Environmental Impact Assessment (EIA)

1. Introduction

1.1 Environmental Impact Assessment

An **environmental impact assessment** is a planning tool that is used for **identifying, predicting and communicating information about the environmental effects (**on the environment and human health**) of a proposal**. It is designed to:

- anticipate and prevent **environmental** problems
- identify ways to increase **environmental** benefits
- support informed decisions on project options and trade-offs
- integrate **environmental** considerations into the planning, design and construction of projects at all scales

1.2 When is an Environmental Impact Assessment (EIA) required?

An **environmental impact assessment** must be prepared for all proposals that require federal land use and design approval, and for some land access permits.

In most jurisdictions, legislation now requires that EIAs be conducted for many types of projects. Project proponents must prepare a submission before government approval may be granted. In addition, the public is increasingly calling for accountability on the part of proponents and government to ensure that the environment and livelihood of local residents are not adversely affected.

1.3 Philosophy and Objective

The philosophy of EIA:

- EIA is designed as a preventive measure
- EIA should be introduced early on in the planning processes
- Broad public participation should ensure wide acceptance of projects implemented

The objectives of the EIA are:

- To disclose significant environmental effects of proposed projects to decision-makers and the public
- To identify ways to avoid or reduce environmental damage

- To prevent adverse environmental impacts by requiring implementation of feasible alternatives or mitigation measures
- To disclose reason of approvals for the projects with significant environmental impacts to the public
- To foster interagency co-ordination and enhance public participation
- To document and ensure that environmental aspects such as potential physical, biological, social and health effects are addressed for the planned activity
- Potential problems are foreseen at the appropriate stage of project design
- EIA should be envisaged as an integral part of the planning process and initiated at the project level from the start

1.4 Guidelines

Various guidelines on EIA are available. The main steps are as follows:

- Preliminary activities include the selection of a coordinator for the EIA and the collection of background information. This should be undertaken as soon as a project has been identified.
- Impact identification involves a broad analysis of the impacts of project activities with a view to identifying those which are worthy of a detailed study.
- Baseline study entails the collection of detailed information and data on the condition of the project area prior to the project's implementation.
- Impact evaluation should be done whenever possible in quantitative terms and should include the working-out of potential mitigation measures. Impact evaluation cannot proceed until project alternative has been defined, but should be completed early enough to permit decisions to be made in a timely fashion.
- Assessment involves combining environmental losses and gains with economic costs and benefits to procedure a complete account to each project alternative. Cost-benefit analysis should include environmental impacts where these can be evaluated in monetary terms.
- Documentation is prepared to described to the work done in the EIA. A working document is prepared to provide clearly stated and argued recommendations for immediate action. The working document should contain a list of project alternative with comments on the environmental and economic impacts of each.
- Decision-making begins when the working document reaches the decision maker, who will either accept one of the project alternatives, request further study or reject the proposed action altogether.
- Post audits are made to determine how close to reality the EIA predictions were.

1.5 Evolution and History of EIA

	Development of EIA
Pre-1970	Project review based on the technical/engineering and economic analysis. Limited consideration given to environmental consequences.
Early/mid – 1970s	EIA introduced by NEPA in 1970 in US. Basic principle: Guidelines, procedures including public participation requirement instituted. Standard methodologies for impact analysis developed (e.g. matrix, checklist and network). Canada, Australia and New Zealand became the first countries to follow NEPA in 1973-1974. Unlike Australia, which legislated EIA, Canada and New Zealand established administrative procedures. Major public inquires help shape the process's development.
Late 1970 and early 1980s	More formalised guidance. Other industrial and developing countries introduced formal EIA requirements (France, 1976; Philippines, 1977), began to use the process informally or experimentally (Netherlands, 1978) or adopted elements, such as impact statements or reports, as part of development applications for planning permission. Use of EA by developing countries (Brazil, Philippines, China, Indonesia) Strategic Environment Assessment [1] (SEA), risk analysis included in EA processes [2]. Greater emphasis on ecological modelling, prediction and evaluation methods. Provision for public involvement. Coordination of EA with land use planning processes.

Mid 1980s to end of decade	□ In Europe, EC Directive on EIA establishes basic principle and procedural requirements for all member states. □ Increasing efforts to address cumulative effects. □ World Bank and other leading international aid agencies establish EA requirements. □ Spread of EIA process in Asia.
1990s	□ Requirement to consider trans-boundary effects. □ Increased use of GIS and other information technologies. □ Sustainability principal and global issues receive increased attention. □ India also adopted the EIA formally. □ Formulation of EA legislation by many developing countries. □ Rapid growth in EA training.
Source: International Study of the Effectiveness of environmental assessment, final report, environmental assessment in a changing world, Prepared by Barry Sadler, June 1996.	
[1] Definition of SEA: Policy tool to assess the environmental consequences of development policies, plans and programmes [2] Definition of risk assessment: An instrument for estimating the probability of harm occurring from the presence of dangerous conditions or materials at a project site. Risk represents the likelihood and significance of a potential hazard being realized	

1.5 EIA Around the World

EIA systems vary by each country and agency, and each system holds their own unique characteristics.

EIA in Canada

- Introduced in 1973 with the passing of a federal cabinet directive.
- *Canadian Environmental Assessment Act* (CEAA) was passed in 1992 and came into force in January 1995.

EIA Implementation in Europe

- In 1997 the European Commission began drafting a directive on EIA.
- Directive 85/337/EEC on the *Assessment of the Effects of Certain Public and Private Projects on the Environment*, "EIA Directive" was adopted in July 1985.
- The EIA Directive defines a project as:
  - The execution of construction works or of other installations or schemes
  - Other interventions in the natural surroundings and landscape including those involving the extraction of mineral resources
- Member States had until 3 July 1988 to implement its requirements:

France	1976	Belgium	1985
Spain	1986	Netherlands	1986
Italy	1988	Denmark	1989
Germany	1990	Portugal	1990
Greece	1990	UK	1990

EIA Implementation in Asia

Thailand	1975	Philippines	1978
Indonesia	1987	Japan	1984

EIA in China

- In 1979, the *Environmental Protection Law* (pilot-phase) stipulated that all construction related projects must implement EIA.
- In 1981, the *Basic Construction Items Environmental Preservation Management Law* clearly defined EIA procedures.
- China's new *Environmental Impact Assessment Law* was passed in 2002 and became effective on September 1, 2003.

EIA in International Treaties and Protocols

- 1982 - United Nations Law of the Sea Treaty
- 1991 - Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention)
- 1991 - Protocol on Environmental Protection to the Antractic Treaty
- 1992 - Biodiversity Treaty
- 1992 - United Nations Framework Convention on Climate Change

United Nations Environment Program (UNEP)

- Set up an EIA expert committee and common guidelines for the promotion of EIA, examined standards and regulatory models, and
- Published the "Goals and Principles of Environmental Impact Assessment" in 1987.

2. EIA Procedure

Essentially EIA is a systematic process that examines the environmental consequences of development actions, in advance. The stages of an EIA process depend upon the requirements of the country or donor. However, most EIA processes have a common structure and the application of the main stages is a basic standard of good practice. The environment **impact assessment** consists of eight steps with each step equally important in determining the overall performance of the project. Typically, the EIA process begins with screening to ensure time and resources are directed at the proposals that matter environmentally and end with some form of follow up on the implementation of the decisions and actions taken as a result of an EIA report. The eight steps of the EIA process are presented in brief below:

- **Screening:** First stage of EIA, which determines whether the proposed project requires an EIA and if it does, then the level of assessment required.

- **Scoping:** This stage identifies the key issues and impacts that should be further investigated. This stage also defines the boundary and time limit of the study.

- **Impact analysis:** This stage of EIA identifies and predicts the likely environmental and social impact of the proposed project and evaluates the significance.

- **Mitigation:** This step in EIA recommends the actions to reduce and avoid the potential adverse environmental consequences of development activities.

- **Reporting:** This stage presents the result of EIA in a form of a report to the decision-making body and other interested parties.

Different names for the same report

An EIA report may be known by several other names such as:

- **Environmental impact assessment** (EIA)
- Environment **impact** statement (EIS)
- **Environmental** statement (ES)
- **Environmental assessment** report (EA report)
- **Environmental** effects statement (EES)

- **Review of EIA:** It examines the adequacy and effectiveness of the EIA report and provides the information necessary for decision-making.

- **Decision-making:** It decides whether the project is rejected, approved or needs further change.

- **Post monitoring:** This stage comes into play once the project is commissioned. It checks to ensure that the impacts of the project do not exceed the legal standards and implementation of the mitigation measures are in the manner as described in the EIA report.

The overview of the EIA process is represented in Fig. 1.

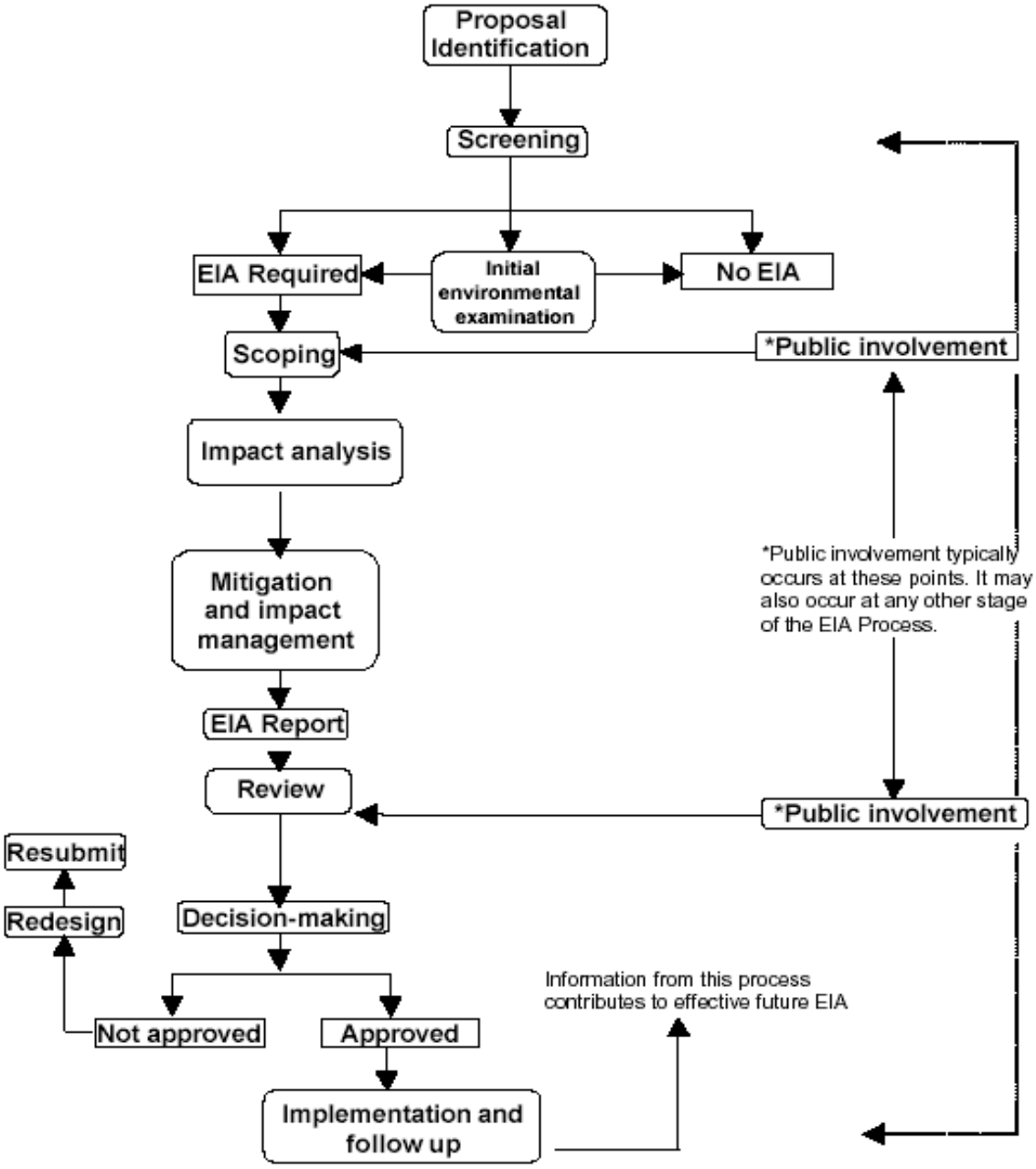

Figure 1: Generalized process flow sheet of the EIA process

Source: The manual in perspective, EIA Training Resource Manual, United Nations Environment Program, 2002

3. EIA Report:

The **assessment report** must be informative, clear and concise to enable decision makers to quickly and easily understand the **environmental** implications of the proposed project.

At a minimum, the document should contain:

- A description of the proposed activity
- A description of the potentially affected environment, including specific information necessary for identifying and assessing the environmental effects of the proposed activity
- A description of practical alternatives as appropriate
- An assessment of the likely or potential environmental impacts of the proposed activity and alternatives, including the direct, indirect, cumulative, short-term and long-term effects
- An identification and description of measures available to mitigate adverse environmental impacts of the proposed activity and alternatives, and an assessment of those measures
- An indication of gaps in knowledge and uncertainties which may be encountered in compiling the required information
- An indication of whether the environment of any other State or areas beyond national jurisdiction are likely to be affected by the proposed activity, and possible alternatives
- A brief non-technical summary of the information provided under the above headings.

Contents of EIA Report:

- Executive Summary
- Policy, Legal and Administrative Framework
- Description of the Environment
- Description of the Proposed Project
- Significant Environmental Impacts
- Socio-Economic Analysis of Proposed Projects
- Analysis of Alternatives
- Mitigation Action/Mitigation Management Plan
- Environmental Management and Training
- Environmental Monitoring Program
- Public/Community Involvement
- Conclusion and Recommendation

Examples of EIA Report:

- **USA:** U.S. EPA
  - http://www.epa.gov/compliance/nepa/index.html
- **China:** State Environmental Protection Administration (SEPA)
  - http://www.epd.gov.hk/eia/english/register/open/island.html
  - http://www.worldbank.org.cn/Chinese/Publications/publications_information.htm
- **Newfoundland and Labrador:** Environmental Assessment Division, Department of Environment and Conservation
  - http://www.env.gov.nl.ca/env/Env/EA%202001/pages/index.htm

Example Format of Environmental Impact Assessment (EIA) Report:

SOURCE: **THE CANADIAN NATURAL RESOURCES LIMITED PRIMROSE EAST IN-SITU OIL SANDS PROJECT Approximately 30 km North of Cold Lake, Alberta**
ISSUED BY: **ALBERTA ENVIRONMENT**
DATE: **April 1, 2005**

❖ **INTRODUCTION**

Purpose, Scope of Environmental Impact Assessment Report, Public Consultation, Proponent's Submission.

❖ **PROJECT OVERVIEW**

The Proponent and Lease History, The Project Area and EIA Study Area, Project Components and Development Schedule, Project Need and Alternatives, Regulatory Review, EIA Summary.

❖ **PROJECT DESCRIPTION**

Site Development
Infrastructure and Transportation
Air Emissions Management
Emission Control Technologies
Greenhouse Gas Emissions
Water Supply, Water Management and Wastewater Management
Hydrocarbon, Chemical and Waste Management
Management of Waste Streams
Hydrocarbons and Chemical Products
Reclamation/Closure (See Appendix for Additional Requirements)
Environmental Management Systems and Contingency Plans

Adaptive Planning
Participation in Co-operative Efforts

- **ENVIRONMENTAL ASSESSMENT**

Study Areas
Information Requirements for the Environmental Assessment
Modelling
Cumulative Environmental Effects Assessment
Climate, Air Quality and Noise
Collection of Baseline Information
Methodology
Impact assessment
Climate Change
Land Use, Access to Public Lands and Aggregate Resource Conservation4.6.1
Collection of Baseline Information
Methodology

- **PUBLIC HEALTH AND SAFETY**

- **TRADITIONAL ECOLOGICAL KNOWLEDGE AND LAND USE**

- **HISTORICAL RESOURCES**

- **SOCIO-ECONOMIC FACTORS**

Collection of Baseline Information
Methodology
Impact assessment
Mitigation

- **PUBLIC CONSULTATION REQUIREMENTS**

APPENDIX
Reclamation Plan
Water Supply, Water Management And Wastewater Management
Groundwater/ Surface Water

4. EIA Methods and Techniques

Environmental impact factors/Areas of consideration varies according to the type of project, development, or action under evaluation. Generally, consideration should include:

- Physical environmental factors
- Social environmental factors
- Economic environmental factors
- Others

Choosing a Method

Environmental impacts of projects or actions generally encompass a broad range of impacts (e.g., air, water, soil, ecological, and social impacts). They vary in magnitude as well as in their beneficial or adverse classification. As a result, EIA method range from simple to complex, requiring different kinds of data, different data formats, and varying levels of expertise and technological sophistication for their interpretation. The analyses they produce have differing levels of precision and certainty. All of these factors should be considered when selecting a method. Some EIA methods are given below:

- Network methods
- Ad hoc method
- Impact checklist method
- Matrix method
- Overlay method (McHarg method or GIS based method)

Network Methods

- Start with a list of project activities or actions and then generate cause-condition-effect networks (i.e. chains of events) or "impact tree".
- An attempt to recognized that a series of impacts may be triggered by a project action. A "road-map" type of approach to identify second- and third-order effects.
- A series of questions related to each project activity must be answered. There may include, what are the primary impact areas, the primary impacts within these areas, the secondary impact areas, the secondary impacts within these areas, and so on.

- Advantages:
    - Provides a means for displaying primary, secondary, tertiary, and higher order impacts
    - Helps in exploring and understanding the underlying relationships between environmental components that produce higher order changes that are often overlooked by simpler approaches
    - Provides in a summary form an overview of the impacts caused by the project

- Disadvantages:
  - If the environmental condition changes and possible interrelationships are complex, impact networks could be too extensive and complex
  - Cycles of effects may occur

Table 1 shows an example of network analysis showing the impact of a policy to utilize groundwater by subsidizing tube wells.

Table 1: Network Analysis

Primary impacts	Secondary impacts	Tertiary impacts	Quaternary impacts	Mitigation
Lowering of groundwater in dry season	Loss of income & water from domestic hand pumps	Use of poorer quality water	Increased health risks	1. Ensure that the new DTW either hold domestic water locally or feed into distributary system. Note Effected group are poorer people
		Income diverted to buy water	Decreased income & time	
		Travel to distant source	Reduced quality of life	
	Loss of income & water from shallow tubewells for irrigation	Income diverted to buy water	Decreased income & time leading to possible food shortage	1. Deepen STW
		Crop failure	Reduced quality of life	2. Ensure new DTWs supply STWs in dry season
			Abandonment of land & migration	3. Provide compensation from DTW taxation
	Drawdown of surface water bodies	Decreased fish capture/fish mortality	Loss of protein intake	1. Artificially stock water bodies
			Loss of income for fishermen	2. Recharge water bodies from DTW Note: Fishermen are already poorer than farmers in general

		Loss of wetland	Loss of wetland flora/fauna migratory birds, fish spawning areas	
			Loss of wetland products	1. Restrict DTW development in vulnerable areas Note Landless & Rural poor are greatest users of wetlands
		Reduced navigation possibilities	Increased transport costs	1. Increase navigation depth by dredging

STW = Shallow Tubewells
DTW = Deep Tubewells

Ad hoc Method

- Ad hoc method is useful when time constraints and lack of information require that the EIA must rely exclusively on expert opinion.
- It provides minimal guidance for total impact assessment while suggesting the broad areas of possible impacts and the general nature of these possible impacts.
- When more scientific methods are available, it is not recommended.

Impact Checklist Method

- Combining a list of potential impact areas that needs to be considered in the EIA process with an assessment of the individual impacts.
- This approach has been adopted by a number of public agencies since it insures that a prescribed list of areas is considered in the assessment process.
- However, this method,
    - does not provide for the establishment of direct cause-effect links to the various project activities, and
    - is weak to give an overall interpretation of the collective environmental impacts

Checklists are standard lists of the types of impacts associated with a particular type of project. Checklists methods are primarily for organizing information or ensuring that no potential impact is overlooked. They are a more formalized version of ad hoc approaches in those specific areas of impact. Sophisticated checklists include: 1) Scaling checklists in which the listed impacts are ranked

in order of magnitude or severity, and 2) Weighting-scaling checklists, in which numerous environmental parameters are weighted (using expert judgment), and an index is then calculated to serve as a measure for comparing project alternatives.

There are four general types of checklists:

Simple Checklist: A list of environmental parameters with no guidelines on how they are to be measured and interpreted.

Descriptive Checklist: Includes an identification of environmental parameters and guidelines on how to measure data on particular parameters.

Scaling Checklist: Similar to a descriptive checklist, but with additional information on subjective scaling of the parameters.

Scaling Weighting Checklist: Similar to a scaling checklist, with additional information for the subjective evaluation of each parameter with respect to all the other parameters

Matrix Method

- It basically incorporates a list of project activities or actions with a checklist of environmental conditions or characteristics that might be affected.
- Combining these lists as horizontal and vertical axes for a matrix allows the identification of cause-effect relationships between specific activities and impacts.
- The entries in the cell of the matrix can be either qualitative estimates or quantitative estimates of these cause-effect relationships.

Matrix method identifies interactions between various project actions and environmental parameters and components. They incorporate a list of project activities with a checklist of environmental components that might be affected by these activities. A matrix of potential interactions is produced by combining these two lists (placing one on the vertical axis and the other on the horizontal axis).

Overlay Method

- It generally relies on a set of maps of a project area's environmental characteristics (physical, social, ecological, aesthetic, etc.).
- These maps are overlaid to produce a composite characterization of the area's environment.

The Role of Expert Judgment

Most method and techniques for identifying, measuring, and assessing impacts rely on expert judgment. In fact, many checklists, matrices, and models used in EIA represent decades of experience accumulated by numerous experts. The experts themselves are heavily involved in all aspects of the assessment — they are used to help identify the potential for significant impacts, plan data collection and monitoring programs, provide their judgment on the level of significance for specific impacts, and suggest ways of reducing or preventing impacts.