they are analytic rather than encyclopedic; that is, when the information presented in the several EIA sections is directly relevant to the risks and benefits of the proposed action and its reasonable alternatives. This balance between information content and relevance to the decision at hand is a delicate one that is best approached by close adherence to the general principles of scientific writing. The findings and recommendations of the EIA should be supported by the information and analyses contained in the document or, if very voluminous, in documents incorporated by reference. The logic of the steps in the impact assessment should be clearly presented in a manner that will be understandable by lay persons that review the report.

The basic framework of EIAs has been tested and refined for several decades. The basic elements of that framework are shown in Figure 6-1 and discussed in detail below.

THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS



U.S. Environmental Protection Agency

PARTICIPANTS

Who should participate in the process?

The EIA process requires the participation of several groups: the agencies responsible for administering the EIA regulations, representatives of the entity proposing the action, scientific and engineering experts in relevant disciplines, representatives from interested public organizations, and the public at large. This combination of participants is needed to achieve balance in the decision-making process. The participants should be involved in the process as early as possible and, through the scoping process, should identify the key issues.

The report documenting the EIA process should characterize the nature and extent of participation by summarizing the participatory process and by identifying the groups involved in such efforts. In addition, the qualifications of the preparers should be presented early in the document.

PURPOSE AND NEED

Purpose and need must be defined before the EIA process can proceed.

In organizing the EIA process, it is important to articulate a clear definition of the purpose and need for a proposed action. In the absence of a clear perspective on these aspects of an action, it would be difficult to identify reasonable alternatives, balance the risks and benefits of an action, and evaluate the reasonableness of the no-action alternative. Where purpose and need are not clearly justified and documented, the process should not proceed further.

The report documenting the EIA process should include a summary discussion and demonstration of the need, or absence of need, for the proposed project. Where the project entails new development, an analysis demonstrating the inadequacy of existing development is desirable. Where the project entails redevelopment or remediation, an analysis demonstrating the benefits to be gained from such actions should be clearly stated.

ALTERNATIVES THAT SATISFY PURPOSE AND NEED

Alternatives are compared with respect to economics, policy, technical feasibility, and environmental impact.

The alternatives section of the EIA report should include a comparative analysis of feasible options that would meet the stated purpose and need of the proposed action. The analysis of alternatives should include consideration of the no-action alternative. The feasible alternatives should be compared with respect to capital and operating costs; direct, indirect, and cumulative environmental impacts; physical, legal, or institutional constraints; and compliance with regulatory requirements. The reasons for rejecting any alternative should be clearly stated, together with a summary of any significant environmental benefits precluded by rejection of an alternative.

Alternatives often involve location, new or different technologies, and/or alternative methods for accomplishing the purpose and need. In a proposal to site an industrial facility, for example, the alternatives analysis might identify several locations or sites on which the facility could be constructed and operated. The EIA process then should consider the range and magnitude of environmental impacts that would occur at each location should the facility be constructed there. The alternative of not proceeding with the proposed action (the no-action alternative) should also be accorded serious consideration and discussion.

SCREENING ALTERNATIVES

Screening eliminates unfeasible alternatives based on objective criteria.

The initial screening of alternatives should be rigorous and consider all possible means by which the purpose and need of the action might be accomplished. This initial set of alternatives will likely include some actions that are clearly impractical, uneconomical, or environmentally unacceptable based on objective screening criteria. It is important to document the screening criteria and identify the class or types of project that do not satisfy the criteria. Unreasonable alternatives can be identified in an initial screening process, and eliminated from detailed consideration in the full analysis of reasonable alternatives. For some projects, this step may still leave an unwieldy number of alternatives to evaluate in detail, in some cases hundreds of alternatives. For these projects, it

would be reasonable to reduce the number of alternatives to a manageable few for detailed evaluation, using a more refined or restrictive set of evaluation criteria. The use of objective screening criteria enhances the reproducibility of the results.

The number of alternatives carried forward for detailed comparative evaluation and consideration should not be arbitrarily set, but instead depend on the range of practical alternatives available. The alternatives considered in detail should be representative of the entire range of all alternatives and should represent real alternatives to the proposed action, not just modified versions of the preferred alternative. However, the alternatives not considered further should be documented in the EIA record, together with the reasons why these particular alternatives were screened from further evaluation.

How many alternatives should be reviewed in detail?

DESCRIBING THE AFFECTED ENVIRONMENT

The description of the environmental setting sets forth in detail the characteristics of the area in which the proposed action would occur. This description should be of the study area, which is a defined area within which all effects, impacts, features, and potential compensation efforts would occur from a proposed action and its alternatives. The level of detail in this description of the study area should be sufficient to convey to a reader or reviewer the precise nature of the natural and human resources potentially affected by the proposed action and alternatives. This description also provides baseline data with which environmental impacts can be predicted, and against which the predicted impacts of the proposed action can be compared.

The description of the environmental setting defines the study area and provides the baseline for the impact analysis.

The approach commonly adopted in treating this aspect of EIA is the subdivision of the environmental setting into a logical and hierarchical set of categories. The major categories would likely include the following:

Geology - geological provinces, bedrock formations, history of geological stability or instability.

Environmental Setting

- **Geology**
- **Topography**
- **Soils**
- **Groundwater Resources**
- **Surface Water Resources**
- **Terrestrial Communities**
- **Aquatic Communities**
- **Environmentally Sensitive Area**
- **Air Quality**
- **Land Use**
- **Demography**
- **Sound Levels**
- **Socioeconomics**
- **Infrastructural Services**
- **Transportation**
- **Cultural Resources**
- **Project Economics**

Topography - general topography of region, specific topography of project area.

Soils - soils mapping, soil series properties, constraints to development.

Groundwater Resources - nature of water-bearing formations, recharge rates, sustainable safe yields, locations and depths of existing wells, quality.

Surface Water Resources - drainage basins and subbasins, named and unnamed water bodies and watercourses, regulatory classification of water bodies, flow regimes, water quality data and evaluation, identification of existing permitted discharges to surface waters.

Terrestrial Communities (botanical and zoological) - spatial arrangement of vegetative community types, vegetative species-abundance listings, wildlife species-abundance listings, records of threatened and endangered plant and animal species.

Aquatic Communities - nature of aquatic habitats, species-abundance listings for aquatic macroinvertebrate and fish communities, ecological indexing of community data.

Environmentally Sensitive Areas - identification of wetlands, floodplains, steep slopes, stands of mature vegetation, aquifer recharge areas, areas of high water table, areas of rock outcrop, prime agricultural lands, and mines.

Air Quality - regional quality and trends, data from local monitoring stations, reported exceedances of standards.

Land Use - existing patterns of land use in region, regional planning for future use, zoning.

Demography - censused or estimated population, recent trends and projections for future population.

Sound Levels - existing sound levels, sources of sound.

Socioeconomics (or Human Environment) - economic and social structure of communities, tax rates, characteristic types of development.

Infrastructural Services - nature and status of human services such as police and fire protection, hospitals, schools, utilities.

Transportation - layout and function of existing roadways, railways, airports; existing and projected capacities and demands.

Cultural Resources - location and characterization of identified cultural resources (archaeological, historical, cultural, landmark), potential for unidentified resources to be present in project area.

Project Economics - comparative analysis of proposed alternatives with present worth cost-effective criteria, cost/benefit criteria, or other methods.

The level of detail contained in the description of the environmental setting will vary with the nature of the proposed action and affected resources. Where an action (and its anticipated effects) is compact and essentially confined to a particular piece of property, it is generally appropriate to describe all natural and man-made features of the property and vicinity. This approach would be appropriate in the EIA for a moderately-sized industrial/commercial facility or for a residential development. Where the action extends across several regions or political subdivisions, as with a transmission line, pipeline, or canal, the discussion of existing environments may necessarily be less detailed in certain categories.

FORECASTING AND ASSESSING IMPACTS

Biological Environment, Including Terrestrial and Aquatic Habitats - assessment of these natural features focuses initially on the nature and distribution of existing habitats and biotic communities, and the selective forces that have determined these characteristics. The addition of new selective forces related directly or indirectly to the proposed action should then be considered. If the effects related to the proposed action are likely to induce a "change of state" in one or more of the affected habitats or biotic communities, the impact could be considered significant. A change in state could be anticipated by forecasting with ecological indices or habitat evaluation models; for example, if the project could increase phosphorous levels in a lake, the post-development trophic state of the lake can be predicted. Likewise, if one or more habitats are likely to be reduced significantly in size or habitat value, such an effect might be deemed significant. The use of habitat evaluation models can summarize present and future habitat values and can quantify the degree of change likely to occur if the action were implemented.

Change of state is important in forecasting impacts on the biological environment.

Water Environment - assessment of water resources focuses on the identification of surface water and groundwater resources, their existing quality and use, and the regulatory standards applied to them. If water resources are to be used, the capacity of the resource to accommodate this additional use should be evaluated. Where water might be drawn from subsurface aquifers and then, after use, discharged to surface waters, the effects of this "diversion" of water from existing hydrological cycles should be examined. The quality of water might be altered by the proposed action from a wastewater discharge. Water quality models can be run to forecast impacts, and then future water quality should be compared to regulatory standards and to the tolerances of organisms using the water bodies as habitat.

Water quantity and quality should be considered.

Air Environment - assessment of the air environment begins with the documentation of existing air quality, desirable air quality, and prevailing regulatory standards. The potential effects of the proposed action should be understood well enough

to model the concentrations of important air-born contaminants that would be expected if the action were implemented. These anticipated concentrations can be compared to regulatory standards and to standards or guidelines for safe human exposure. Because the effects of air quality changes are generally gauged in terms of the affected human population, the determination of significance in impacts may be more clearly discernible by human health standards.

Air models can forecast changes in air quality.

Noise Environment - assessment of the noise environment is similar to that for air; the existing sound levels can be compared to regulatory standards, guidelines, health criteria, or some measures of acceptible levels and the increases in sound levels, if any, can be gauged for significance against these "standards". As with air assessments, sound level assessments are generally considered in the perspective of the human population affected.

Sound levels can be measured in the field.

Socioeconomic Environment - assessment of socioeconomic impacts should consider existing demography, land values, income distribution, tax schedules, and other related information about the structure and function of the human communities affected by a proposed action. The changes in these properties resulting from implementation of the action can often be estimated as monetary costs or benefits, resulting in a net gain or loss of socioeconomic assets.

How will the action impact on costs to the community?

Cultural Environment - assessment of cultural impacts focuses on the existence of recorded archaeological, historic, or cultural resources potentially affected by the proposed action. Where such resources have not been formally described, literature and field studies may be necessary to describe sufficiently the nature and extent of such resources. The assessment of impacts should consider the importance of cultural resources destroyed by the action and the feasibility of recovering or conserving all or portions of the resources.

Literature reviews and field studies may aid in cataloging cultural resources.

MITIGATING ADVERSE IMPACTS

Mitigation in the EIA sense refers to measures taken to eliminate or reduce undesirable effects that could result from a proposed action. Mitigation may be required as a formal component and a series of defined tasks in the approval of an action, but mitigation as a philosophy can be invoked at any stage of project planning.

In the United States, NEPA regulation 40 CFR 1508.20 defines mitigation as a hierarchical series of actions that include:

- avoiding the impact altogether by not taking a certain action or parts of an action,
- minimizing impacts by limiting the degree or magnitude of the action and its implementation,
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment,
- reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action, and
- compensation for the impact by replacing or providing substitute resources or environments.

The hierarchical nature of these mitigative categories is a guide to project planning; during the initial phases of planning, the action can be designed to avoid or minimize impacts to sensitive resources through site selection and site layout. Additionally, the plans for construction can include measures to repair or restore affected areas and to maintain certain areas during the life of the project. Compensation for the impact by the substitution of resources or environments is the mitigative measure of choice only if the preceding four categories of mitigation do not adequately reduce the level of undesirable impacts.

Mitigation by compensation can be accomplished by the creation or enhancement of areas that are predicted to provide equivalent resource value as the areas lost or disturbed by the

proposed action. For example, if a wetlands area of low to medium quality and value must be filled to accommodate a project, an area of wetland can be created from upland habitat. The specific techniques for this are reasonably well understood (Hammer, 1989, 1992). However, a wetlands constructed from uplands can seldom replace the functions and values of a high quality and value wetlands; such wetlands, given their difficulty to replace, should be more stringently protected and if filled, should require greater compensation than for low to medium value wetlands. In the United States, regulatory agencies that administer permitting procedures for such wetland disturbances often require that the area of compensation be larger in area than the area impacted. The rationale for this is that created wetlands do not often achieve the same habitat value as do natural wetlands, and value is lost over the time required for compensated wetlands to reach full maturity.

Compensation for adverse impacts is less desirable than avoiding the impacts altogether.

IDENTIFYING PREFERRED ALTERNATIVES

The information on existing conditions and potential environmental impacts that is collected in the EIA process can ultimately lead to the identification of preferred alternatives that can meet the needs and purposes of the proposed action while simultaneously keeping undesirable environmental impacts to a practicable minimum. The identification of preferred alternatives meeting these criteria should therefore be as analytically rigorous and objective as is the documentation of conditions and impacts.

The selection of the preferred alternative is an analytical and objective process.

Several objective techniques for conducting analyses to select the "best" alternative are described in Chapter 7. In general, the relative merits of several alternatives are often considered through three general perspectives: 1) engineering feasibility and requirements, 2) economic viability, and 3) environmental soundness. These general perspectives can be used for orienting the initial screening of alternatives and the final discussion of alternatives; however, the identification of preferred alternatives should, if possible, use more discriminating measures for comparing the several options available to the decision-making body.

Engineering feasibility and requirements can be quantitatively described in terms of facility requirements, estimated costs to provide those required features, facility construction and maintenance costs, and similar estimations that are routinely carried out by businesses or site engineers when new facilities are planned. The framework for these estimates is well established in the industrial/commercial sector of virtually every country.

Likewise, the economics of selecting one or another alternative action can be well defined in monetary units well understood by all persons and need to be determined for each viable alternative. The estimation of economic costs, economic benefits, changes in tax structures, infrastructural demands and capacities, and employment opportunities that underlie such an assessment are well understood and use commonly-accepted techniques.

The Three E's

- **Engineering**
- **Economics**
- **Environment**

The environmental soundness of one or another alternative is probably the most difficult aspect of the alternative selection process to quantify. Projecting the risks and benefits of proposed actions is possible, but these projections, estimated as environmental changes, can only rarely be expressed in economic units. Individuals and governments readily acknowledge the intrinsic value of open spaces; of large tracts of native vegetation; and of wetlands, coastlines, and diverse wildlife communities. The balancing of losses of, or impacts to, these environmental features is difficult to express in the same terms as engineering requirements or economic benefits. The techniques discussed in Chapter 7 describe various methodologies that address this issue.

DOCUMENTING RESULTS AND SOLICITING COMMENTS

The summary of results of the EIA process for a particular proposed action and its alternatives should be compiled in a formal document, the EIA. The EIA should summarize the entire EIA process, from the notice of intent to prepare an EIA and scoping to release of the EIA. Although public participation

should be encouraged throughout the EIA process, the stages in which the public most eagerly participates are when EIA reports are released for comment. Ideally, the EIA should be released for public comment two separate times. The public comments received during the first release of the document (draft EIA) should form the basis for revisions to the next draft of the EIA (final EIA) in which responses should provided to all comments received. Comments received on the final EIA should be considered when a decision on the choice of alternatives is made.

The release of EIA reports is when public participation is greatest.

DECISION

The decision to adopt a particular alternative for implementing a proposed action should be thoroughly documented. The decision should be made with consideration given to the comments received on the final EIA. The decision made should be explained and justified in light of the EIA and comments received. In the United States, the formal decision document for a particular EIA is either a Finding of No Significant Impact or a Record of Decision, (ROD). This determination summarizes the EIA process that led to the particular decision and includes all conditions, such as compensation requirements, for approval. The ROD should also be circulated for review.

Decision documents describe the outcome of the EIA process.

MONITORING AND FOLLOW-UP

Once a proposed action has been approved through the EIA process, the implementation of that action should be periodically monitored for compliance with constraints set as "conditions of approval." Such conditions might include specific protective or mitigative measures, the monitoring of discharges to air or water, the filing of periodic status reports, or the performance of other activities to ensure that the action does not have unanticipated impacts on environmental resources.

Can there be conditions of approval?

NOTES

7 METHODS FOR FORECASTING AND ASSESSING IMPACTS

7. METHODS FOR FORECASTING AND ASSESSING ENVIRONMENTAL IMPACTS

INTRODUCTION

The establishment of environmental laws and EIA procedures in a variety of countries, and levels of government in some of these countries, has catalyzed the development or modification of many techniques for assessing environmental impacts. The assessment of impacts, however, still retains a high degree of subjectivity, as evidenced by the spirited discussions that characterize many public hearings on EIAs. Although the assessment of the existing environmental conditions can be done with a reasonably high degree of accuracy and precision, the forecasting of impacts will continue to benefit from new methodologies and refinements of existing techniques.

In developing a general approach to forecasting and assessing environmental impacts, there are several fundamental questions that must be asked early in the planning process. They include:

- Are there sufficient predictive models and site-specific data to support a quantitative assessment of environmental impacts?
- Is there a quantitative threshold (e.g., a standard or generally-accepted criterion) that can be used to distinguish significant levels of environmental impacts from all possible levels of impacts?
- Are there quantitative/statistical methodologies available for objectively describing levels of impacts, or will subjective scoring be used at one or more stages of the assessment?
- Are there prior, related assessments that have been conducted on similar actions?

Considerations in forecasting:

- **Models**
- **Threshold levels**
- **Statistical methods**
- **Prior, related assessments**

The ideal assessment circumstance would be where there is a substantial base of data specific to the site or area being evaluated, where there are well-tested predictive models that use those categories of data, where there is general agreement among professionals as to the level of environmental impact that would be deemed "significant," where the need for subjective scoring is minimal or absent, and where documentation of other similar assessments is available. It is unlikely, however, that there will be many situations where these ideal conditions will be satisfied, and most EIAs require a substantial input of professional judgement. In these situations, case studies of comparable situations provide insight into the range and magnitude of impacts.

Absolute vs. comparative methods.

Assessment methodologies generally can be separated into two major subgroups: 1) those methodologies that use empirical values to generate output that predicts future conditions (absolute methods), and 2) those methodologies that use relative measures to predict differences between two sets of conditions (comparative methods).

ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGIES

The number of specific methodologies that have been developed to assess the environmental impacts of human actions is substantial, too large to itemize in this document. The methodologies, however, tend to fall into a manageable number of general categories. Some of these are:

- **Habitat Evaluation Methods** - assessment of the existing quality of various habitats can be standardized through the derivation of a set of habitat evaluation models that assign certain values (which may be binary, incremental, or continuous) to certain environmental conditions. These habitat evaluation methods may be generalized for specific regional habitats, or may be specific to particular species of concern. The U.S. Fish and Wildlife Service has, with the help of expert ecologists, produced many of these habitat evaluation

methods, or "models," termed Habitat Evaluation Procedure (HEP) models, and programmed these models to be used interactively on microcomputers. An investigator choosing to evaluate a particular geographical area can select appropriate target species from a master list, and use the habitat requirements of these target species to generate a sublisting of environmental variables that must be analyzed or quantified. After these environmental variables are measured or evaluated in field studies, the habitat information can be entered into the interactive program.

Biological models can assess the suitability of habitats.

The HEP output reports each habitat type in terms of its Habitat Suitability Index (HSI), scaled from 0.0 to 1.0. These HSIs are computed for each of the target species and, as a weighted mean, for the total area being evaluated. The investigator can also examine intermediate model outputs and perform a sensitivity analysis of the input variables. The HSIs and the areas of the habitats can be combined by simple multiplication to yield Habitat Units (HUs) for each habitat category and for a series of scenarios (target years) with varying combinations of land use.

The HEP outputs can be used to assess environmental impacts by comparing the HUs available to each target species in pre-action and several post-action scenarios. Additionally, if the areas of certain habitats are to be created or enhanced through mitigation, the effects of such changes can be compared with the unmitigated scenario.

- **Ecological Indices** - ecological indices simplify complex data sets to scales of 0-1 or 0-100 for uniformity. The generation of indices from detailed data sets can facilitate comparisons among existing environments, and can, in certain cases, be used to compare pre-development and post-development conditions.

Diversity is one measure of ecological conditions.

An ecological index in common use in environmental monitoring and assessment is the Shannon-Wiener diversity index and used principally to describe the taxonomic diversity of ecological communities. This index describes the information content of any system as defined by a Fano code (Shannon and Weaver, 1949). The Shannon-Wiener index is easily computed from listings of species commonly acquired during random sampling of communities; moreover, the index can be broken into various contributing subindices, and can be applied hierarchically to several taxonomic levels (Pielou, 1975). Other similar community diversity indices include Simpson's index and Brillouin's index. Simpson's index is based on joint probabilities and can be used in the same context as the Shannon-Wiener index. Brillouin's index is preferred when the community of concern is totally censused rather than randomly subsampled. All three of these indices use the taxonomic representation of any group as its proportion of the total number in the sample.

These community diversity indices can be applied not only to taxonomic lists, but also to other analyses where an aggregate can be separated into its components. For example, information appropriate for habitat evaluation models (i.e., where a large area is subdivided into subareas of habitat types) can be evaluated by diversity index models to describe the complexity of the existing and future habitats.

Ott (1978) has published a discussion of the formulation of environmental indices, including indices for air, water, and quality of life.

Cause-effect relationships are forecasted with mathematical models.

- **Mathematical Modeling** - in this approach to environmental impact assessment, the principal cause-effect relationships of a proposed action are described in terms of mathematical functions and combined to yield a mathematical model capable of predicting future environmental conditions. Mathematical models come in all degrees of complexity, from simple variations on

mass balance equations (e.g., for estimating nitrate-nitrogen in groundwater) to highly complex multivariate systems. The mathematical functions may be purely determined by existing conditions, or may have strong random elements contributing to the model output. Some models include statistical routines for estimating error associated with model outputs. Most commonly used mathematical models for impact assessment have been adapted for computers, in either batch or interactive modes.

A listing, though certainly a non-inclusive one, of environmental effects that have been mathematically modeled would include:

- Energy
- Thermal Plumes
- Noise
- Transportation
- Air Emissions
- Stormwater Runoff
- Pollutant Transport in Water
- Pollutant Transport in Soils
- Risk Assessment
- Ecological Risk Assessment
- Wasteload Allocations

Group consensus is the outcome of the Delphi Technique.

- **Delphi Technique** - this method uses the opinions of knowledgeable experts and, through a repetitive process, converges toward group consensus. The technique originated by Rand Corporation in 1964 and has been used and tested in a wide variety of applications and dimensions. The main attribute of this technique is that is forces a group, typically an expert panel, to think in a structured fashion and to focus such thinking toward a common goal. The technique commences with an initial survey, the collective results of which are resubmitted to the experts for a second round of comment. This process of refinement continues until a group consensus is reached on the issue being investigated.

How can experts be polled to obtain objective assessments?

One example of an environmental assessment methodology developed using the Delphi technique is the National Sanitation Foundation Water Quality Index (WQI) developed in the United States. The goal was to derive a system for indexing key water quality variables and integrating a small group of variables into an indexing system. In this way, water quality data could be used in a standardized system of rating that had use for comparisons in space and time. The first step in developing the WQI was the polling of 142 water quality experts, who were asked to rate the importance of 35 water quality variables in describing the status of a water body. One hundred and two opinions were returned in this initial polling (a 72% return rate), and the collective results were resubmitted to the participating experts for additional comment. Eventually, the group opinion converged on a "short list" of water quality variables that were considered most important in describing the status of a water body. These were dissolved oxygen saturation, fecal coliform bacteria, pH, 5-day biochemical oxygen demand (BOD_5), nitrates, phosphates, temperature (as a deviation from ambient temperature), turbidity, and total solids. The polling also allowed the experts to graphically portray their opinions on how water quality changed with changes in the key variables; the results of this polling were used to generate graphs or rating curves relating the concentration of the water quality variable to the quality of the water body on a 0-100 scale. Finally, the polling of the experts allowed the generation of variable weights that expressed the relative importance of specific variables. For example, dissolved oxygen saturation was considered more important than total solids, and was accorded a greater weight in index computation.

With the Delphi technique having provided the list of key water quality variables, the relative weighting that should be assigned to each variable, and the graphical relationship between concentration and subjective water for each variable, the WQI was created. The index, which requires measurement of nine water quality variables and a manual or computerized calculation of a

water quality index, has been used by various regulatory and environmental organizations in the United States. It should be noted that the reduction of environmental data to index values, for water quality or for other ecological attributes of a system, should be done carefully because, by definition, the data base is simplified enormously to generate the index. The implications of certain index values should be corroborated by other assessment techniques. Also, any such assessment index should be validated by field testing. Nonetheless, the use of indices derived from the consensus of experts can facilitate comparison of data from different geographical areas or from different points in time.

Multivariate Statistical Methods.

- **Adaptation of Common Multivariate Statistical Methods** - the use of commonly accepted statistical methods can reduce one potentially troublesome aspect of impact assessment - the reliance on subjective judgements or scoring in comparing different ecological conditions. Assessment by opinion, even when those opinions are those of experts on the specific issue, is difficult to accomplish with limited resources, and is always open to criticism. If there are sufficient and suitable data available on particular environmental resources, multivariate statistical routines can be used to group, sort, and discriminate among general ecological conditions. In some cases, these statistical procedures can be used to quantify the predicted magnitudes of environmental impact or even the positive effects of mitigating measures. Multivariate statistical methods often require the use of a computer, and are performed by someone who is extremely familiar with statistical analysis.

  The types of multivariate statistical routines that can be used include, but are not limited to, discriminant analysis, case clustering, principal components analysis, ordination, and canonical correlation. These methods can isolate key variables that differentiate among different sets of variables (discriminant analysis), can be used to identify

environments having similar collections of properties (case clustering), can determine major axes along which various environmental conditions or sets of variables can be arranged and separated, and can arrange sets of variables in a hierarchical manner (ordination, case cluster). A primary advantage of these multivariate statistical methods is that they use empirical values to describe statistically significant similarities or differences; the element of subjectivity inherent in subjective scoring is drastically reduced.

An example of the use of multivariate statistical analysis applied to an EIA can be drawn from a study directed toward mitigating potential impacts to an estuarine fish population resulting from the proposed filling of near-shore habitats in a coastal river. Extensive trawl, water quality, and bathymetric sampling generated an extensive data base, from which the apparent habitat preferences of the fish species was derived using case clustering and discriminant analysis. The results of these analyses were used to identify habitat conditions that could, in theory, be changed to enhance the value of marginal habitats for use by this fish species; in fact, by changing the inputs in the analysis to the "enhanced values," it was possible to estimate the degree of usage that the fish would make of the enhanced habitats (Bell et al., 1985). An extensive review and discussion of the statistical analysis of environmental impacts has been published by Green (1979).

Graphical Overlays

- **Graphical Overlays** - this is a technique that has always been extremely useful in identifying areas that have high environmental sensitivity. The technique entails the separate mapping of various critical environmental features - wetlands, steep slopes, soils, floodplains, bedrock outcrops, wildlife habitats, vegetative communities, and cultural resources - at the same scale as the project's site plan. The environmental features are mapped on transparent plastic in different colors. The several environmental maps can then be overlaid on the project map to highlight the areas of highest environmental sensitivity.

GIS

- **Geographical Information Systems (GISs)** - these systems are essentially computerized graphical overlays and interacting data files. Environmental features are mapped, and the mapping digitized and stored in the GIS data base. The mapped features can be combined to produce computer-generated displays of one or more environmental features in a specified geographical area. If the GIS mapping is conducted systematically, information acquired on specific projects can be combined, and the GIS data base becomes more detailed over time.

Simulation

- **Simulation**- simulation methodologies are generally used to assess the probabilities of various classes of events, or to forecast environmental changes from existing general trends. Where environmental properties have significant variation and constant input values are not sufficiently descriptive, simulation methods can be used to select input values from a specified probability distribution into a mathematical function. The function is solved repetitively, and the distribution of output values evaluated. The Monte Carlo simulation technique is widely used in this manner.

  For example, if a proposed water treatment plant had a variable rate of discharge with variable concentrations of a contaminant and variable efficiencies in the removal of the contaminant, and if each of these variables could be described by a known probability distribution, Monte Carlo simulation methods could be used to estimate how frequently the concentration of the contaminant in the discharge might exceed a particular value.

  Monte Carlo simulation methods can also be used where technical experts do not agree on the values of correction factors to be used in assessing empirical data. Such technical disagreements can lead to different experts arriving at conclusions that are

orders of magnitude apart (as evidenced by recent international discussions on the effect of the fires in the Kuwait oilfields, global warming, and ozone depletion). In a major environmental assessment recently conducted on a proposed transportation project in the northeastern United States, several experts independently analyzed catch data from fisheries to estimate the proportion of the population affected by the project. Those estimates, which started with the same data set, ranged from 0.1% to 96%. The differences originated in the corrections each expert made for efficiency of the sampling gear and vertical distribution of the fish. Monte Carlo simulation could have been used to generate probability functions that would have been more realistic than the extreme values generated by the contending experts. Presenting a decision-maker with scientific testimony that the proportion of a population potentially affected by an action ranges from 0.1 to 96% is hardly conducive to informed decision-making.

Risk Assessment

- **Risk Assessment** - this refers to a category of analyses by which the potential risk of harm to individuals, communities, and ecosystems can be evaluated. The general techniques include comparison of expected conditions with prevailing environmental standards, modeling of expected conditions and estimation of error terms associated with model estimates, and Monte Carlo simulation of the frequency of certain events under expected conditions.

Cost-Benefit Analysis

- **Cost-Benefit Analysis** - this is a formalized accounting of the anticipated costs and benefits of an action. The cost-benefit analysis is of particular use when comparing alternative forms of an action. The "costs" of an action include, but are not limited to the economic costs, the risks to long-term environmental quality and public health, and the impacts to natural and man-made resources. The benefits include monetary benefits, but also extend to positive changes in the quality of life, protection of sensitive environmental resources, and long-term enhancements to human health and welfare.

COMPARATIVE METHODOLOGIES

Comparative methods are based on a uniform evaluation that is not necessarily quantitative.

The strong point of comparative assessment methods is that the absolute values of environmental attributes need not be quantified precisely. As long as a uniform treatment of environmental variables is maintained, the assessment should predict anticipated changes in environmental conditions with reasonable accuracy, and in many cases it is the description of the degree of change in environmental condition that is the principal goal of the impact assessment.

Comparative assessment is also of principal importance in the evaluation of alternatives; for a fair and full treatment of all reasonable alternatives, there must be equivalency in descriptions of the potential environmental impacts of each alternative. The checklist and matrix methodologies described in the following sections are examples of environmental assessment methodologies that are appropriate for comparison of alternatives. The case study approach can also be used. The proposed project can be compared to similar projects that were previously implemented.

A special case of comparative assessment of potential environmental impacts is the so-called "worst-case analysis." This was an analytical approach that resulted from language in the CEQ NEPA Regulations, which states in 40 CFR 1502.22(b)(2) that "[F]or the purposes of this section, 'reasonable foreseeable' includes impacts which have catastrophic consequences, even if their probability is low, provided that the analysis of impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason." This well-intentioned mandate was rapidly exploited by EIA participants seeking to cast a proposed action in the worst possible light, and worst-case scenario-making showed some tendency to exceed the "rule of reason" stipulated by the Council's regulations. The worst-case analysis is useful as a component in a spectrum of comparative analyses ranging from the worst to the most likely case.

Model validation is a step necessary in the creation of predictive models. The use of unvalidated predictive models in impact assessment should be an approach used only when validated models are unavailable or inappropriate. In one major EIA for a highway project in the northeastern United States, an unvalidated mathematical model was used to predict the distribution of fish in a major estuary; the mathematical model, which formed the technical basis for the findings of the EIA, was later shown to converge on particular solutions with widely varying sets of input data. This particular model was shown by sensitivity analysis to be fundamentally flawed; expediency had resulted in its use before adequate validation had been performed.

CHECKLISTS

Checklists are commonly used tools to identify impacts.

The use of checklists for identifying and, to a limited extent, characterizing, environmental impacts, is very common throughout existing EIA processes. A checklist forces the assessment to consider a standardized set of activities or effects for each proposed action, thus bringing uniformity to the assessment process. Checklists can be used to determine environmental impact thresholds, thus indicating whether a full-scale EIA is needed for a particular project or whether a finding of no significant impact could be issued.

In implementing NEPA, all United States federal agencies prepared guidance documents demonstrating how their procedures would conform with NEPA requirements. Many of those agencies and their environmental consultants prepared checklists that would be used for assessing all relevant aspects of proposed actions in standardized format. An example of one such checklist, adapted from that prepared by A.D. Little (1971) for a proposed federal action is shown in Table 7-1.

MATRICES

Matrices are widely used to compare alternatives.

Matrices are very likely the most popular and widely used EIA methodology. One common application is in the comparison of alternative actions. Alternative actions (measures, projects, sites, designs) are listed as column headings, while the rows are the criteria that should determine

the choice of alternative. In each cell of the matrix, a conclusion can be listed indicating whether the alternative action is likely to have a positive or negative effect relative to the indicated criterion. Very often, the conclusion is stated as a numerical value or symbol indicating the level of intensity of the effect. There is an opportunity, moreover, to apply relative weighting to the various criteria when evaluating the completed matrix.

How many factors can you consider?

Optimum is fewer than the entire Leopold Matrix which includes 8,800 different factors

An early example of a comparative matrix with provisions for weighting various criteria, adapted from Odum et al.(1971) is shown in Table 7-2. This matrix was used in the EIA process for a section of interstate highway in the southeastern United States. A total of 56 factors were identified and sorted into four general groups: economic and highway engineering factors, environmental and land use considerations, recreational considerations, and social and human considerations. Data were evaluated for each of eight alternative highway alignments. The data were scaled against the maximum value occurring in the range of alternatives. Then, an interdisciplinary team assigned relative weights (over a range of -20 to +50) characterizing the initial and long-term effects of project implementation on each individual factor. The weighted scores were summed into a "relative impact" term characterizing each alternative. The advantage of this technique is that an error term can be calculated for each relative impact score, and the technique can be repeated several times in a Monte Carlo simulation to yield average scores adjusted for error.

Checklists can evolve into matrices.

The evolution of an EIA methodology from checklist to matrix is intuitively and easily accomplished. A checklist can be viewed as a single-column summary of a proposed action, with only a coarse characterization of the nature and magnitude of potential environmental impacts provided. An EIA matrix provides a finer degree of impact characterization by associating a set of columns (effects) with each row (environmental attribute) of the matrix. The United States Geological Survey matrix formulated by Leopold et al.(1971) (the "Leopold Matrix") consists of 100 columns representing examples of causative actions, and 88 rows representing environmental components and characteristics. As a first step, the columns

TABLE 7-1
CHECKLIST OF POTENTIAL ENVIRONMENTAL IMPACTS OF A TRANSPORTATION PROJECT

CATEGORY	PLANNING, DESIGN	CONSTRUCTION	OPERATION
I. Noise Impacts A. Public Health B. Land Use			
II. Air Quality Impacts A. Public Health B. Land Use			
III. Water Quality Impacts A. Groundwater 1. Flow and water table alteration 2. Interaction with surface drainage B. Surface Water 1. Shoreline and bottom alteration 2. Effects of filling and dredging 3. Drainage and flood characteristics C. Quality Aspects 1. Effect of effluent loadings 2. Implication of other actions, such as a. Disturbance of benthic layers b. Alteration of currents c. Changes in flow regime d. Saline intrusion in groundwater 3. Land use 4. Public health			
IV. Soil Erosion Impacts A. Economic and Land Use B. Pollution and Siltation			
V. Ecological Impacts A. Flora B. Fauna (other than humans)			

TABLE 7-1
CHECKLIST OF POTENTIAL ENVIRONMENTAL IMPACTS OF A TRANSPORTATION PROJECT

CATEGORY	PLANNING, DESIGN	CONSTRUCTION	OPERATION
VI. Economic Impacts A. Land Use 1. In immediate vicinity of project 2. In local jurisdiction served 3. In region B. Tax Base 1. Loss through displacement 2. Gain through increased values C. Employment 1. Access to existing opportunities 2. Creation of new jobs 3. Displacement from jobs D. Housing and Public Services 1. Demand for new services 2. Alteration in existing services E. Income F. Damage to economically-valuable natural resources			
VII. Sociopolitical Impacts A. Damage to, or use of: 1. Cultural resources 2. Scientific resources 3. Historical resources 4. Recreational areas B. Lifestyle and Activities 1. Increased mobility 2. Disruption of community C. Perception of cost/benefit by different cohesive groups 1. Racial 2. Ethnic 3. Income class D. Personal Safety			

TABLE 7-1
CHECKLIST OF POTENTIAL ENVIRONMENTAL IMPACTS OF A TRANSPORTATION PROJECT

CATEGORY	PLANNING, DESIGN	CONSTRUCTION	OPERATION
VIII. Aesthetic and Visual Impacts A. Scenic Resources B. Urban Design C. Noise D. Air Quality E. Water Quality			

Source: A.D. Little, Inc. (1971)

that correspond with the nature of the proposed action are checked off. Then, for each column that is marked, the cells corresponding to environmental effects are examined. Two scores (on a scale from 1 to 10) are listed in each cell, separated by a slash (/); the first score represents the *magnitude* of the possible impact, while the second score represents the *importance* of the possible impact. Beneficial impacts are indicated by a plus (+) sign. The interpretation of the matrix is based on the professional judgement of those individuals performing the EIA.

The Leopold Matrix assigns numerical values for magnitude and importance of impacts.

Several variants of the Leopold Matrix have been prepared; some of them have been adapted for computerized analysis (Schlessinger and Hughes, 1972; LMS Engineers, 1985). These variants may also integrate the scores in groups of cells to provide a quantitative and/or graphical summary of the matrix scoring.

With the characterization of a particular action expanded to two dimensions, comparison of several alternatives requires the addition of a third dimension. This is readily accomplished both conceptually and practically. The LMS Engineers adaptation of the Leopold Matrix provides a graphical summary (a bar histogram plot) of the anticipated impacts of a proposed action. The Leopold Matrix analysis can be performed on several alterative scenarios, yielding graphical summaries that can be visually or mathematically compared. The three-dimensional spreadsheet software programs now available also lend themselves to the comparison of EIA matrices in three-dimensional format.

Graphical summaries of matrices help to visually illustrate the results.

TABLE 7-2
OPTIMUM PATHWAY MATRIX - TYPICAL FORMAT

COMPONENT	Relative Weight: Initial Effects	Relative Weight: Long-term Effects	Classification
Land affected - pine forest			
Land affected - mixed forest			
Land affected - hardwood forest			
Land affected - agricultural			
Land affected - idle			
Land affected - surface waters			
Land affected - wetlands			
Land affected - mined land			
Land affected - urban			
Water supplies affected			
Unique areas			
Streams crossed			
Small abridgements			
Major bridges - number across major water bodies			
Major bridges - length of spans across water bodies			
Major bridges - number across other water bodies			
Major bridges - length across other water bodies			
Composite soil limitations			
Maximum sedimentation effects possible			
Minimum sedimentation effects achievable			
Area to be paved			
Area greatly affected by noise			
Area somewhat affected by noise			
Total system cost			
Annual costs			
Total excavation required (volume)			
Annual road user costs			
Benefit/cost ratio			
Interstate highway mileage			
Taxable land removed (area)			
Public land removed (area)			
Total family displacements			
Nearby residences affected by noise			

TABLE 7-2
OPTIMUM PATHWAY MATRIX - TYPICAL FORMAT

COMPONENT	Relative Weight: Initial Effects	Relative Weight: Long-term Effects	Classification
Daytime residential activities somewhat affected			
Daytime residential activities greatly affected			
Nighttime residential activities somewhat affected			
Nighttime residential activities greatly affected			
Churches somewhat affected by noise			
Churches greatly affected by noise			
Schools somewhat affected by noise			
Schools greatly affected by noise			
Lives saved/route - short-term			
Lives saved/route - long-term			
Number of interchanges			
Secondary growth impact - potential for development			
Secondary growth impact - suitability for development			
Secondary impact - water quality			
Secondary impact - visual disturbance			
Secondary impact - hunting and game			
Secondary impact - natural character of area			
Secondary impact - safe access			
Impact on planned surface water supply pattern			
Driving for pleasure			
Composite noise effect - camping			
Composite noise effect - picnicking			
Recreational land loss - present lands			
Recreational land loss - future lands			

Source: Odum et al. (1971)

NOTES

8 WRITING EIA REPORTS

8. WRITING EIA REPORTS

INTRODUCTION

The EIA report documents the process of impact assessment, serves as a primary information source for those organizations and individuals reviewing and commenting on the report, and presents in clear and objective manner options to be considered in the decision-making process. Clarity, objectivity, and conciseness in the report are of paramount importance in the preparation of the EIA report. To promote uniformity in the basic preparation of EIA reports, the laws and regulations implementing the EIA process should specify a basic format and recommend general or specific styles for writing, indexing, referencing, and illustrating to be followed.

The EIA Report is:

- **Clear**
- **Objective**
- **Concise**

GENERAL FORMAT

The general document format for EIA reports recommended by the CEQ in the United States is as follows:

Cover Page
Summary
Table of Contents
Purpose and Need for Action
Alternatives including Proposed Action
Affected Environment
Environmental Consequences
Comments and Responses to Comments
List of Preparers
List of Agencies, Organizations, and Persons to Whom Copies of the Report are Sent
Index
Appendices (if any)

Table 8-1 provides a summary discussion of each of these major topics.

TABLE 8-1
SUMMARY FEATURES OF MAJOR COMPONENTS OF AN EIA REPORT

Cover Page

A single page listing the responsible agency and cooperating agencies; the title of the proposed action and its location; the name, address, and telephone number of a contact person, a designation of the report as draft or final, a one-paragraph abstract of the EIA report, and the date by which comments must be received.

Summary

A summary of the proposed action, preferably less than 15 pages in length, that accurately and adequately describes the content of the EIA report. The summary should stress the final conclusions, areas of controversy, and the issues to be resolved.

Table of Contents

A list and page number index of the chapters, sections, and subsections in the EIA report, including a list of tables and a list of figures.

Purpose and Need for Action

A brief statement of the purpose and need to which the agency is responding in proposing the alternatives, including a description of the proposed action.

Alternatives Including Proposed Action

A presentation of the environmental impacts of the proposed action and all reasonable alternatives in comparative form, exploring each alternative, including the no-action alternative, and the reason why certain alternatives were recommended or eliminated.

Affected Environment

A succinct description of the environment of the areas to be affected by the alternatives under consideration. Data and analyses for any given subject area should be commensurate with the importance of the impact in that subject area, with less important material summarized or referenced.

TABLE 8-1
SUMMARY FEATURES OF MAJOR COMPONENTS OF AN EIA REPORT

Alternatives

Different means of meeting the basic purpose and need of a proposed action. The alternatives should include a full and rigorous consideration of all reasonable alternatives, including non-structural alternatives, that would satisfy the purpose and need of the proposal. The goal is to identify the least environmentally damaging alternative that satisfies the basic purpose and need of the proposed action.

Environmental Consequences of the Alternatives

A discussion of the environmental impacts of the various alternatives being considered, identifying any adverse environmental effects that cannot be avoided if the action is implemented, all mitigation measures to be employed to reduce the adverse effects, the relationship between short-term uses of the environmental and the enhancement of long-term productivity, and any irretrievable or irreversible commitments of resources that would occur if the action were implemented as proposed.

Comments and Responses to Comments

A listing of the written comments submitted by reviewing governmental agencies, public and private organizations, and interested individuals, and comments submitted in public hearings on the project. The comments included should be only those requiring a substantive response. The author of the comment should be identified by name and address. Comments may be paraphrased, and repetitive comments or questions may be listed once and cross-referenced to multiple sources.

The responses to the comments should either follow the comment directly, or reference the particular comment requiring any specific response. If the response references material already contained in the EIA report, the pertinent page number should be cited. The responses should address the substance of the comments as directly as possible.

List of Preparers

A list of the names and a summary of the professional qualifications of persons who were primarily responsible for the preparation of the EIA report or significant background materials.

TABLE 8-1
SUMMARY FEATURES OF MAJOR COMPONENTS OF AN EIA REPORT

List of Agencies, Organizations, and Persons to Whom Copies of the Report Are Sent

A list detailing the agencies, organizations, and persons that have been sent copies of the EIA report, including the addresses of public repositories (libraries, government offices) where the report is available for review.

Index

A listing of the major components of the EIA report by topic or issue, together with page number references.

Appendices

Materials prepared in connection with an EIA report that substantiate analyses fundamental to the report, that relate to the decision to be made, and that should be circulated with the EIA report. Material incorporated by reference is generally not included in these appendices.

INCORPORATION BY REFERENCE

EIA reports, as noted earlier, should be analytic rather than encyclopedic, providing information necessary and sufficient for reasoned decision-making. The EIA report, therefore, should be a document of moderate size, on the order of 100 pages. The bulk of the report can be reduced by incorporation by reference; incorporated material should be cited in the report and its content briefly described. No material should be incorporated unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Material that is based on proprietary data that is itself not available for review and comment should not be incorporated by reference.

Referring to other documents by reference helps to make a concise EIA.

Tiering is another method used to reduce paperwork. The term refers to the process of initially addressing a broad topic in an EIA report and then analyzing a narrower, site-specific project related to the broad topic. The purpose of tiering is to eliminate repetitive discussions and focus on relevant issues that are undergoing decision-making.

Materials typically incorporated by reference include other EIA reports, research papers in the general technical literature, technical background papers, data reports prepared independently from the EIA, textbooks, handbooks, other reference materials.

STAGES OF PREPARATION

EIA reports for major actions by national or regional agencies are likely to generate substantial discussion among reviewers, and may require modifications to components of the proposed action before the action is considered acceptable. The process of review and comment can be expedited by circulating a draft EIA report to environmental agencies and the public for review. The draft EIA should be complete in form and content, so that all relevant information about the proposed action is available for review.

A draft EIA is complete in form and content.

Following submission of comments from reviewers, the EIA report can be revised to address substantive concerns and to evaluate modifications in the proposed action. The revised report can be re-issued in full as a final EIA report; alternatively, a final EIA report that discusses only the changes to the draft EIA report can be issued. This latter procedure may save considerable time and resources by concentrating on changes and incorporating by reference the sections of the draft EIA that have not been modified in the course of review and comment.

The final EIA should address comments received on the draft EIA.

The final EIA report should also contain copies of letters submitted in comment on the draft EIA, transcripts of public hearings held on the draft EIA, and responses to substantive comments. These responses may reference pertinent sections in the EIA in answer to particular written or verbal questions.

GENERAL WRITING SUGGESTIONS

The EIA report must serve multiple functions, being simultaneously a decision-making document, a technically rigorous scientific analysis of potential environmental impacts, a record of the EIA process and participants, and a source of information for public citizens. Preparing a report that will serve these different readerships requires careful consideration of the ways in which information is presented. The following items are useful guidelines to follow in preparing the EIA report.

Use graphs and charts

- **Use Visual Displays** - visual displays of descriptions of existing and future conditions, data sets, impact analyses, alternatives comparison, and mitigation measures are extremely effective in communicating information about the proposed action. Maps and/or photographs should be used to familiarize readers with the affected area. Graphs, bar charts, pie diagrams, summary matrices, and similar information summaries should be used where possible. The visual displays can be briefly explained and discussed in accompanying text.

- **Avoid Vague Generalities, Cliches, or Professional Jargon** - the findings and conclusions of the report should be phrased in clear language that can be understood by lay persons reading the document. Where effects are understood, they should be stated clearly and objectively; where sophisticated analyses are performed, the summaries of these analyses should explain the findings in ordinary phrases.

Avoid Jargon

- **Maintain Continuity Throughout the Report** - the EIA report, though likely to be highly technical and lengthy, should "tell a story"; the sequence in which information is introduced should have strong continuity so that a review can follow the logic of the assessments, analyses, and conclusions.

Try to tell a story!

- **Review and Edit the Draft EIA Report for Consistency in Style and Content** - EIA reports are likely to be drafted by interdisciplinary teams. Differences in writing style could result in contradictory statements or information in various sections of the report. A thorough internal review of the completed draft EIA report should be conducted to identify and resolve such contradictions, if present. Legitimate differences of scientific opinion should not be omitted, but should rather be included to provide decision-makers and reviewers with these different assessments. Conflicting statements based on technical errors in data presentation or analysis should be resolved and revised.

Edit, Edit, Edit

- **Present All Relevant Risks and Benefits Objectively** - the purpose of the EIA report is to present to decision-makers relevant and objective information about the alternative ways of meeting a declared purpose and need. The risks and benefits of alternatives reasonably available should be presented without bias.

Objective writing facilitates non-biased decision-making.

NOTES

9 REVIEWING AND EVALUATING EIA REPORTS

9. REVIEWING AND EVALUATING EIA REPORTS

INTRODUCTION

The various environmental agencies administering EIA laws and regulations should review EIA reports and submit comments in writing to the principal oversight agency for the EIA being considered. If the laws and regulations provide for the review of a draft EIA report, review and comment on the completed draft can be extremely constructive. The review should be concerned with the completeness of the EIA report, the adequacy of the information and analyses contained therein, and the identification of significant impacts and appropriate mitigative measures.

COMMENTING

Comments should be widely solicited.

The agency or entity that prepares an EIA document should circulate for comment copies of the report to other governmental agencies that have legal jurisdiction, special expertise, or permitting and administrative responsibilities for any aspect of the proposed action. Comments should also be solicited from regional and local authorities, organizations, and individuals that have requested to review the EIA document. In the United States, such comments are solicited upon the issuance of a draft report, thereby allowing substantive changes to be made at this point in the EIA process, if necessary.

Specific comments are more constructive than vague generalities.

Comments made by an agency, organization, or individual on an EIA report should be as specific as possible and may address either the adequacy of the report or the merits of the alternatives discussed, or both. Comments that identify inadequacies should include a description of the additional information and/or analysis that would remedy the inadequacy. Any comments or criticisms that are directed toward the methodology used in the EIA should include constructive suggestions about alternative methodologies that might be used. If comments express

reservations concerning the level of environmental impacts resulting from the proposed action, those comments should include specifics on the mitigation measures that would be necessary to reduce the impacts to tolerable levels.

How do you respond to the comments?

The preparer of the draft EIA report should assess and consider comments both individually and collectively, and should respond to such comments by 1) modifying one or more of the various alternatives, including the proposed action, 2) developing and evaluating alternatives not previously given serious consideration, 3) supplementing or modifying the analyses, 4) making factual corrections where errors are acknowledged, or 5) explaining why certain comments do not warrant any further responses. The substantive comments and the written responses to those comments should be attached to the final EIA report.

INADEQUACIES

Review the EIA for:

- **Completeness**
- **Adequacy**
- **Merit**

A review of an EIA report may be structured to incorporate three levels of review: 1) a review for *completeness* to determine whether the report conforms with regulations concerning format and content, 2) a review for *adequacy* to determine whether the report provides adequate information on the issues of concern, and 3) a review for *merits* to determine whether the action should be approved as proposed.

Completeness review.

The review for completeness is principally a baseline administrative review, examining the EIA report for compliance with the relevant regulations on format, style, and general content, identifying deficiencies in these aspects of the EIA report. If the report fails to pass the review for completeness, further reviews will be delayed until the report is complete. If the report passes the completeness review, it can be circulated for more substantive examination in the review for adequacy.

Adequacy review.

The review for adequacy is directed toward determining whether the EIA adequately sets forth the environmental impacts of the proposed action and of the alternatives reasonably available to the action. The USEPA adopted three categories into which a draft EIA report can be classified (USEPA, 1984); these are:

1. **Adequate** - the draft EIA report adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. Nor further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

2. **Insufficient Information** - the draft EIA report does not contain sufficient information to assess fully the environmental impacts that should be avoided in order to protect the environment, or the reviewer has identified new and reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIA report and that could reduce the environmental impacts of the proposal. The additional information, data, analyses, or discussion so identified should be included in the final EIA report.

3. **Inadequate** - the draft EIA report does not adequately assess the potentially significant environmental impacts of the action, or the reviewer has identified new, reasonably available alternatives that are outside the spectrum of alternatives analyzed in the draft EIA report and that should be analyzed in order to reduce potentially significant environmental impacts. The additional information, data, analyses, or discussions so identified are of such a magnitude that they should have full public review at a draft stage. This rating indicates a determination that the draft EIA does not meet the purposes of the environmental law, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIA report.

The third level review, the review for merit, examines whether the draft EIA report has demonstrated that the action as proposed has identified and avoided, minimized, or mitigated significant environmental impacts

Possible ratings for a review of the adequacy of an EIA report:

- **Adequate**
- **Insufficient information**
- **Inadequate**

Possible ratings for the Merit review of an EIA report:

- **Lack of objections**
- **Environmental concern**
- **Environmental objections**
- **Environmentally unsatisfactory**

that should be avoided to protect environmental resources. This is the most substantive level of review, where the review must determine whether the content of the draft EIA report supports the alternative preferred in the report's findings and conclusions. While the reviews for completeness and adequacy essentially determine whether the report surpasses minimum criteria, the review for merit examines the accuracy and legitimacy of the report's findings.

The USEPA assigns one of four ratings to draft EIA reports (USEPA, 1984):

1. **Lack of Objections** - the review has not identified any potential environmental impacts requiring substantive changes to the preferred alternative. The review may have disclosed opportunities for the application of mitigation measures that could be accomplished with relatively minor changes to the proposed actions.

2. **Environmental Concern** - the review has identified environmental impacts that should be avoided in order to protect fully certain environmental resources. Measures to correct these concerns might require changes to the preferred alternative, or the application of mitigation measures that could reduce the level of environmental impact.

3. **Environmental Objections** - the review has identified significant environmental impacts that should be avoided in order to protect environmental resources. Corrective measures could require substantive changes to the preferred alternative or consideration of some other action alternative, including the no-action alternative or a new alternative. The bases for environmental objections could include circumstances where the action might violate, or be inconsistent with, achievement or maintenance of an environmental standard; where the agency violates its own substantive environmental requirements relating to jurisdiction or expertise; where there is a violation of declared policy; where there are no applicable standards, or where applicable standards will not be violated, but there remains a potential for significant environmental degradation that could be

corrected by modification of the action or other feasible alternatives; or where proceeding with the proposed action would set a precedent for future actions that collectively could result in significant environmental impacts.

4. **Environmentally Unsatisfactory** - the review has identified adverse environmental impacts that are of sufficient magnitude to cause the agency to believe that the proposed actions should not proceed as proposed. The basis for an environmentally unsatisfactory determination consists of identification of environmentally objectionable impacts as defined above, and in one or more of the following conditions: the potential violation of, or inconsistency with, an environmental standard is substantive and/or will occur on a long-term basis; there are no applicable standards, but the severity, duration, or geographical scope of the impacts associated with the proposed action warrant special attention; or the potential environmental impacts resulting from the proposed action are of national importance because of the threat to national environmental resources or to environmental policies.

REVISIONS/SUPPLEMENTAL REPORTS

Revisions to the EIA report can be best accommodated by circulating a complete draft or a supplemental EIA report for review and comments. The substantive changes deriving from agency and public comments can be incorporated into either a complete, revised final EIA report or can be documented in an abbreviated final EIA report that incorporates the draft EIA report by reference.

Supplemental EIA reports may contain additional field studies or responses to comments raised on the draft EIA.

Where review of an EIA report discloses a topic area that needs substantial supplementation, either through further field studies or through further analysis and evaluation, the results of those further studies can be issued

in a supplemental EIA report that incorporates the main EIA report by reference. The supplemental EIA report thus would focus only on the few issues that were inadequately dealt with in the main EIA report.

THE U.S. SECTION 309 ENVIRONMENTAL REVIEW PROCESS

Section 309 of the United States' Clean Air Act requires the EPA to review and comment in writing on the environmental impact of any matter relating to EPA's duties and responsibilities pursuant to the act or any other provisions under the authority of EPA. These review requirements apply to (1) legislation proposed by a Federal agency; (2) newly authorized Federal projects for construction and any major Federal action, or actions, other than a project for construction; and (3) proposed regulations published by any department or agency of the Federal Government.

The objective of EPA's Section 309 Environmental Review Process is to foster the goals of the NEPA process. The process ensures that the EPA's environmental expertise, as expressed in its comments on Federal actions and other interagency liaison activity, is considered by agency decision-makers.

EPA uses the 309 Review Process in conjunction with other statutes (e.g., NEPA and CEQ implementing regulations) to assist other federal agencies in integrating sound and cost-effective environmental analysis into their decision-making. EPA's policy is to identify environmentally unsatisfactory proposals early in the planning process, and negotiate with other agencies to provide technical assistance to federal, state, regional, and local governmental entities in the EIA process.

Pursuant to this objective, EPA has established specific policies and detailed procedures for conducting reviews of Federal actions that affect the quality of the environment. These policies and procedures for carrying out the Environmental Review Process assign specific responsibilities and outline mechanisms for resolving

problems that might arise in the review process (EPA, 1984). Table 10-1 presents a summary of the important features of those Section 309 review procedures.

The policies and procedures established by EPA stress several characteristics of the environmental review process that are important for its effective functioning. Among these are:

- The coordination of the environmental review process among participating agencies at the early stages of the assessment (e.g., scoping). This interagency coordination promotes the production of concise, well-reasoned decision documents that identify project impacts, a range of project alternatives, and mitigation measures that will avoid or eliminate adverse effects on the environment.

- The thorough understanding of agency policy, procedures, hierarchy, language, and statutory responsibilities. The agency's comments resulting from environmental reviews should be consolidated into one document consistent with the agency's policies and regulatory language, and reflective of the agency's authority and responsibilities.

- An appreciation of the type and purpose of the document being reviewed. For example, review comments on a feasibility report should address the general issues of project feasibility rather than design-level specifics.

- The clear identification of whether conclusions about a document's adequacy reflect mitigation. A draft EIS might be rated inadequate because the mitigation measures that are proposed to minimize adverse impacts are only listed generally, rather than being presented as firm commitments with project-specific designs. Subsequent agency reviews could be more positive if more specific commitments to mitigation are agreed upon; the basis for this

change in the agency's position should have a well-documented basis in that agency's record of review comments.

TABLE 9-1
GENERAL EIS REVIEW PROCEDURES AND RESPONSIBILITIES
(Based on Section 309 of the U.S. Clean Air Act)

A. OBJECTIVE: The objective of the Environmental Review Process is to foster the goals of the EIA process by ensuring that the oversight agency's environmental expertise, as expressed in its comments on national actions and other interagency liaison activity, is considered by agency decision-makers.

B. STAFFING AND RESPONSIBILITIES: The Section 309 review process identifies a Review Coordinator, a Principal Reviewer, and Associate Reviewers. The Review Coordinator is responsible for assuring that the review is conducted in timely fashion and in compliance with all established procedures, consolidating comments from other reviewers, and documenting and resolving any disagreements of inconsistencies between reviewers. The Principal Reviewer is designated by the Review Coordinator to consolidate review comments and prepare a comment letter. The Associate Reviewer is designated by the Principal Reviewer to provide technical and policy advice in specific review areas.

C. PRE-EIS REVIEW ACTIVITIES: At this point in the process, the Review Coordinator should take steps to establish and maintain general liaison with other agencies to assist in early identification of potential project impacts, alternatives, mitigation measures, and assessment techniques; to participate in scoping meetings to identify environmental issues, information gaps, reasonable alternatives, and mitigation measures; and to provide review guidance as a cooperating agency (if the oversight agency is not the lead agency in the environmental review). All agency responses and correspondence related to these activities should be made part of the official project file.

D. REVIEW OF DRAFT EIS: The Review Coordinator and Principal Reviewer are responsible for establishing deadlines for receiving comments on the Draft EIS (DEIS); for rating the DEIS for adequacy according to an established system; for consolidating comments on the DEIS with suggestions for additional information that is needed (e.g., on mitigation, statutory authorities, alternatives, purpose and need); for distributing review comments to other agencies; and for documenting all comment letters and correspondence as part of the official project file.

E. POST-DRAFT EIS FOLLOW-UP: The Review Coordinator should initiate consultation with other participating agencies, particularly if the DEIS receives an "inadequate" rating. The Review Coordinator should also prepare status reports on the resolution of these inadequacies, and document all consultations in the official project file.

F. REVIEW OF FINAL EIS: This review should follow the general procedures of "D" above, concentrating on consideration of the impacts of the project, any unresolved major issues, or additional mitigation measures needed. If substantial new information is needed, a supplementary EIS may be requested. All comments and correspondence should be documents in the official project file.

G. MONITORING AND FOLLOW-UP: After transmittal of comments on the Final EIS, the Review Coordinator and/or Principal Reviewer should ensure that the record of decision incorporates all conditions agreed upon, that appropriate agencies are informed of the oversight agency's position on the EIS, and that mitigation measures are carried out. All comments and correspondence should be documented in the official project file.

NOTES

10 BUILDING AN EFFECTIVE EIA PROGRAM

10. BUILDING AN EFFECTIVE EIA PROGRAM

INTRODUCTION

As countries and governmental subdivisions within countries create or refine EIA programs, policymakers should consider some of the major issues that have arisen in the application of EIA procedures in the United States and other countries. These basic issues are discussed in terms of 1) selecting elements for the program, 2) testing the program, and 3) overseeing the program.

SELECTING THE APPROPRIATE ELEMENTS

As noted several times in this document, the EIA process is a method for facilitating the decision-making process on issues that affect the environment. In this regard, the specific EIA format adopted by any particular country or region is, in part, a function of that area's priorities. One can conceive of circumstances where development and redevelopment is both a necessity and a priority, while in other cases, development may be considered less compelling. Whatever the necessity of development may be, however, the EIA process should be used to avoid affecting environmental resources more than is absolutely necessary.

As a fundamental decision-making tool, the overall purpose of EIA is to facilitate answering a fundamental question. Should a proposed action be undertaken or not? The process by which this fundamental question is answered can be the full and complex EIA process or an abbreviated adaptation of the full EIA process. Whatever adaptation of EIA is adopted by a country, region, or local community should be oriented toward answering this question through a process open to public participation.

As has been discussed at several points in this text, the decision of whether or not to undertake a particular action is generally made at one of three points in the EIA.

The selectivity of the screening, initial EIA, and EIA stages can be intensified or relaxed, depending on other economic, politic, and environmental factors. Relaxing the selectivity of screening or EIA procedures would allow more actions to proceed without a full EIA; intensifying such procedures would have the opposite effect.

Mitigation is an essential component and should be emphasized even if a streamlined approach is used.

When, due to overriding economic or policy concerns, a decision is made to relax and/or streamline the EIA process, the mitigation aspect of EIA should be emphasized. Mitigation can provide a substantial measure of environmental protection, even when economic or policy circumstances dictate that certain actions proceed in environmentally sensitive areas. Specifically, the minimization, rectification, reduction, and compensation categories of mitigation should be employed to protect or restore environmental resources where avoidance or the disturbance of such resources is not the preferred alternative.

Emergency Procedures

In addition, it may be necessary to incorporate procedures within an EIA program to provide for emergencies. On occasion, it may be necessary to move forward with an action that will have significant environmental impacts. Procedures should be developed to identify notification requirements, coordination steps, and how actions will be limited only to those necessary to address immediate impacts.

STREAMLINING THE PROCESS

The experience in the United States with EIAs has demonstrated that, in some circumstances, the process can become very lengthy, extending over several years in some highly-contested projects. The circumstances where this has been most likely to occur are with 1) projects that are highly controversial, 2) projects that require extensive site-specific data collection to complete impact assessments, or 3) projects that involve the issuance of one or more major environmental permits. There are several approaches that can be used to streamline the process to reduce the time between initiation and completion of an EIA.

- **Comprehensive Scoping** - the scoping phase of the EIA process should define clearly the information needed to make a balanced decision on project alternatives. Although it is impossible to anticipate all issues that might arise during the course of an EIA for any particular project, the general limits of the work should be resolved during scoping, and a firm schedule established for conducting the work. For this reason, the parties participating in the scoping should be prepared to cooperate to the fullest extent on generating the scope of work for the EIA process. For example, the scoping participants should agree generally on the range of reasonable alternatives and the type and extent of site-specific data collection that should be undertaken. If one or more important wildlife populations show seasonal variations (e.g., migratory birds or fishes), the number of seasons of data that will be necessary should be agreed upon.

Effective scoping aids in streamlining the EIA process.

- **Program and Policy EIAs** - as noted in Chapter 4, program and policy EIAs evaluate the environmental effects of programs or policies that, when implemented, generate a number of similar projects. Program and policy EIAs can help to streamline the EIA process by resolving certain important environmental issues in advance of specific project proposals. Program and policy EIAs can define the purpose and need for certain classes of actions, compare alternative means of meeting those needs, outline the spectrum of important environmental issues that would be relevant within the reasonable alternatives, and recommend particular patterns of action. After the program or policy EIA has been completed, reviewed, and adopted, the EIA process for specific projects originating under that program or policy can incorporate by reference the analyses and findings of the program or policy EIA.

By using the EIA process for programs and policies, certain environmental issues can be resolved in advance of specific project EIAs.

- **Generic EIAs** - these EIAs, like program or policy EIAs, encompass several possible site-specific projects that have relevant similarities such as

Generic EIAs may contain reference materials for site specific EIAs.

common timing, impacts, alternatives, methods of implementation, or subject matter. A generic EIA identifies factors to be evaluated, and methodologies for quantifying those factors. Moreover, it may present reference materials that are useful for evaluating the environmental impacts of site-specific projects.

SELECTING THE INTERDISCIPLINARY TEAM

EIAs are often conducted by interdisciplinary teams of ecologists, scientists, planners, and engineers to assess existing conditions and potential environmental impacts. These teams can be assembled from many sources such as government agencies, universities, environmental interest groups, and environmental consultants. The goal is to assemble a team of the best available technical and scientific experts to evaluate the environmental impacts of a proposed action and its alternatives, particularly for those key issues identified in the scoping process.

When these experts cannot be assembled from within the organization preparing the EIA, then such expertise can be sought from other organizations or from a well-qualified, experienced environmental consultant. Consulting firms may differ significantly in their capacity to assist in the EIA process. The following points should be considered in the process of selecting an environmental consultant:

- **Make the Selection Process Competitive** - the agency or organization seeking to retain an environmental consultant should inform several such consultants of the services being sought, and solicit proposals from those several firms. The solicitation in its formal form is often termed a Request For Proposal or RFP.

- **Request Details of the Firm's Qualifications** - a firm proposing to conduct EIA work should be able to demonstrate that its personnel have the professional qualifications to conduct EIAs.

- **Request Details of the Firm's Experience with Related EIAs** - a firm proposing to conduct EIA work is more

likely to produce a competent assessment on schedule if that firm has substantial prior experience in such projects. Admittedly, when a new EIA program is initiated in a country or region, the number of experienced environmental consultants may initially be limited, but prior experience is nonetheless an asset to be evaluated in the selection process.

- **Have the Proposals Include a Detailed Work Plan** - the RFP to prospective consultants should include a request for a detailed work plan for the specific project. The work plan should provide a breakdown of tasks and subtasks, a schedule of these tasks, estimates of the level of effort needed for each task, senior personnel that would be responsible for each task and overall project coordination, and estimated costs broken down by task and by type of cost (labor or expense).

- **Request a Discussion of the Availability of Key Personnel** - the RFP should ask for the names and responsibilities of key personnel involved in the EIA, and should require that the availability of such personnel over the estimated schedule of the project be specified.

- **Request Information on Requisite Insurance** - if a professional firm is required by law to provide insurance coverage to its personnel, or provide professional liability insurance for its professional work, the prospective consultant should be required to produce evidence that its various insurance coverages are adequate and in force or that the firm has adequate financial resources in lieu of insurance.

The proposal submitted by the environmental consultant is, if accepted, essentially a contract between the consultant and the project developer. Thus, the RFP should elicit written responses for all those items that will become contract obligations for the consultant. Ambiguous RFPs and incomplete proposals can lead to delays in the EIA

process stemming from contractual rather than technical difficulties.

OVERSIGHT OF THE EIA PROGRAM AND PROCESS

Oversight of the EIA process is necessary to ensure that the intent of an EIA process is implemented in a fair and equitable manner. Several processes are included in such oversight.

- **Establishing Uniform Procedural Requirements** - One agency must be relied upon to provide leadership for establishing the basic procedural requirements and guidelines for undertaking the basic components of the EIA process. That agency's primary objective is to establish ground rules to ensure uniform application of legal EIA procedural requirements fashioned to minimize adverse impacts from projects. It should also be responsible for producing guidance documents, as needed, to aid responsible parties in carrying out their duties (e.g., clarifying requirements of the law, or clarifying how the basic requirements may apply to new assessment situations, or clarifying the nature and detail required in a particular assessment).

  This lead agency should also be responsible for gathering information about the conditions and trends in environmental quality, evaluating the programs of all responsible parties in light of the goals established in law, developing and promoting national policies to improve environmental quality, and conducting studies, surveys, research programs, and analyses relating to ecosystems and environmental quality. Each year, an annual report should be published to inform all responsible parties and the general public about the status of various environmental concerns, including the success, or lack thereof, of the EIA process.

- **Responsible Party Adaptation of the EIA Process** - Once established, the EIA process should be applied uniformly across all program areas. This does not mean

that the EIA process need be pursued apart from other planning processes established under individual program requirements. It only means that EIA's should be prepared using a common format modified to include all other project planning information needed for an agency to reach its final decision. The format should be such that decisions resulting in adverse impacts to the environment will clearly highlight the trade-offs being made between project benefits and impacts. It should also allow for presenting how project benefits outweigh impacts or how other priorities override the environmental concerns involved.

- **Independent Review of Projects** - When many entities are involved in an EIA process, there are bound to be differences of opinion and interpretation of the significance of impacts, including the acceptability of permissible changes to elements of the natural and man-made environment. For this reason, several countries, including the United States, have established an independent evaluation process for all major projects (i.e., projects determined to have significant impacts). Usually, the same agency that establishes the basic EIA guidelines is also charged with the independent evaluation of major projects. The function of this reviewing agency is twofold. First, it must review individual project EIA documentation for adherence to the minimum set of requirements for EIA, including public notification and participation in the process. Second, it must review for acceptability of the impacts generated, including whether or not the alternative chosen is the most appropriate in minimizing adverse impacts to protected environmental resources. The reviewing agency should also have the responsibility for maintaining files, available for public inspection, on all major projects being evaluated, including brief descriptions of the proposed action, how well the agency met the requirements of the law, and how acceptable the agency's action is in protecting or restoring

environmental resources. In the United States, the CEQ originally formulated the EIA requirements and provided an independent evaluation of major project assessments. The independent review is now conducted by the USEPA, with a provision to refer unresolvable decisions to the CEQ.

DATA MANAGEMENT

An automated data management system can be a useful tool for keeping track of the EIA process. Depending on the EIA program that is developed, the system can be simple or complex. If, for example, one agency or government organization is responsible for the EIA program, then a data management system could include all stages in the preparation, writing, and review of the EIA document. On the other hand, an organization that is responsible for reviewing EIA reports may develop a data management system to keep track of the review and comment process. Another advantage of this type of system is that it can be used to document the decision-making process, an important factor described in Chapter 6.

There are a number of aspects of the EIA program that should be considered for inclusion in the automated data management system, such as:

- Timeframes and responses to the EIA document review process,
- Key steps in the public participation process,
- Milestones or requirements in the mitigation plan or record of decision document, or
- Relationship to other permitting or planning activities.

At a minimum, the data management system should keep a record of the titles of EIAs, and the date of initiation and completion. In the United States, the USEPA uses a system called the Environmental Review Tracking System to record and track the various stages in the formalized EIA document review process. This centralized system enables the USEPA to record the principal reviewer of the document, the comments received, and document the public's access to review comments.

A data management system for an environmental review process might comprise, as a minimum, the categories and data elements on Table 10-1. This would establish a mechanism for directly and routinely communicating dates and other information related to EIA filing and review.

TABLE 10-1
DATA MANAGEMENT
SYSTEM ELEMENTS

Category	Data Element/Code
File/Track EIA Documents	H (Heading). Identifies the time period in which EIAs were filed with instructions on receipt and nonreceipt of EIAs. RF# (Reference Number). Assigned at the time each EIA is received and used to track the EIA in the filing system. DF (Date Filed). Month, day, year the EIA was received. Also, the date the document preparer is required to complete distribution of EIA to reviewers. T (Title). Identifies the EIA filed. AN (Amended Notice). Indicates previous EIA, or if extended, withdrawn or corrected. Designate by an * and provide an explanation.
Review Process	DD (Due Date). Month, day, year comments are due to preparer. PR (Principal Reviewer). Designates office responsible for EIA review.
Public Access to Review Comments	ND (Note Date). Month, day, year that a Notice appears advising public of availability of comments on EIA. ND is also date EIA is received for the review period. Day one of the review period.
Publication of Unsatisfactory Determinations	ND (Note Date). Month, day, year that a notice appears advising public of unsatisfactory determinations.

11 ASSESSMENTS FOR SMALL PROJECTS AND CONTAMINATED SITES

11. ASSESSMENTS FOR SMALL PROJECTS AND CONTAMINATED SITES

INTRODUCTION

Special environmental evaluations can be employed for projects so small that a full, comprehensive EIA document would not be warranted and for sites that are being considered for development, sale, transfer, or acquisition but that are potentially contaminated by hazardous or toxic substances. These special evaluations are discussed in the following sections.

SMALL-PROJECT EIAs

Small project EIAs follow the EIA framework.

Although EIA laws, regulations, and programs of a particular country are often initially implemented at the national level, reflecting adoption of a national policy of environmental protection, the principles of EIA can be readily applied at the regional and local levels as well. In the United States for example, many regional and local governments have adopted EIA requirements that closely parallel NEPA in format. Small projects can thus be subjected to EIA requirements at the national, regional, and local levels. Small projects are normally those having impacts of small scale and scope and may therefore require an environmental report that is less comprehensive and extensive than a full-scale EIA. Such a report can often take the form of an initial EIA. The use of simplified, standardized forms are particularly effective for small projects. In addition, a generic EIA can, in some cases, be carried out for categories of projects with similar impacts.

Regardless of whether a report is prepared or a checklist approach is used, an initial EIA should be as comprehensive and extensive as required for the small project to fully comply with all the provisions of the EIA process. The efforts to identify and evaluate alternatives in many cases can be reduced for small projects. Efforts to

avoid and minimize environmental impacts, however, should be rigorous in all cases.

The proponent of a small project should notify the public and begin the initial EIA as early in the planning phase as practical. The person conducting the initial EIA is often separate from the site engineer, requiring that the site engineer and the EIA preparer coordinate their activities on the project. The EIA preparer should examine the conceptual plan as early as possible and make recommendations, if necessary, for design changes to protect environmental resources.

Small project EIA reports can be based on checklists or standardized formats.

The format of the initial EIA report should follow the format specified in the regulation requiring the EIA process; if a format is unspecified, the general format shown in Table 11-1 is generally applicable to small projects. The small-project EIA should contain the following sections:

I. **Plan and Description of Development** - descriptions of the preliminary site plan, including roadway access and internal roadway configurations; local zoning and land use in the vicinity of the project site; a plan for water supply; a plan for wastewater disposal; a plan for stormwater management; and a solid waste plan. These project details are generally provided to the environmental consultant by the project engineer, who must configure the project to conform with local land use regulations.

II. **Inventory of Existing Environmental Conditions** - descriptions of local geology, soils, surface waters, groundwater, vegetation, wildlife, sensitive environmental features (wetlands, floodplains, steep slopes, areas of high water table, areas of hydric soils, areas with shallow depth to bedrock, areas with exemplary stands of native vegetation, habitats for endangered species), air quality, cultural and historic resources, demography, socioeconomics, and traffic. Much of the information needed in this inventory section should be available from regional resource maps (e.g., geological mapping, soils mapping), topographic maps,

TABLE 11-1
REPRESENTATIVE SMALL-PROJECT EIA REPORT FORMAT

TABLE OF CONTENTS

TABLE 11-1
REPRESENTATIVE SMALL-PROJECT EIA REPORT FORMAT

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REPRESENTATIVE SMALL-PROJECT EIA REPORT FORMAT

regional lists of flora and fauna, and local zoning/land use/demographic surveys.

Small Project EIA Reports

- **Plan and Description of Development**
- **Inventory of Existing Environmental Conditions**
- **Assessment of Environmental Impacts**
- **Listing of Adverse Impacts**
- **Comparison of Alternatives**
- **Mitigation**
- **Infrastructure Needs**
- **Licenses, Permit and Approvals**

III. **Assessment of Potential Environmental Impacts of Project** - discussions of potential environmental impacts, both short-term and long-term, that would result from constructing the proposed project. The potential impacts should be discussed in the ordered categories used in the inventory section ('B' above), and the measures incorporated into the project design to mitigate these potential impacts should also be discussed. Where the potential for significant impacts exists, these discussions should provide reasonably detailed information about the anticipated level of impact and the measures taken to mitigate such impacts. Where the potential for significant impacts is low, the category can be treated in an abbreviated manner. For example, if a site has a significant area of floodplain, the EIA section on impacts should discuss how the project has been designed to minimize impacts to these sensitive environments; if a site has no floodplains, a statement to that effect (verifiable through mapping or modeling) is sufficient.

IV. **Listing of Adverse Environmental Impacts** - identification of those environmental attributes that will be affected by the project even after all mitigation measures are employed. A development that clears forested land for residential or commercial buildings clearly changes the character of that land, reducing the area of forest and increasing the area of developed land. The area of impervious surface will likely increase, and stormwater runoff into surface waters will carry higher loadings of nutrients and contaminants. Water supply demands may cause groundwater levels to drop perceptibly. These adverse impacts may result even though the developer has complied with all pertinent design standards for site development; they are, in this regard, unavoidable impacts that result from a decision to proceed with development of a particular property.

V. **Steps to Minimize Environmental Damage** - discussion of the various measures used to minimize environmental impacts, both during construction on the site (short-term impacts) and during operation of the facility constructed (long-term impacts). Such measures could include erosion control through use of silt fences or hay bales, stormwater management

through detention of surface runoff in basins, and soil stabilization through mulching and planting of disturbed areas.

VI. **Comparison of Alternatives** - identification of alternative plans considered for site development, including the no-action alternative. The discussion of alternatives in a small-project EIA is usually less extensive than that in a large-scale EIA because, in a small-scale project, the developer generally has few or no options in site location.

Alternatives are usually fewer in number for small project EIAs.

VII. **Infrastructure** - identification of the sewage facilities, water supply, drainage, solid waste disposal, air pollution, and traffic components of the small project.

VIII. **List of Licenses, Permits, and Other Approvals Required** - a listing of the various approvals needed from governmental agencies (local, regional, and possibly national environmental agencies). The EIA report should, if possible, describe the permitting authority, the permit needed, and the status of the permit application.

References - a listing of books, reports, and other technical references consulted during the preparation of the EIA report.

Appendices - one or more appendices that contain materials important to the review of the EIA report, including pertinent correspondence from permitting agencies, data reports central to conclusions about environmental impacts, and materials describing the qualifications and experience of the preparers of the EIA report.

The schedule for the completion of a small-project EIA should be substantially shorter than that for a large project, taking a few weeks or a month to prepare if the site engineering has been substantially completed, the local resource mapping is available, and numerous site-specific studies are not required.

The EIA report will be correspondingly shorter, with a typical small-project report being about 75-100 pages in length.

Many of the smaller governmental units in the United States (i.e., counties, townships) have cataloged the principal environmental features within their boundaries in "Natural Resource Inventories" (NRIs). These NRIs, if available, are extremely helpful to a small-project EIA preparer. NRIs contain many of the resource maps and lists from which the existing environmental characteristics of the project site can be characterized. NRIs also may provide quantitative data on water quality, aquifer recharge rates, and air quality, and may specify guidelines that describe the carrying capacity of the lands affected by the proposed small project. For example, an NRI prepared by a particular local government may recommend certain values to be used when evaluating the safe sustained yield of local groundwater aquifers, or the minimum land areas (lot sizes) needed for safe operation of individual septic systems. In the absence of compelling contrary evidence, the developer and the developer's small-project EIA preparer should use the carrying capacity values derived by the local government.

Small project EIA review should be based on completeness, adequacy, and merit.

The review of small-project EIA reports is generally carried out by local commissions, councils, or boards. The reports should be evaluated on the same criteria as are large-project EIAs: completeness, adequacy, and merit. Some local governments have volunteer commissions (variously called environmental commissions, conservation commissions, or environmental management councils) that act as independent reviewers for the local government, reporting comments and recommendations on EIA reports and projects to the local decision-making body. Some local governments also retain full-time planners and/or planning staffs that can provide expert comment and review at various stages of project designs. Most local governments or their planning boards hold public hearings on projects requiring their approval. At these hearings, developers and the developers' small-project EIA preparers may offer testimony, and comments are encouraged from citizens of the community. In general, small projects evaluated at the local level experience a great deal of public participation and review. Also, negotiation usually plays a more important role in the final design of projects at the local

level, as the aims of the community are expressed through the public hearing process.

The EIA review may extend to the regional governmental body, which evaluates the project for conformance with regional planning goals and regional environmental standards (e.g., soil erosion, stormwater management, roadway changes). The Appendix to this document contains a checklist used by the state of New York, United States, for use in scoping the environmental issues that should be addressed in EIAs.

The checklist approach is useful for small project EIAs.

For certain categories of small projects or actions, criteria have been established at the national, state, and local levels of environmental regulation to permit such small actions with a minimum of time and effort in EIA procedures. Prime examples of this are the nationwide permits issued by the U.S. Army Corps of Engineers (COE) for certain projects or actions that disturb wetlands. Under this system, a nationwide permit is issued covering small wetland disturbances. Therefore, these small wetland disturbances (e.g., wetland filling of one acre or less) can be undertaken without site specific permits. In effect, the regulatory agency has concluded in advance that such actions will not generate significant adverse environmental effects. It should be noted, however, that the COE went through an EIA process and determined that there were no significant impacts, (both individually and cumulatively) from this approach. The only requirement is notifiying the regulatory agency of the nature of the action and, providing sufficient information to demonstrate that the action meets the criteria for the nationwide permit.

Nationwide Permit Procedures.

These COE nationwide permits, and other small projects (e.g., construction of small subdivisions, renovation of existing structures) that have no site specific EIA requirement, can be considered specific regulatory exemptions or categorical exclusions. The significance and timing of such categorical exclusions has been discussed earlier in Chapter 4.

What are the differences between EIAs for small projects and large projects?

In summary, the EIA process for small projects works well as a scaled-down version of the full-scale process and framework described in this chapter for large projects. The major differences are generally in the level of detail with which environmental features and potential impacts are assessed, the magnitude and duration of site-specific studies, the degree of review given to the EIA report, and the governmental bodies involved in the decision-making process.

ENVIRONMENTAL SITE ASSESSMENTS

An environmental site assessment is used to determine the potential for existing environmental contamination.

A special type of EIA relates to assessing existing conditions at a site where a proposed action is planned. Environmental site assessments, also known as preacquisition site assessments, are typically conducted to determine if a site is contaminated by hazardous and/or toxic substances prior to the development, sale, transfer, or acquisition of the property. Hazardous substances may include chemicals, manufacturing wastes, petroleum products, toxins, and so on. The site may contain such materials because of, among other mechanisms, past manufacturing activities, illegal "dumping," or subterranean migration of contaminants through groundwater.

They are sometimes referred to as "Environmental Audits", but are only a close relative since they do not involve the traditional audit concept of comparing performance or observation to pre-established conditions or criteria. These site assessments may be conducted on behalf of any one of the parties involved in a property transfer transaction, such as investment bankers, attorneys, financial institutions, borrowers, sellers, buyers, or insurers. These parties generally retain experts to perform the assessments prior to closing a transaction.

The objective of a site assessment is to conduct a preliminary evaluation of a site or property in order to identify and assess the magnitude of any existing environmental hazards and associated risks. Environmental hazards include soil and groundwater contamination, leaking underground storage tanks, asbestos, polychlorinated biphenyls (PCBs) and other materials hazardous to human health and the environment. All properties

and systems affecting the transaction, including the land, buildings, plant and equipment, and neighboring properties, should be evaluated as sources of potential concern. The audit can also be used to establish baseline conditions prior to development.

For parties involved in property transactions, the results of these evaluations may be the difference between a profitable and a bad investment. In case the audit indicates no signs of environmental hazards, the transaction can be closed by the parties with a higher degree of confidence. If environmental hazards are found, then corrective actions can be taken to remediate the problem. Such an approach is likely to minimize health impacts and save considerable costs in the future. An assessment or environmental audit can offer liability protection against unknown risks for an unsuspecting party involved in a property transaction. The problems caused by contamination can be very significant and create a substantial financial risk for the site's owners over the long term.

Environmental site assessments are typically conducted in three or four phases depending on the time and resources available. The scope of work for each phase depends, in part, on the findings of the preceding phase. In general the screening phase, or Prephase I, involves an initial EIA based upon a general knowledge of the current and past on-site activities. If there is evidence of prior contamination or a reason to conclude that contamination may have occurred, the investigation should proceed to Phase I.

The tasks involved in Phase I of an audit include: historical records search and review, site inspection and visual survey, and preparation of a Phase I report. Phase I activities generally involve a search and review of available historical records related to manufacturing or disposal activities, a review of historical aerial photographs, initial site inspection, and visual survey of current materials handling practices. The investigation is strictly nonintrusive in nature and no sampling or analysis is performed on-site.

Conclusions of this phase are based upon any documentary evidence, interviews with personnel knowledgeable about recommendations for additional phases, and a description of the limitations of the tasks performed.

Phase II is an in-depth study that involves field sampling.

If the historical records review and site reconnaissance either provide evidence of or indicate the potential for contamination on-site, an intrusive Phase II of the audit should be performed to determine the nature and extent of contamination. Phase II is an in-depth study that includes: surface and subsurface exploration, multi-media sampling and analysis, and if necessary, geophysical testing.

During Phase II, the actual sampling and analysis of the various media of concern are performed at the site. The media of concern that are tested may include soil, groundwater, and air. Intrusive inspections may also be performed to assess the potential for contamination in aboveground structures, utilities, and underground sewer systems. Prior to initiating the Phase II investigation a detailed work plan is developed that identifies the specific sampling and analytical procedures that will be used. As with the Phase I study, the Phase II report documents the findings and limitations of the investigation.

Phase III includes steps to clean-up the site.

If the results indicate that hazardous substances are present at levels that may be dangerous to human health and the environment, a Phase III investigation may be undertaken to clean-up, or remediate, the site. This final phase is also known as the clean-up or corrective action phase.

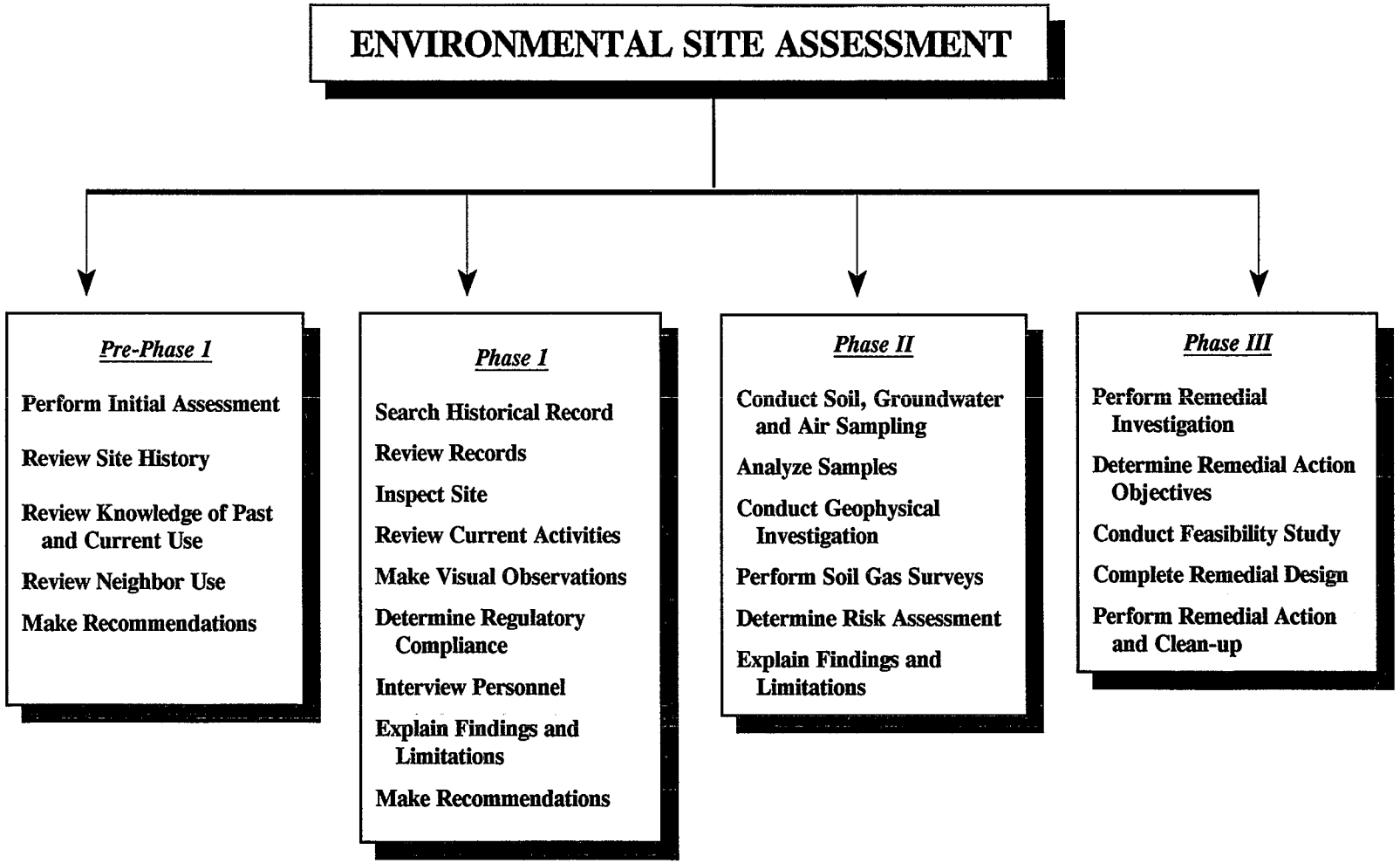
A typical scope of work under a Phase III investigation includes:

- Remedial investigation - An in-depth field investigation to document the nature and extent of contamination.
- Feasibility study - An investigation of feasible methods to remediate the site. The study evaluates the technical and economic feasibility of alternative clean-up methods. Computer modeling or pilot testing of treatment technologies may also be performed.

- Remedial design - The preparation of construction drawings and specifications for the selected remedial action.

Figure 11-1 provides a graphical summary of the various activities usually completed under each of the assessment phases.

FIGURE 11-1


ENVIRONMENTAL SITE ASSESSMENT
Pre-Phase 1
Perform Initial Assessment
Review Site History
Review Knowledge of Past and Current Use
Review Neighbor Use
Make Recommendations
Phase 1
Search Historical Record
Review Records
Inspect Site
Review Current Activities
Make Visual Observations
Determine Regulatory Compliance
Interview Personnel
Explain Findings and Limitations
Make Recommendations
Phase II
Conduct Soil, Groundwater and Air Sampling
Analyze Samples
Conduct Geophysical Investigation
Perform Soil Gas Surveys
Determine Risk Assessment
Explain Findings and Limitations
Phase III
Perform Remedial Investigation
Determine Remedial Action Objectives
Conduct Feasibility Study
Complete Remedial Design
Perform Remedial Action and Clean-up

12 LESSONS LEARNED FROM OTHER EIA PROGRAMS

12. LESSONS LEARNED FROM OTHER EIA PROGRAMS

The creation and implementation of an EIA program in any particular country, region, or local area will almost certainly go through a period of adjustment, modification, and refining as the program becomes a standard for project review. The experiences of countries that have had EIA programs in place for several years or more can provide some useful guidance in initiating a new EIA program. The following listing of "lessons learned" may be helpful in this regard. Many of these lessons are drawn directly from a report prepared by the International Association for Impact Assessment in 1996 with the Canadian Environmental Assessment Agency (see Sadler).

- Two trends stand out in the advances made to date in EIA process development and application. First is the widespread establishment of EIA systems by many developing countries and by countries in transition. Second is the emergence in several industrialized nations of a second-generating, integrated, strategic EIA process more closely linked to national planning and decision-making processes.

Three critical challenges to the contemporary practice of EIA can be identified:

- sharpening EIA as a tool for sustainability assurance, so as to provide guidance to the larger process of decision making'
- ensuring the practical application of the integrated, second-generation EIA, process, particularly in the light of public sector resource constraints and the lack of consensus regarding sustainability criteria; and
- quality control into the EIA process to help bridge the gap between its practice and potential.

- A review of recent experience world-wide suggests four necessary ingredients to the effective application of EIA:

    - appropriate timing in initiating the assessment so that the proposal is reviewed early enough to scope for development of reasonable alternatives;

    - clear, specific directions in the form of terms of reference or guidelines covering priority issues, timelines, and opportunities for information and input at key decision-making stages;

    - quality information and products fostered by compliance with procedural guidelines and use of "good practices"; and

    - receptivity of decision makers and proponents to the results of the environmental impact assessment, founded on good communication and accountability.

- Project-level EIA remains a core mechanism for identifying and mitigating adverse environmental effects of development proposals. This process typically addresses issues and impacts that are complex, controversial and cross-cutting -- transcending both jurisdictional and disciplinary boundaries.

Despite the many methodological and administrative advances in EIA over the past two decades, recent experience in many countries confirms that there is still considerable scope for strengthening the process. Immediate and cost-effective measures could help improve the process in four key areas: scoping, evaluation of significance, review of environmental assessment reports, and monitoring and follow-up.

- When full EIA requirements are adopted, the number of EIAs conducted peaks soon after the passage of the statute. In the United States, 1,949

EIAs were filed in 1971, the year following adoption of NEPA. In following years, the numbers dropped somewhat, with 1,371 in 1972, 1,148 in 1973, and 1,294 (estimated) in 1974 (Canter, 1977). The decline was seen in all categories of EIAs.

- The decline was seen in all categories of EIAs. The cause of the decline could have been due to experience gained in screening projects, the waning of the bottleneck effect caused by a change in regulations, or the elimination of projects that clearly caused significant environmental impacts.

- The EIA process becomes more efficient of as environmental agencies gain experience in scoping and reviewing EIAs, as environmental consultants become experienced in formatting EIAs to avoid unnecessary detail, as program and generic EIAs are produced, and as EIA documents evolve toward incorporating more material by reference.

- Public participation in the EIA process tends to become more extensive as citizens and citizens' groups become more familiar with EIA laws and procedures, and as they become more confident that their participation can affect the review of proposed actions.

- Inadequacies in EIAs tend to occur in certain topics: analysis of a full range of alternatives, site-specific data, secondary impacts, and cumulative impacts. In these areas, the level of specificity is more likely to be inadequate.

13 INFORMATION SOURCES

13. INFORMATION SOURCES

The sources listed in this chapter are provided for reference. The EPA documents can be obtained from EPA via the Internet "www.epa.gov/oeca/ofa.html", by fax: 1-202-564-0070, or by writing to USEPA, Office of Federal Activities, MC-2251-A, 401 M Street SW, Washington D.C. 20460. Other reference materials can be obtained through publishers and libraries.

EPA Resource Materials: Materials most often requested from U.S. EPA are general publications on the environmental assessment process, specific publications related to EIA for specific industries, and information on the U.S. program. We also have responded to requests for Sample EIA's, Sample EIA preparation contracts, Sample EIA law: NEPA and implementing regulations and Description of the U.S. program.

Training Materials

- Student Text: Principles of Environmental (Impact) Assessment
- Student Text and Resource Manual: Principles of Environmental Review of Environmental Impact Assessments (under development)
- CD-ROM with interactive EIA case study, resource materials and key USEPA guidance documents for reviewers of EIA (under development)

Information on the NEPA and 309 review processes: EPA documents describing EPA's responsibilities under NEPA and Section 309, and procedures for implementation are of general interest to the public as they provide for opportunities for public participation. In particular, several documents help to explain the process used to file Environmental Impact Statements and gain access to them for public review and comment. These documents are distributed on in response to questions about the process. Starred documents are currently available on the Internet as well:

- EPA Policy and Procedures for the Review of Federal Actions Impacting the Environment (1995);
-Facts about the National Environmental Policy Act;
-Guidelines for Environmental Justice considerations in 309 Reviews *;
-EPA Voluntary NEPA Compliance Policy
-National Environmental Policy Act Review Procedures for EPA Facilities (1994)
-Cross-Cutting Environmental Laws: A Guide for Federal/State Project Officers (1991)

Guidance documents for EIS review/NEPA program implementation: issued principally for use within U.S. EPA but also of interest to other Federal Agencies and to the public as they define our expectations for complete and accurate Federal agency compliance with NEPA.

Habitat Evaluation: Guidance for the Review of Environmental ImpactAssessment Documents (1993)
Grazing on Federal Lands: Background for NEPA Reviewers (1993)
Highway Development: Evaluation of Ecological Impacts (1993)
Guidance Memorandum Incorporating EPA's Pollution Prevention Strategy into the Environmental Review Process (1993)
Pollution Prevention Environmental Impact Reduction Checklists for NEPA/309
Environmental Impact Assessment Guidelines for New Source Permits/Activity or Economic-Sector Guidance For:

- Fossil Fueled Steam Electric Generating Stations (1994)
- Pulp and Paper and Timber Products (1994)
- Petroleum Refineries and Coal Gasification Facilities (1994)
- Mining (1994)
- Crude oil and Natural Gas Exploration Development and Production (1992)
- Phosphate Fertilizer Manufacturing Facilities (1981)
- Non-Ferrous Smelters (1979)
- Leather Tanning & Finishing (1980)
- Iron & Steel Manufacturing Facilities (1980)
- Canned and Preserved Seafood Processing Facilities (1981)
- Mechanical Products Manufacturing Plants (1981)
- Phosphate Fertilizer Manufacturing Facilities (1981)
- Rubber Manufacturing Facilities (1981)
- Explosive Manufacturing Industry (1981)
- Non-Fertilizer Phosphate Manufacturing (1981)
- Non-Coal Mine Sites (1991)

General EA Guidance

Environmental Assessment Sourcebook, U.S. EPA (Sep. 1993) Text and Environmental Assessment Resource Guide, CD-ROM (requires Windows™ V3.1), available Purdue University, The Farm Building Plan Service, 1146 AGEN Building, West Lafayette, IN 47807-1146 or Dale Luecht, U.S. EPA Region 5, 77 W. Jackson, S-14J, Chicago, IL 60604-3590: contains the U.S. EA Sourcebook with selected reference materials from World Bank are included.

GENERAL REFERENCES

See the **World Bank, United Nations Environment Program and U.S. Agency for International Development** (USAID) sources. with particularly excellent resources on women and children and how to factor in gender differences.

The following technical journals contain information relating to EIA and EIA:

The Environmental Professional (the Official Journal of the National Association of Environmental Professionals). Published in cooperation with the Department of Life Sciences, University of New England, Biddeform, Maine, USA.

Environmental Monitoring and Assessment. Kluwer Academic Publishing Group, Dordrect, Netherlands.

Journal of Environmental Management. Academic Press Limited, London, England.

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The following sources were drawn on in preparation of this text:

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Bell, D.M., K.A. Abood, R.A. Alevras, and G.R. McVoy. 1985. Analysis of habitat characterisitcs and fisheries abundance characterisitics in habitat-loss mitigation planning. In: Brodtmann, N.V., Jr. (ed.), Second Water Quality and Wetlands Management Conference Proceedings, New Orleans, LA, Oct. 24-25, 1985.

Burchell, R.W., and D. Listoken. 1975. *The Environmental Impact Handbook*. Center for Urban Policy Research, Rutgers-The State University, New Brunswick, New Jersey, USA. 234 pp.

Canter, L.W. 1977. *Environmental Impact Assessment*. McGraw-Hill Book Company, New York, New York, USA. 331 pp.

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Erickson, P.A. 1979. *Environmental Impact Assessment: Principles and Applications.* Academic Press, New York, New York, USA. 395 pp.

Golden, J., R.P. Ouellette, S. Saari, and P.N. Cheremisinoff. 1979. *Environmental Impact Data Book.* Ann Arbor Science Publishers Inc., Ann Arbor, Michigan, USA. 864 pp.

Green, R.H. 1979. *Sampling Design and Statistical Methods for Environmental Biologists.* Wiley, New York, NY.

Hammer, D.A. 1989. *Constructed Wetlands for Wastewater Treatment*. Lewis Publishers, Inc., Chelsea, MI, USA. 831 pp.

Hammer, D.A. 1992. *Creating Freshwater Wetlands*. Lewis Publishers, Inc., Chelsea, Michigan, USA. 298 pp.

Leopold, L.B., E. Clarke, B.B. Hanshaw, and J.B. Balsley. 1971. A Procedure for Evaluating Environmental Impact. United States Geological Survey Circular 645, United States Geological Survey, Washington, D.C., USA.

LMS Engineers. *A Generic Method for Quantitative Environmental Impact Assessment.* LMS Engineers, New York, USA.

Odum, E.P., et al. 1971. Optimum Pathway Matrix Analysis Approach to the Environmental Decision-Making Process. Institute of Ecology, University of Georgia, Athens, GA.

Ott, W.R., 1978. *Environmental Indices: Theory and Practice*. Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, USA. 371 pp.

Pielou, E.C. 1975. *Ecological Diversity*. John Wiley & Sons, Inc., New York, New York, USA. 162 pp.

Rau, J.G. and D.C. Wooten. 1980. *Environmental Impact Analysis Handbook*. McGraw-Hill Book Company, New York, New York, USA. 615 pp.

Rosen, S.J. 1976. *Manual for Environmental Impact Evaluation*. Prentice Hall, Inc., Englewood Cliffs, New Jersey, USA. 192 pp.

Sadler, Barry. 1996. *Environmental Assessment in a Changing World: Evaluating Practice to Improve Performance.* Canadian Environmental Assessment Agency and the Internaitonal Association for Impact Assessment. Canada. 248 pp.

Schlessinger, B, and D. Daetz. 1973. A Conceptual Framework for Applying Environmental Assessment Matrix Techniques. J. Environ. Sci. 16(4): 11-16.

Schlessinger, B., and R.A. Huges. 1972. Environmental Assessment of Alternate Shipbuilding Sites. Bechtel Corporation, San Francisco, CA.

Shannon, C.E., and W. Weaver. 1949. *The Mathematical Theory of Communication.* Univ. Illinois Press, Urbana, IL. 177 pp.

BIBLIOGRAPHY OF TECHNICAL REFERENCES

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Air Quality

Canter, L.W., "Air Pollution Impacts", Conference Proceedings, Bologna, Italy. 1989-1990.

This paper provides a methodology for the prediction and assessment of changes in air quality due to project activities.

Water Quality

Canter, Larry W., *Water Resources Assessment - Methodology and Technology Sourcebook.* Ann Arbor Science Publishers, Inc. 1979.

This document reviews 254 references discussing EIA methods. The majority deal with water resources assessment.

USEPA. *Water Quality Assessment: A Screening Procedure for Toxics and Conventional Pollutants in Surface and Groundwater - Parts I and II.* EPA1600/6-85-002D. Washington, D.C. United States Goverment Printing Office.

Biology (Aquatic and Terrestrial Biota)

Farmer, Adrian - Division of Ecological Sciences, *Habitat Evaluation Procedures (HEP) ESM102.* United States Fish and Wildlife Service March, 1980.

This is a habitat-based evaluation methodology that outlines how concepts can be implemented in a standardized procedure for conducting habitat evaluations in the field.

Farmer, Adrian - Division of Ecological Sciences, *Standards for the Development of Habitat Suitability Index Models 103ESM.* United States Fish and Wildlife Services. April, 1981.

This document provides guidance and standards for the development of models or the adaption of existing models to be used in determining Habitat Suitability Indices for use with the HEP (102ESM).

Margules, C. and M.B. Usher. "Criteria Used in Assessing Wildlife Conservation Potential: A Review," *Biological Conservation*. V21. 1981.

This article describes criteria used in assessing wildlife during a site investigation.

USEPA. *Risk Assessment Guidance for Superfund Volume II Environmental Evaluation Manual.* EPA 540/1-89/001. Washington, D.C.: United States Government Printing Office. March 1989.

This document provides guidance for ecological assessment during site investigations.

Ward, D.V., *Biological Environmental Impact Studies - Theory and Methods - Modeling.* Wastewater Research Center, 1978.

This document uses mathematical models classified into four categories to perform environmental impact studies. The models are used to develop interaction tables and functional relationships.

Wetlands

Bunker, S. "The Maryland Critical Area Program: A Comprehensive Land Management Approach." *National Wetlands Newsletter 9, No. 1.* January/February 1987.

Carpenter, J.M. and G.T. Farmer. *Peat Mining: An Initial Assessment of Wetland Impacts and Measures to Mitigate Adverse Effects.* Washington, D.C.: United States Environmental Protection Agency, 1981.

Kusler, J.A. *Our National Wetland Heritage: A Protection Guidebook.* Environmental Law Institute, Washington, D.C. 1983.

Thibodeau, F.R., and B.D. Ostro. "Economic Analysis of Wetland Protection." *Journal of Environmental Management*. Vol.12. 1981.

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Canter, L.W., *Prediction and Assessment of Impacts on the Socio-Cultural - Economic Environment*. Conference Proceedings - Bangkok, Thailand. April, 1990.

This document outlines a systematic approach to identifying, quantifying, and interpreting significance of changes on the socio-cultural - economic environment.

Yain, R.K., L.U. Urban, and G.S. Stacey. *Environmental Impact Analysis: A New Dimension in Decision Making*. New York: Van Nostrand Reinhold. 1977.

This document reviews the input-output and economic based models used to perform economic impact analysis.

United States Agency for International Development: See USAID literature on gender issues in Environmental Impact Assessment.

United States Army Corps of Engineers, Oregon. *Environmental Assessment Manual: Columbia River and Tributaries*. 1974.

This document contains an extensive explanation of economic impact assessment methods and data sources.

Archaeological and Cultural Resources

King, Thomas F., Patricia Hickman, and Gary Berg, *Anthropology in Historic Preservation.* New York: Academic Press, 1977.

This text presents methodologies used when evaluating a site for archaeological and cultural resources.

Schiffer, Michael and George T. Gumerman, ed., *Conservation Archaeology.* New York: Academic Press, 1977.
This text focuses on approaches used for archaeological conservation while conducting site investigations.

Field Sampling Techniques

Ford, Patrick J., et al, *Characterization of Hazardous Waste Sites - A Methods Manual Volume II Available Sampling Methods.* EPA 600/4-89-076. Washington, D.C.: United States Government Printing Office, December 1989.

This document is a compilation of sampling methods and materials suitable to address most needs that arise during site investigations.

New Jersey Department of Environmental Protection and Energy, *Field Sampling Procedures Manual.* February 1988.

This manual details the scope of field investigation related activities. From sampling plan preparation through chain of custody procedures, the manual details the handling requirements and offers a variety of collection techniques for samples of various matrices.

United States Environmental Protection Agency, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites.* EPA 540/P-91/001. Washington, D.C.: United States Government Printing Office, February.

This document summarizes a field program for collecting data during site investigations to be used to identify human health risk assessment, exposure assessment, toxicity evaluation, and ecological risk assessment.

Environmental Impact Analyses

Canter, Larry W., "EIA Methodologies"Conference Proceedings, Bologna, Italy. 1989-1990.

This paper describes various methodologies for evaluating environmental impacts, particularly those that could be useful in performing an EIS.

Environmental Resources, LTD, *Methodologies, Scoping and Guidelines.* Ministry of Health and Environmental Protection, March 1981.

This document is a summary of a study conducted on 29 different methodologies. It provides an overview of the use and purpose of an EIA methodology, and provides examples of specific types of methodologies.

Shopley, J.B. and R.F. Fuggle, "A Comprehensive Review of Current Environmental Impact Assessment Methods and Techniques," Journal of Environmental Management 18, No. 1, 1984.

This article identifies, defines, and evaluates a series of EIA approaches.

Vougias, S., "Training for Environmental Impact Assessment". University of Thessaloniki, Greece.

This paper deals in general with the methodology and practices for EIA, as well as with the classification of the various tasks required and all the practical information on methods and materials.

Warner, Maurice L., and Edward H. Preston, *A Review of Environmental Impact Assessment Methodologies.* EPA-600/5-75-002. Washington, D.C.: United States Government Printing Office, April 1975.

This document summarizes the EIA methodologies that can be used to evaluate projects.

14. GLOSSARY

ACTION - An action is any policy, program, plan, or project that would affect the environment.

ACTION ALTERNATIVE - An action alternative is one that would implement a plan, program, or project, as differentiated from the "no action" alternative.

ADVERSE IMPACT - An adverse impact is an environmental effect that is considered undesirable.

ALTERNATIVES TO THE PROPOSED ACTION- Alternatives are different means of meeting the general purpose and need of a proposed action (project or program), including:

- not proceeding with the action
- carrying out the action in a different location or facility
- implementing a non-structural solution
- alternatives *within* an action, such as different designs or materials, are not usually considered alternatives

ALTERNATIVES ANALYSIS - The alternatives analysis is the process of screening and evaluating alternatives.

BENEFIT-COST ANALYSIS - Benefit-cost analysis is a method of comparing alternative actions according to the relative costs (technical, environmental, and economic) incurred and the relative benefits gained. The analysis incorporates discounting calculations to take into account the time value of investments.

BEST MANAGEMENT PRACTICES - Best management practices are those methods or techniques that effectively accomplish a certain purpose with the least environmental impact.

CONDITIONS OF APPROVAL - Conditions of approval are stipulations (e.g., mitigation requirements, discharge standards) listed in the decision document, such as a Record of Decision, that a project must meet for approval and implementation.

CUMULATIVE IMPACTS - Cumulative impacts result from the incremental impact of the proposed action on a common resource when added to other impacts from past, present, and reasonably foreseeable future actions. These may include the collective effects of individually minor actions over a period of time.

DOCKET - The documentation of the EIA process for any given action.

ENDANGERED SPECIES - Endangered species is term for a species of plant or animal that

is in danger of extinction throughout all or a significant portion of its range.

ENVIRONMENTAL IMPACT ASSESSMENT PROCESS - Environmental impact assessment is the systematic, reproducible, and interdisciplinary consideration of the potential effects of a proposed action and its reasonable alternatives on the physical, biological, cultural, and socioeconomic attributes of a particular geographical area. It is a decision making process designed to help integrate economic, social and environmental concerns and of mitigating the adverse environmental impacts of activities related to projects, plans, programs or policies.

ENVIRONMENTAL IMPACT ASSESSMENT REPORT - an environmental impact assessment is the report that documents the Environmental Impact Assessment process for a particular action or class of actions.

ENVIRONMENTAL REPORT - an environmental report is a generic term for reports other than Environmental Impact Assessments, initial EIAs, and environmental site audit reports.

ENVIRONMENTAL SITE ASSESSMENT- An environmental site assessment is a preliminary evaluation of a site or property to identify and assess the magnitude of any existing environmental hazards and associated risks.

FULL DISCLOSURE - Full disclosure is the maintenance of a complete and open record of all relevant matters and procedures for any given action.

IMPACT - A change in the environment brought about by implementation of a project or alternative.

INITIAL ENVIRONMENTAL IMPACT ASSESSMENT - An initial EIA is a report containing a preliminary evaluation of the types of impacts that would result from an action. An initial EIA can serve as a stand-alone document or the preliminary step that leads to the preparation of an EIA.

IRRETRIEVABLE, IRREVERSIBLE IMPACT - An irretrievable, irreversible impact is an environmental change that will persist for a long period of time and is resistant to remediation.

LEAD AGENCY - A lead agency is an agency responsible for preparing and issuing an EIA for a proposed governmental action.

LEGISLATIVE EIA - A legislative EIA is an EIA report conducted on prospective legislation that would affect the environment.

MAN-MADE RESOURCE - Man-made resources are those of historical, archaeological, or cultural significance.

MITIGATION - Mitigation is the purposeful implementation of decisions or activities that are

designed to reduce the undesirable impacts of a proposed action on the affected environment. Mitigation is a general concept that could include 1) avoiding impacts altogether by not taking a particular action, 2) minimizing impacts by limiting the magnitude of the action, 3) restoring or repairing particular features of the affected environment, 4) reducing impacts over time by performing maintenance activities during the life of the action, and 5) compensating for impacts by providing additions to or substitutes for the environment affected by the action.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) - NEPA is the environmental assessment statute used in the United States.

NATURAL RESOURCES - Natural resources are features that have ecological, economic, recreational, educational, or aesthetic value.

NO-ACTION ALTERNATIVE - The no-action alternative is the option of not engaging in the proposed action, project, or program. It considers the potential long-range outcomes resulting from no action.

NON-GOVERNMENTAL ORGANIZATION (NGO) - An NGO is a general term for organizations outside of government agencies such as public organizations and environmental interest groups.

OVERSIGHT AGENCY - The oversight agency is the governmental agency responsible for administering the EIA statute.

PIGGYBACKING - Piggybacking is the combining of an EIA report with another project planning document (e.g., land use plan) to reduce unnecessary paperwork and facilitate environmental review of a project. The EIA report must, however, stand on its own as an analytical document.

PREFERRED ALTERNATIVE - The preferred alternative is that alternative that a particular decision maker believes best meets the purpose and need of the action, project, or program while keeping environmental impacts to a practicable minimum. Selection often considers three perspectives:

1) engineering feasibility and requirements
2) economic viability, and
3) environmental soundness

A preferred alternative is usually identified within a draft EIA to put commenters on notice as to the decision that the decision-maker intends to make at the time public comment is sought to better direct commenters attention to the analysis in the EIA.

PRIMARY IMPACTS - A primary impact is direct and occurs at the same time and place as the action. Primary impacts are usually associated with the construction, operation, or maintenance of a facility or activity, and are generally obvious and quantifiable.

PROPOSED ACTION - A proposed action is a policy, plan, program, or project that is

offered for consideration in the EIA process.

PUBLIC PARTICIPATION - Public participation is the involvement of citizens and citizens groups in the EIA process for the purpose of balancing any decision between policy makers and those who are affected by the policy.

PUBLIC MEDIA - The public media (radio, newspapers, television) are the means by which information is communicated to the citizens of a country, region, or locality.

PURPOSE AND NEED - The purpose and need of a project is the justification for undertaking the action, and may originate from legislation, administrative decisions, or from private enterprise. It must be defined before the EIA process can proceed.

RECORD OF DECISION (ROD) - The record of decision is the formal document approving or disapproving the alternative selected by the EIA process.

REMEDIAL ACTION - Remediation is an activity whose purpose is the restoration of a degraded environment to prior conditions.

SCOPING - Scoping is the early, open process of considering the issues and choices of alternatives to be examined in the environmental impact assessment of a particular action, policy, or program.

SCREENING - The initial screening considers all possible impacts to the action, project, or program. It identifies whether significant impacts are expected or not.

SECONDARY IMPACTS - Secondary impacts occur later in time, or at a different place from the initial action. These impacts are indirect or induced changes in the environment, population, economic growth, and land use.

SIGNIFICANT IMPACT - A significant environmental impact is, in general, an impact that could alter the properties of a natural or man-made resource in a way judged important by a set of relative standards.

TIERING - The process of initially addressing a broad, general program, policy, or proposal in a EIA report, and then analyzing a narrower, site-specific proposal related to the broad program, plan, or policy in a subsequent EIA report. The purpose of tiering is to eliminate repetitive discussions and focus on issues ripe for decisions at each level of environmental review.

TRIGGERING MECHANISM - A triggering mechanism is a means of identify a key property of an action that would cause that action to be treated in a particular way in the EIA process.

WORST-CASE ANALYSIS - A consideration, based on reasonable projection, of the worst possible consequences of a proposed action, and generally understood to be a low probability/catastrophic impact event. The worst case analysis should also include consideration of a spectrum of events of higher probability but less dramatic impact.

NOTES

15 MODEL EIA CHECKLISTS

Source: New York State Department of Environmental Conservation. 1982. State Environmental Quality Review Handbook.

Model EIS Scoping Checklist

Introduction

The following checklist of topics is intended as a starting point for developing a detailed scope for a project-specific Draft Environmental Impact Statement. Typically, no one project will require a discussion of all the topic areas contained in this document. Through the scoping process, this list of topics should be refined to reflect issues unique to the proposed project. Topic areas may be deleted, added, or elaborated upon, to arrive at the final scoping document.

The purpose of the checklist format is to identify the basic topic areas for the Draft EIS. This is accomplished by reviewing the list and placing a check in the box located to the left of those topics which should be discussed. The model scoping checklist can also be used as a worksheet, including comments, suggestions and identification of the particular example(s) that are relevant to a detailed discussion of the topic or issue that has been checked. Conversely, those topics which are not checked, are issues not associated with the project, and may be eliminated from discussion in the Draft EIS. Minimum requirements for any Draft EIS are already checked for convenience.

The next step is to expand the list to include or elaborate on those topics unique to the proposed project. A blank sheet is included at the end of the checklist for such additional information.

The scoping process involves several steps in addition to compiling a list of topics. Scoping also includes discussions on the quantity and quality of information required and the methods for obtaining that data.

NOTE: This checklist was designed to be used in conjunction with the section on scoping contained in the SEQR Guideline-Draft and Final EIS's. It is also important to emphasize that this checklist should serve only as a model to assist in the scoping of a Draft EIS. It should not be used as a substitute for actively scoping a Draft EIS for a specific project.

I. Cover Sheet

All EIS's (Draft or Final) shall begin with a cover sheet that indicates:

A. Whether it is a draft or final statement
B. Name or other descriptive title of the project
C. Location (county and town, village or city) of the project
D. Name and address of the lead agency which required preparation of the statement and the name and telephone number of a person at the agency to be contacted for further information
E. Name and address of the preparers of any portion of the statement and a contact name and telephone number
F. Date of acceptance of the Draft EIS
G. In the case of a Draft EIS, the deadline date by which comments are due should be indicated

II. Table of Contents and Summary

A table of contents and a brief summary are required for Draft and Final EIS's exceeding 10 pages in length. However, one should include these features in any size EIS to provide the review agency with easy reference to EIS topics.

The summary should include:

A. Brief description of the action
B. Significant, beneficial and adverse impacts, (issues of controversy must be specified)
C. Mitigation measures proposed
D. Alternatives considered
E. Matters to be decided (permits, approvals, funding)

III. Description of the Proposed Action

Place a check in the box to the left of those topics to be included in the draft EIS.

☐ A. PROJECT PURPOSE AND NEED
1. Background and history
2. Public need for the project, and municipality objectives based on adopted community development plans
3. Objectives of the project sponsor

b.) identification of present uses and level of use of groundwater
examples:
—location of existing wells
—public/private water supply
—industrial uses
—agricultural uses

☐ 2. Surface water
a.) location and description of surface waters located on project site or those that may be influenced by the project
examples:
—seasonal variation
—quality
—classification according to New York State Department of Health
b.) identification of uses and level of use of all surface waters
examples:
—public/private water supply
—industrial uses
—agricultural uses
—recreation
c.) description of existing drainage areas, patterns and channels
d.) discussion of potential for flooding, siltation, erosion and eutrophication of water sources

☐ C. AIR RESOURCES

☐ 1. Climate
a.) discussion of seasonal variations and extremes
examples:
—temperature
—humidity
—precipitation
—wind

☐ 2. Air quality
a.) description of existing air quality levels
examples:
—list the National and State Air Quality Standards for the project area and the compliance status for each standard
b.) identification of existing sources or pollutants-fixed or mobile
c.) identification of any sensitive receptors in project area
examples:
—hospitals, schools, nursing homes, parks
d.) description of existing monitoring program (if applicable)

☐ D. TERRESTRIAL AND AQUATIC ECOLOGY

☐ 1. Vegetation
a.) list vegetation types on the project site and within the surrounding area
b.) discussion of site vegetation characteristics
examples:
—species present and abundance
—age
—size
—distribution
—dominance
—community types
—unique, rare and endangered species
—value as habitat for wildlife
—productivity

☐ 2. Fish and Wildlife
a.) list of fish and wildlife species on the project site and within surrounding area, including migratory and resident species
b.) discussion of fish and wildlife population characteristics
examples:
—species present and abundance
—distribution
—dominance
—unique, rare and endangered species
—productivity

☐ 3. Wetlands
a.) list wetland areas within or contiguous to the project site
b.) discuss wetland characteristics
examples:
—acreage
—vegetative cover
—classification
—benefits of wetland such as flood and erosion control, recreation

☐ B. LOCATION
1. Establish geographic boundaries of the project (use of regional and local scale maps is recommended)
2. Description of access to site
3. Description of existing zoning of proposed site
4. Other:

☐ C. DESIGN AND LAYOUT
1. Total site area
a.) proposed impervious surface area (roofs, parking lots, roads)
b.) amount of land to be cleared
c.) open space
2. Structures
a.) gross leaseable area (GLA), if applicable
b.) layout of buildings (attached, enclosed, separate)
c.) site plans and profile views
3. Parking
a.) pavement area
b.) number of spaces and layout
4. Other:

☐ D. CONSTRUCTION AND OPERATION
1. Construction
a.) total construction period anticipated
b.) schedule of construction
c.) future potential development, on site or on adjoining properties
d.) other:
2. Operation
a.) type of operation
b.) schedule of operation
c.) other:

☐ E. CLOSURE AND POST CLOSURE PLANS
(for projects of planned limited life such as landfills)

☐ F. APPROVALS
1. Required changes or variances to the zoning regulations
2. Other permit approval or funding requirements

IV. Environmental Setting

Place a check in the box to the left of those topics to be included in the Draft EIS.

Natural Resources

☐ A. GEOLOGY
☐ 1. Subsurface
a.) composition and thickness of subsurface material
examples:
—depth to, and nature of, bedrock formations and impermeable layers
—occurrence of an extractive mineral resource
—usefulness as construction material
b.) earthquake potential
☐ 2. Surface
a.) list of soil types
b.) discussion of soil characteristics
examples:
—physical properties (indication of soils hydrological (infiltration) capabilities)
—engineering properties (soil bearing capacity)
c.) distribution of soil types at project site
d.) suitability for use
examples:
—agriculture
—recreation
—construction
—mining
e.) other:
☐ 3. Topography
a.) description of topography at project site
examples:
—slopes
—prominent or unique features
b.) description of topography of surrounding area

☐ B. WATER RESOURCES
☐ 1. Groundwater
a.) location and description of aquifers and recharge areas
examples:
—depth to water table
—seasonal variation
—quality
—quantity
—flow

Human Resources

☐ A. TRANSPORTATION
- ☐ 1. Transportation services
  - a.) description of the size, capacity and condition of services
    examples:
    —roads, canals, railroads, bridges
    —parking facilities
    —traffic control
  - b.) description of current level of use of services
    examples:
    —a.m. and p.m. peak hour traffic flow
    —vehicle mix
    —sources of existing traffic volume
- ☐ 2. Public transportation
  - a.) description of the current availability of service
  - b.) description of present level of use
- ☐ 3. Pedestrian environment
- ☐ 4. Other:

☐ B. LAND USE AND ZONING
- ☐ 1. Existing land use and zoning
  - a.) description of the existing land use of the project site and the surrounding area
    examples:
    —commercial
    —residential
    —agricultural
    —business
    —retail
    —industrial
    —vacant
  - b.) description of the existing zoning of site and surrounding area
- ☐ 2. Land use plans
  - a.) description of any land use plans or master plans which include project site and surrounding area
  - b.) discussion of future development trends or pressures
- ☐ 3. Other:

☐ C. COMMUNITY SERVICES (for this section include a list of existing facilities and a discussion of existing levels of usage and projected future needs)
- ☐ 1. Educational facilities
- ☐ 2. Police protection
- ☐ 3. Fire protection
- ☐ 4. Health care facilities
- ☐ 5. Social services
- ☐ 6. Recreational facilities
- ☐ 7. Utilities
- ☐ 8. Other:

☐ D. DEMOGRAPHY
- ☐ 1. Population characteristics
  - a.) discussion of the existing population parameters
    examples:
    —distribution
    —density
    —household size and composition
  - b.) discussion of projections for population growth
- ☐ 2. Other:

☐ E. CULTURAL RESOURCES
- ☐ 1. Visual resources
  - a.) description of the physical character of the community
    example:
    —urban vs. rural
  - b.) description of natural areas of significant scenic value
  - c.) identification of structures of significant architectural design
- ☐ 2. Historic and archaeological resources
  - a.) location and description of historic areas or structures listed on State or National Register or designated by the community
  - b.) identification of sites having potential significant archaeological value

☐ 3. Noise
- a.) identification of existing level of noise in the community
- b. identification of major sources of noise
  examples:
  —airports
  —major highways
  —industrial/commercial facilities

☐ 4. Other:

V. Significant Environmental Impacts

Identify those aspects of the environmental setting in Section IV that may be adversely or beneficially affected by the proposed action and require discussion.

VI. Mitigation Measures to Minimize Environmental Impact

Describe measures to reduce or avoid potential adverse impacts identified in Section V. The following is a brief listing of typical measures used for some of the major areas of impact.

Natural Resources

☐ A. GEOLOGY
1. Subsurface
   - a.) use excavated material for land reclamation
   - b.) use facility wastes (ash, sludge) for land reclamation
   - c.) other:
2. Surface
   - a.) use topsoil stockpiled during construction for restoration and landscaping
   - b.) minimize disturbance of non-construction sites
   - c.) design and implement soil erosion control plan
   - d.) other:
3. Topography
   - a.) avoid construction on areas of steep slope
   - b.) design adequate soil erosion devices to protect areas of steep slope
   - c.) other:

☐ B. WATER RESOURCES
1. Groundwater
   - a.) design adequate system of treatment for stormwater runoff prior to recharge of groundwater
   - b.) maintain permeable areas on the site
   - c.) institute a program for monitoring water quality in adjacent wells
   - d.) other:
2. Surface water
   - a.) ensure use of soil erosion control techniques during construction and operation to avoid siltation
     examples:
     —hay bales
     —temporary restoration of vegetation to disturbed areas
     —landscaping
   - b.) design adequate stormwater control system
   - c.) restrict use of salt or sand for road and parking area snow removal
   - d.) avoid direct discharges to surface water resources
   - e.) other:

☐ C. AIR RESOURCES
1. Air quality
   - a.) assure proper construction practices
     examples:
     —fugitive dust control
     —proper operation and maintenance of construction equipment
   - b.) design traffic improvements to reduce congestion and vehicle delay
   - c.) install and ensure the proper operation of emission control devices
   - d.) initiate a program for monitoring of air quality
   - e.) other:

☐ D. TERRESTRIAL AND AQUATIC ECOLOGY

1. Vegetation
   a.) restrict clearing to only those areas necessary
   b.) preserve part of site as a natural area
   c.) after construction, landscape site with naturally occurring vegetation
   d.) purchase open space at another location and dedicate to local government or conservation organization
   e.) other:
2. Fish and Wildlife
   a.) provide adequate habitat (shelter and food) for remaining wildlife species
   b.) schedule construction to avoid sensitive periods of fish and wildlife life cycles
   c.) other:

Human Resources

☐ A. TRANSPORTATION

1. Transportation services
   a.) design adequate and safe access to project site to handle projected traffic flow
   b.) install adequate traffic control devices.
   c.) optimize use of parking areas
   d.) encourage car pooling and operation of facility during non-peak traffic times
   e.) design special routing and restricted hours for delivery truck traffic
   f.) other:
2. Public transportation
   a.) adjust public transportation routes and schedules to service the facility
   b.) encourage use of public transportation by using incentive programs for employees or by selling tickets in facility
   c.) other:

☐ B. LAND USE AND ZONING

1. Existing land use and zoning
   a.) design project to comply with existing land use plans
   b.) design functional and visually appealing facility to set standard and precedent for future surrounding land use
   c.) other:

☐ C. COMMUNITY SERVICES

1. Police protection
   a.) minimize local police protection responsibilities by providing private security force
   b.) provide security systems, alarms for facility
   c.) provide equipment, funds or services directly to the community
   d.) other:
2. Fire protection
   a.) use construction materials that minimize fire hazards
   b.) incorporate sprinkler and alarm systems into building design
   c.) provide equipment, funds or services directly to the community
   d.) other:
3. Utilities
   a.) install utility services underground
   b.) incorporate water saving fixtures into facility design
   c.) incorporate energy-saving measures into facility design
   d.) other:

☐ D. CULTURAL RESOURCES

1. Visual resources
   a.) design exterior of structure to physically blend with existing surroundings
   b.) minimize visual impact through thoughtful and innovative design of lighting and signs (consider: height, size, intensity, glare and hours of lighting operation)
   c.) design landscaping to be visually pleasing and to serve as a buffer between surrounding land uses, parking areas, operational equipment and facilities
   d.) other:

2. Historic and archaeologic resources
   a.) allow historical and archaeological officials access to the project site during excavation
   b.) devote space within project site to a display of historical and archaeological artifacts of local interest
   c.) preserve architecturally significant structures and make a photographic and statistical record of those that must be destroyed
   d.) other:
3. Noise
   a.) schedule construction/operation to occur during "normal business" hours minimizing noise impact during sensitive times (early morning, night)
   b.) assure adherence to construction noise standards
   c.) design berms and landscaping to block and absorb noise
   d.) other:

VII. Adverse Environmental Effects that Cannot be Avoided if the Project is Implemented

Identify those adverse environmental effects in Section V that can be expected to occur regardless of the mitigation measures considered in Section VI.

VIII. Alternatives

This section contains categories of alternatives with examples. Discussion of each alternative should be at a level sufficient to permit a comparative assessment of costs, benefits and environmental risks for each alternative. It is not acceptable to make simple assertions that a particular alternative is or is not feasible. Identify those categories of alternatives which should be included in the EIS by placing a check in the box located to the left of the topic.

☐ A. ALTERNATIVE DESIGN AND TECHNOLOGIES
   1. Site layout
      a.) density and location of structures
      b.) location of access routes, parking and utility routes
   2. Orientation
      a.) compatibility with slope and drainage patterns
      b.) site size and setback requirements
   3. Technology
      a.) pollution control equipment
      b.) innovative vs. proven technologies
   4. Mix of activities
      a.) addition of businesses which would affect the operational nature of the facility

☐ B. ALTERNATIVE SITES
   1. Limiting factors
      a.) availability of land
      b.) suitability of alternate site to accomodate design requirements
      c.) availability of utilities
      d.) suitable market area
      e.) compatibility with local zoning and master plan
      f.) compatibility with regional objectives
      g.) accessibility of site to transportation routes and the service population

☐ C. ALTERNATIVE SIZE
   1. Increase or decrease project size to minimize possible impacts
   2. Increase or decrease project size to correspond to market and community needs

☐ D. ALTERNATIVE CONSTRUCTION/OPERATION SCHEDULING
   1. Commence construction at a different time
   2. Phase construction/operation
   3. Restrict construction/operation work schedule

☐ E. ALTERNATIVE LAND USE

1. Suitability of site for other uses
   a.) other types of commercial uses
   b.) other types of industry
   c.) different types of housing
   d.) other:
2. Public vs. private use

☐ F. NO ACTION

1. Impacts of no action
   a.) effect on public need
   b.) effect on private developers' need
   c.) beneficial or adverse environmental impacts

☐ G. OTHER:

IX. Irreversible and Irretrievable Commitment of Resources

Identify those natural and human resources listed in Section IV that will be consumed, converted or made unavailable for future use.

X. Growth Inducing Aspects

Describe in this section the potential growth aspects the proposed project may have. Listed below are examples of topics that are typically affected by the growth induced by a project.

☐ A. POPULATION

1. Increases in business and resident population due to the creation or relocation of business
2. Increases in resident population due to the construction of housing

☐ B. SUPPORT FACILITIES

1. Businesses created to serve the increased population
2. Service industries created to supply new facility

☐ C. DEVELOPMENT POTENTIAL

1. Introduction or improvement of infrastructure (roads, waste disposal, sewers, water) to service proposed project
2. Creation of further growth potential by construction of improved infrastructure

☐ D. OTHER:

XI. Effects on the Use and Conservation of Energy Resources

Identify the energy sources to be used, anticipated levels of consumption and ways to reduce energy consumption. The examples listed below are typical issues to be considered when addressing this topic.

☐ A. PROPOSED ENERGY SOURCES AND ALTERNATIVES

☐ B. ANTICIPATED SHORT-TERM/LONG-TERM LEVELS OF ENERGY CONSUMPTION

☐ C. INDIRECT EFFECTS ON ENERGY CONSUMPTION

1. Increased dependence on automobile use
2. Increased levels of traffic due to proposed project

☐ D. ENERGY CONSERVATION MEASURES

1. Design methods to reduce fuel use for heating, cooling, and lighting
   a.) conventional technology
      examples:
      —insulation
      —thermopane windows
      —use of low wattage lights
   b.) innovative technology
      examples:
      —heat pumps
      —solar panels
      —wind energy
      —use of waste heat from an industrial plant
   c.) efficient layout
      examples:
      —orientation of structures in relation to summer and winter sunlight
      —clustering of structures to maximize common walls
      —shortening of utility runs
      —shared insulation and heating
2. Indirect energy benefits
   a.) location and design of facility to accomodate mass transit
   b.) use of shuttle buses
   c.) location of facility to minimize travel distance

☐ E. OTHER:

XII. Appendices

Following is a list of materials typically used in support of the EIS.

A. List of underlying studies, reports and information considered and relied on in preparing statement

B. List all federal, state, regional, or local agencies, organizations, consultants and private persons consulted in preparing the statement

C. Technical exhibits (if any) at a legible scale

D. Relevant correspondence regarding the projects may be included (required in the Final EIS)

Additional Draft EIS Scoping Topics

Indicate any additional topics for discussion in the Draft EIS. Attach additional sheets if necessary.

MATRIX FOR ENVIRONMENTAL IMPACT ASSESSMENT

Please note that the Leopold Matrix is too long for a single page. Please copy and paste together the following two pages for your use.

INSTRUCTIONS

1. Identify all actions (located across the top of the matrix) that are part of the proposed project.
2. Under each item on the proposed actions, place a slash at the intersection with each item on the side of the matrix if an impact is possible.
3. Having completed the matrix, in the upper lefthand corner of each box with a slash, place a number from 1 to 10 which indicates the MAGNITUDE of the possible impact: 10 represents the greatest magnitude of impact and 1, the least (no zeroes). Before each number place + if the impact would be beneficial. In the lower righthand corner of the box place a number from 1 to 10 which indicates the IMPORTANCE of the possible impact (e.g. regional vs. local); 10 represents the greatest importance and 1, the least (no zeroes).

PROPOSED ACTIONS WHICH MAY CAUSE ENVIRONI

			A. Modification of Regime								B. Land Transformation and Construction											C. Resource Extraction						D. Processing					I Alt
			Biological controls	Mod. of habitat	Alter. of ground cover	Alter. of gr. water hydro.	Alter. of drainage	Burning	Surface or paving	Noise and vibration	Urbanization	Indust. sites and bldgs.	Roads and trails	Railroads	Cables and lifts	Transmission lines	Barriers incl. fencing	Channel dredging	Canals	Piers, seawalls, marinas	Blasting and drilling	Cut and fill	Tunnels/underground. stru.	Blasting and drilling	Surface excavation	Subsurf. excavation	Well drilling	Dredging	Clear cutting/lumbering	Energy generation	Mineral proc.	Oil refinery	Lumbering	Erosion control	
A. Physical and Chemical Characteristics	1. Earth	a. Mineral Resources																															
		b. Construction material																															
		c. Soils																															
		d. Land form																															
		e. Force fields and background radiation																															
	2. Water	a. Surface																															
		b. Ocean																															
		c. Underground																															
		d. Quality																															
	3. Atmosphere	a. Quality (gases, particulates)																															
		b. Climate (micro, macro)																															
B. Biological Conditions	1. Flora	a. Trees, shrubs, grass																															
		c. Microflora																															
		f. Aquatic plants																															
		g. Endangered species																															
	2. Fauna	a. Birds																															
		b. Land animals including reptiles																															
		c. Fish and shellfish																															
		f. Microfauna																															
		g. Endagered species																															
C. Cultural Factors	1. Land Use	a. Wilderness and open spaces																															
		b. Wetlands																															
		c. Forestry																															
		h. Industrial																															
		i. Mining and quarrying																															
	2. Recreation	a. Hunting																															
		b. Fishing																															
		c. Boating																															
		d. Swimming																															
		e. Camping and hiking																															
		f. Picnicking																															
	3. Aesthetics and Human Interest	a. Scenic views and vistas																															
		b. Wilderness																															
		c. Open space qualities																															
		d. Landscape design																															
		f. Parks and reserves																															
		i. Historical or archaeological sites and objects																															
	4. Cultural Status	b. Health and safety																															
		c. Employment																															
		d. Population density																															
	5. Man-made Facilities	a. Structures																															
		b. Transportation network (movement across)																															
		d. Waste disposal																															

Source: Leopold, Luna B. et al, A Procedure for Evaluating Environmental Impact, United States Geological Survey, Circular 645, 1971.

MATRIX FOR ENVIRONMENTAL IMPACT ASSESSMENT

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› top of the matrix) that are part of the proposed

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PROPOSED ACTIONS WHICH MAY CAUSE ENVIRONMENTAL IMPACTS

	A. Modification of Regime								B. Land Transformation and Construction													C. Resource Extraction						D. Processing				E. Land Alteration				G. Changes in Traffic						H. Waste Emplacement and Treatment						Acciden		
	Biological controls	Mod. of habitat	Alter. of ground cover	Alter. of gr. water hydro.	Alter. of drainage	Burning	Surface or paving	Noise and vibration	Urbanization	Indust. sites and bldgs.	Roads and trails	Railroads	Cables and lifts	Transmission lines	Barriers incl. fencing	Channel dredging	Canals	Piers, seawalls, marinas	Blasting and drilling	Cut and fill	Tunnels/undergrnd. stru.	Blasting and drilling	Surface excavation	Subsurf. excavavation	Well drilling	Dredging	Clear cutting/lumbering	Energy generation	Mineral proc.	Oil refinery	Lumbering	Erosion control	Landscaping	Harbor dredging	Marsh fill and drain.	Railway	Automobile	Trucking	Shipping	River traffic	Communication	Landfill	Deep well placement	Cooling waste disch.	Septic tanks	Stack/exhaust emission	Spent lubricants	Explosions	Spill andleaks	Operational failure
a. Mineral Resources																																																		
b. Construction material																																																		
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