

3. Environmental Assessment

3.1 Introduction

The term 'environment' is defined by the Environmental Protection Act, 2053 (1997) as "the interaction and inter-relationship among the components of natural, cultural and social systems, economic and human activities and their components". The environment normally includes the following components:

- Biophysical environment which includes land, water, atmosphere, organic/inorganic matter, living organisms and the interacting natural systems (ecosystems) that include these components.
- Socio-economic and cultural environment that affect the lives of people and communities.
- Man-made environment such as buildings, structures or other physical changes in the biophysical environment made by people.

All of these aspects are inextricably linked together. Humans and their environment are interdependent and interactive. We live within our environment, we shape our environment, we depend upon our environment to support us, and we are shaped by our environment.

3.1.1 Environmental Assessment

Environmental assessment (EA) is the systematic process by which the effects of a proposed project or other human action on the environment are evaluated, producing a set of recommendations which serves as influential input to the design of the project. EA is based upon the following values and principles which will ensure effective implementation at the project level:

- Sustainability:- the EA process will result in environmental safeguards.
- Integrity:- the EA process will conform to agreed standards.
- Utility:- the EA process will provide balanced, credible information for decision making.

This Chapter provides a summary of the EA process. A more complete guide to EA is contained in the Appendices to PWD Part II.

EA often includes consideration of socio-economic and cultural conditions as well as the biophysical environment. However, the need to assess a project in terms of preserving the social fabric, assisting the poor and disadvantaged groups, addressing gender issues and generally ensuring that targeted groups receive the intended project benefits have become increasingly important in Nepal and other developing countries. Consequently, the principal donors now require that a separate, complimentary social assessment be carried out. Social assessment procedures are described in Chapter 4.

3.2 Environmental Legislation and Guidelines

3.2.1 Environmental Protection Act and Rules

HMG/N has enacted the *Environment Protection Act, 2053 (1997)* (EPA) and the *Environment Protection Rules, 2053 (1997)* (EPR). The EPA requires that an EA either in the form of an Initial Environmental Assessment (IEE) or an Environmental Impact Assessment (EIA) shall be carried out for all proposed projects which meet the criteria listed in Schedules 1 and 2 in the EPR.

The Ministry of Population and Environment (MOPE) has published an additional notice in the Nepal Gazette on 23 August 1999 stating that proposed projects which are not listed in Schedule 1 but with an investment cost between Rs. 10 million and 100 million shall require an IEE, and those which are not listed in Schedule 2 but with an investment cost over Rs. 100 million shall require an EIA.

3.2.2 EA Guidelines

The National EIA Guidelines for Nepal were drafted, tested and finalised through a participatory approach and were gazetted in July 1993. Within the broad framework of the National EIA guidelines, two separate EIA guidelines for the forestry and industry sectors were prepared and endorsed by the government in 1995.

The Asian Development Bank, World Bank and other principal donors have developed EA guidelines which Nepal is required to follow in projects funded by them.

3.2.3 Standards

The EPA empowers the government to issue any kind of standards to promote environmental management in Nepal. HMG/N and several sectoral agencies have developed environmental standards and guidelines for effluents, vehicle emissions and pesticide residues.

3.3 Environmental Assessment Process and Project Cycle

The EA process in Nepal as described in the EPA and EPR is illustrated in Figure 3.1.

The EA process should be an integral part of the project cycle and Table 3.1 shows the relationship between the major steps in EA and other stages in the project cycle described in other chapters in PWD Part II.

The EA can be conducted either as an integral part of the project identification and feasibility study, or as a separate study. In either case the EA should be carried out in close coordination with the feasibility study, the social assessment, the engineering design work and construction activities. The EA will assist in determining the scope of the project, mitigation measures and implementation arrangements which should be incorporated into the project design and implementation plan.

3.3.1 Project Identification and Pre-Feasibility

The EA work begins with screening. If screening recommends that either an IEE or EIA is required, then the initial study will begin. At this early stage, an environmental overview/reconnaissance can indicate whether any of the alternatives proposed will be unacceptable from an environmental viewpoint. These can be eliminated from further consideration, and new alternatives can be identified.

Environmental scoping is often carried out as an integral part of pre-feasibility study in order to ascertain the issues/impacts to be investigated, consultations to be undertaken and form/content of the IEE/EIA report.

3.3.2 Feasibility Study

The feasibility study provides a basis for the approval of a project which will include detailed consideration of environmental and social implications of project implementation from the IEE/EIA and social assessment.

3.3.3 Project Appraisal and Approval

During the project appraisal, a decision is made by the Executing Agency, and in some cases by the donor, as to whether the project is viable. At this stage, the IEE/EIA and social assessment findings are considered with feasibility study. Approval of the Executing Agency and MOPE will be required to determine if the project is to be implemented. The IEE/EIA report plays an important role in this decision-making process.

Figure 3.1 Environmental Assessment Process in Nepal

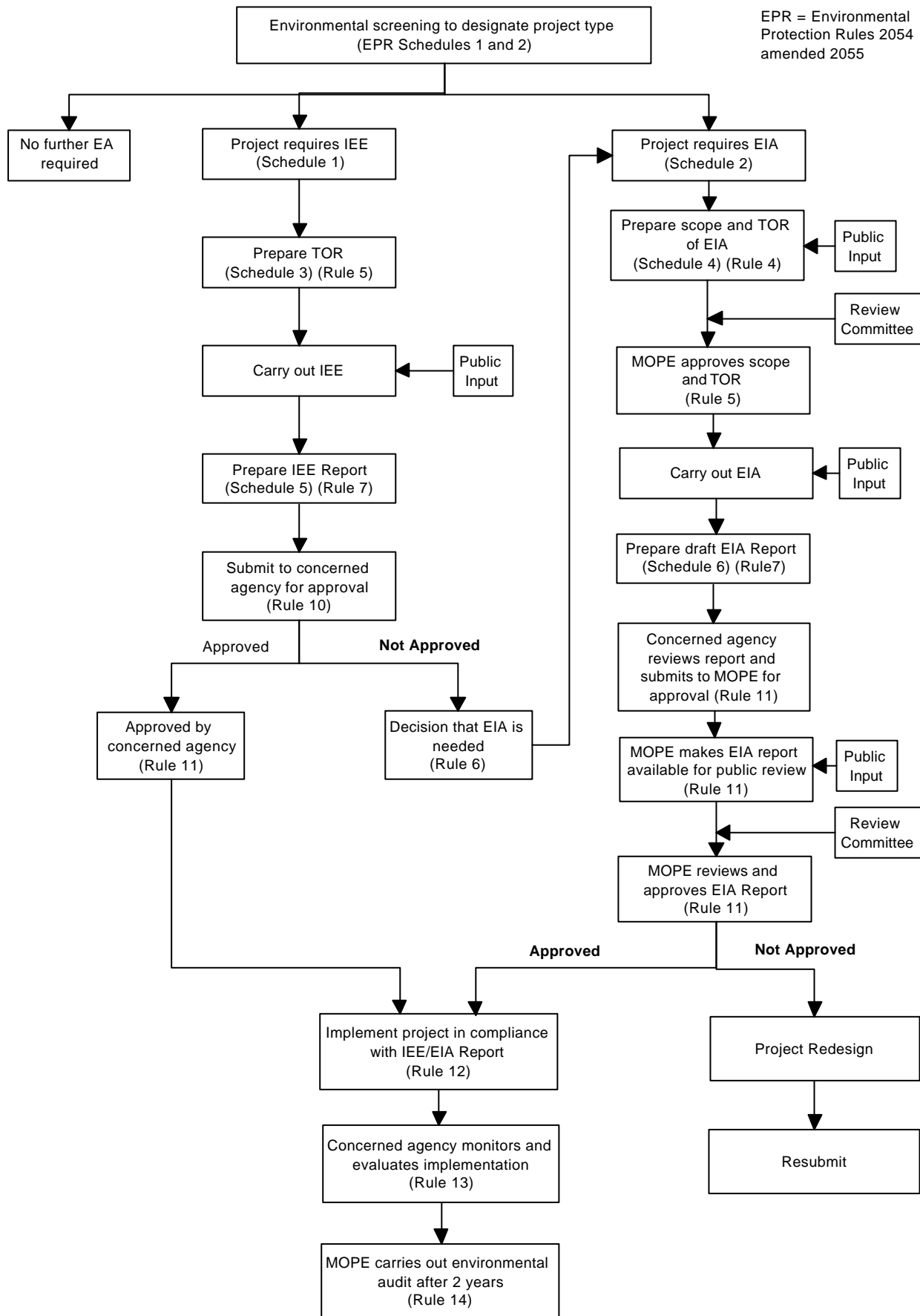


Table 3.1 Relation Between Environmental Assessment and the Project Cycle

Stages in the Project Cycle	Steps in the Environmental Assessment Process
Project Identification and Pre-feasibility (Chapter 1)	1. Environmental Screening: determines whether the project needs and IEE, EIA or no further environmental assessment.
Feasibility Studies (Chapter 2) Social Assessment (Chapter 4)	2. Initial Environmental Assessment (IEE): a less detailed assessment than a full EIA whose findings and recommendations are still incorporated into the project design.
	3. Environmental Scoping: identifies significant potential impacts and project alternatives and proposes terms of reference for the EIA.
	4. Prepare Terms of Reference for EIA Study.
	5. Baseline Data Collection: on present and future environmental conditions without the project.
	6. Predict Environmental Impacts: predicts impacts in terms of characteristics such as magnitude, extent and duration in quantitative terms as far as possible. Describe all reasonable alternatives, including the preferred and 'no action' options.
	7. Develop Mitigation Measures: measures to avoid, reduce and minimise adverse impacts and to enhance beneficial impacts.
Project Appraisal and Approval (Chapter 5)	8. Public Consultation and Participation: occurs at various stages in the EA process to ensure quality, comprehensiveness and effectiveness of EA, and to ensure that stakeholders' views are adequately addressed in the decision-making process.
	9. Prepare EIA Report: summarises all the information obtained, analysed and interpreted in a report form. The report should contain a non-technical summary, including methods used, results, interpretation and conclusions.
Project Implementation Plan (Chapter 6) Engineering Design (Chapter 7)	10. Review and Approve EIA Report: report is reviewed in order to assess whether or not all the possible issues have been adequately addressed and to facilitate the decision-making process. Decision whether or not the project should proceed, or if further alternatives must be examined.
Engineering Design (Chapter 7) Construction of Works (Chapter 11)	11. Prepare Environmental Action Plan (EMAP): specific actions to be taken during the engineering design and construction stages to minimise adverse impacts of the project.
Post-Construction Activities (Chapter 12) Technical Audit (Chapter 16)	12. Environmental Monitoring: of compliance with EMAP and of impacts.
	13. Environmental Audit: after construction and two years after completion.

3.3.4 Project Implementation Plan

The Project Implementation Plan document is prepared prior to proceeding with implementation which describes the arrangements for consultants, contractors, finance, reporting, monitoring and evaluation for the design, procurement and construction of the project. An Environmental and Social Management Action Plan (EMAP) should be prepared which contains all environmental actions to be undertaken in the process of project construction, operation and maintenance. The EMAP actions should be incorporated into the Project Implementation Plan.

3.3.5 Engineering Design

Engineering design includes final design, drawings, specification cost estimate, contract packaging and bidding documents for the construction and operation of the project. Environmental and social requirements contained in EMAP should be incorporated in the final design, cost estimate, specifications and Bill of Quantities (BOQ). All environmental mitigation actions should be clearly identified as separate line items in the BOQ with their specific requirements described in the specifications in the bidding documents.

3.3.6 Construction and Monitoring

Specified project resources for monitoring the implementation of the EMAP should be made available, either using staff of the Executing/Implementing Agency or by hiring specialist consultants. Monitoring should assess if the conditions required by EMAP have been integrated into the contract documents and are being complied with during construction.

3.4 Steps in the Environmental Assessment Process

Step 1. Environmental Screening

The following criteria are used to determine whether a project requires an IEE, EIA or no further environmental study.

Step 1.1 Threshold Criteria

This method of screening compares key features or environmental parameters of a project, against accepted thresholds which, if exceeded, will require further EA. Such environmental factors include: the amount of agricultural land used for a development project; the location, cost, outputs and infrastructure demands of the project; the number of people adversely affected; and the effect in terms of national standards for air, water and noise.

Step 1.2 Project Type Criteria

The EPR contains two schedules listing the type of project requiring either an IEE or EIA:

Schedule 1: projects which are likely to have significant but easily identifiable adverse impacts on the environment and for which mitigation measures can be readily prescribed. Such projects require an IEE and report.

Schedule 2: projects likely to have significant adverse impacts on the environment and require a full EIA and report.

Schedule 2 Section (K) Sensitive Areas: projects located within or near environmentally sensitive areas are required to have an EIA and report prepared unless exempted by the EPA.

Projects which pass the criteria and do not require further EA shall nonetheless be designed and implemented following good environmental and engineering practices.

Step 2. Initial Environmental Examination (IEE)

An IEE is carried out to determine whether potentially adverse environmental effects are significant or whether mitigation measures can be adopted to reduce or eliminate these adverse impacts. An IEE requires more in-depth analysis than applied in the screening procedure. Consequently, an IEE involves more time and resources and requires expert advice and technical input from environmental specialists so that potential environmental problems can be clearly defined. When an IEE is able to provide a definite solution to environmental problems, an EIA is not necessary.

Step 2.1 Preparation and Approval of IEE Work Schedule

Before proceeding with an IEE, the EPR requires that the project office prepare a work schedule in the format prescribed in Schedule 3 of the EPR and summarised in Table 3.3 below. This work schedule must be approved by the concerned ministry.

Table 3.2 Steps in Environmental Assessment

Step	Activity	Responsibility	Time *
1	Environmental Screening	Project Staff, Consultant	1 month
2	Initial Environmental Examination (IEE)	Project Staff, Consultant	2 months
3	Environmental Scoping	Project Staff, Consultant	1 month
4	Prepare Terms of Reference for Environmental Impact Assessment (EIA) Study	Project Staff, Consultant	1 month
5	Baseline Data Collection	Project Staff, Consultant	1-2 months
6	Predict Environmental Impacts	Project Staff, Consultant	1-2 months
7	Develop Mitigation Measures	Project Staff, Consultant	1-2 months
8	Public Consultation and Participation	Project Staff, Consultant, NGOs	1-2 months
9	Prepare EIA Report	Project Staff, Consultant	1 month
10	Approval of EIA Report	Concerned agency and MOPE	2-3 month
11	Develop Environmental Management Action Plan (EMAP)	Project Staff, Consultant	1-2 months
12	Environmental Monitoring	Project Staff, Consultant, NGOs	0.5 month
13	Environmental Audi	Project Staff, Consultant	2-3 months
	Total Elapsed Time To Approval of EIA Report	All	Up to 8-12 months

* Time required for a major project. Time required for smaller projects should be no more than 1-2 months. Many steps can be carried out simultaneously.

Table 3.3 Work Schedule of IEE Requiring Approval (Ref. EPR Schedule 3)

No.	Required Outline of IEE Work Schedule
1	Name and address of the individual or institution preparing the report
2	Proposals : (a) General introduction, (b) Relevancy of the proposal
3	Procedure to be adopted while preparing the report
4	Policies, laws, rules and manuals to be taken into account while preparing the report
5	Preparation of the report : (a) Time, (b) Estimated budget
6	Specific impact of the implementation of the proposal on the environment : (a) Social and economic, (b) Cultural and physical, (c) Chemical, (d) Biological
7	Alternatives for the implementation of the proposal : (a) Design, (b) Project site, (c) Technology, procedure of operation, time schedule, raw materials to be used
8	Matters concerning the prevention of the impact of the implementation of the proposal on the environment
9	Matters to be monitored while implementing the proposal
10	Other necessary matters

Step 2.2 Main Elements in IEE

To prepare an IEE, it is necessary to make a checklist that briefly describes the project activities to be implemented and natural resources to be affected. Typical project activities such as site development, resource demand, waste production and regulation, policies and guidelines are required to be included in the IEE process. For any particular project, only a few of these may be significant and therefore the first step is to narrow the list of activities likely to produce significant impacts. Table 3.4 illustrates the process of identifying significant impacts. The columns in the matrix describe the proposed project activities and the rows the environmental parameters that might be affected. The response of each environmental parameter to each project activity is represented by an interaction cell which should be checked by a rating number ranging from 1 to 3, 1 represent no significant impact, 2 moderate impact and 3 major impact.

Step 2.3 IEE Report and Approval

An IEE report is required. Table 3.5 summaries the contents of an IEE Report as prescribed in Schedule 5 of the EPR.

The project office shall follow the procedures described in the EPR for review of the IEE report by affected persons and communities and approval by the concerned ministry.

Table 3.4 Checklist of Environmental Parameters Used in IEE

Areas of Potential environmental Effects					Identification of Activities	Instructions : i) Check applicable project activities in "Identification of Activities" column; ii) For each applicable cell in matrix indicate: 1. Insignificant impact 2. IEE is adequate 3. Full EIA is necessary.											
Social	Aesthetic		Biological	Physical													
Social Interactions	Individual Well-being	Individual Environmental Interests	Composition	Man Made Objects	Flora and Fauna	Water	Atmosphere	Land	Habitats and Communities	Species and Population	Atmosphere	Land	Noise	Water			
															Access Roads	Site Selection and Preparation	
															Site Surveying		
															Soil Testing		
															Hydrological Testing		
															Environmental Survey		
															Site Clearing		
															Burning		
															Excavation		
															Drainage Alteration		
															Stream Crossing		
															Equipment		
															Waste Disposal and Recovery		
															Product Storage		
															Access Roads		Construction
															Site Clearing (Deforestation)		
															Excavation		
															Blasting and Drilling		
															Demolition		
															Building Relocation		
															Cut and Fill		
															Tunnels and Underground Structure		
															Erosion		
															Drainage Alteration		
															Stream Crossing		
															Equipment Movements		
															Labour Force		
															Waste Disposal		
															Product Disposal		
															Product Storage		
															Abandonment		
															Reclamation		
															Reforestation		
															Fertilization		
															Ancillary transmission Lines and Pipelines	Operation and Maintenance	
															Forest Clearing		
															Excavation		
															Spoil and Overburden		
															Blasting and Drilling		
															Dredging		
															Equipment Operation		
															Operational Failures		
															Energy Requirements		
															Energy Generation		
															Automobile aircraft Vessel Movement		
															Pedestrian Movement		
															Utilities		
															Waste Disposal and Recovery		
															Product Storage		
															Spills and Leaks		
															Explosions		
															De-icing snow removal and Disposal		
															Pest Control		
															Dust Control		
															Abandonment		
															Urbanization	Future and Related Activities	
															Industrial Development		
															Transportation		
															Energy Requirements		

Table 3.5 Table of Contents of IEE (Ref. EPR Schedule 5)

No.	Subject Matter Required in IEE Report
1	Name and address of individual or institution preparing the report
2	Summary of the proposal : (a) Objectives of the proposal (b) Impact on landuse (c) Adverse impact on the environment, impact on human life, and population pressure (d) Damage to be suffered by local goods or objects (e) Other necessary matters.
3	The following matters must be explicitly mentioned in respect to the proposal : (a) Type of proposal (b) If related to delivery, the nature and type of goods to be delivered (c) Proposal's installed capacity and number of hours to be operated (d) Materials to be used (quantity and year to be mentioned) (e) Emissions resulting from the implementation of the proposal (f) Energy to be used (g) Manpower requirements (h) Resources required for the implementation of the proposals (i) Detailed particulars of the area where the project is to be implemented (j) Manufacturing processes (k) Details of the technology (l) Other necessary matters.
4	Impact of the implementation of the proposal on the environment : (a) Impact on the social, economic and cultural spheres (b) Biological impact (c) Physical impact.
5	Alternatives for the implementation of the proposal.
6	Measures to reduce or control the impact of the implementation of the proposal on the environment
7	Matters to be monitored while implementing the proposal
8	Other necessary matters
9	Data, maps, photographs, tables, charts, graphs, etc. as required.

Step 3. Environmental Scoping

If the screening or the IEE determine that a full EIA is required the next step is to determine what should be the coverage or scope of the EIA study. This activity is referred to as 'scoping' whose main purpose is to:

- Identify concerns and issues for consideration in an EIA.
- Determine the assessment methods to be used.

- Provide an opportunity for public involvement in determining the factors to be assessed, and facilitate early agreement on contentious issues.

Scoping is not an isolated exercise. It may continue well into the project planning and design phase, depending if new issues arise for consideration.

Step 3.1 Method of Scoping

The basic components of a scoping exercise are as follows:

- Prepare a plan for public involvement.
- Assemble relevant existing information.
- Distribute information to affected interests.
- Identify major issues of public concern.
- Evaluate the significance of issues on the basis of available information.
- Establish priorities for environmental assessment.
- Developing a strategy for addressing priority issues.

Step 3.2 Agencies Responsible for Scoping

Responsibility for scoping rests with the Implementing Agency but sectoral agencies of the government should also be involved in the EIA scoping exercise (e.g., Agriculture, Forests, Livestock, Water Resources, Health) as well as relevant donor agencies. At the community level, key local persons, leaders, and special-interest groups should also be involved in EIA scoping. This involvement will encourage their participation in the EIA process and in implementation of the EIA of the proposed project including environmental monitoring and evaluation. EIA scoping should be an open and participatory exercise. It should involve review agencies and sectoral representatives and should allow public participation.

Step 4. Prepare Terms of Reference (TOR) for EIA Study

If the screening exercise indicates the need for an EIA, the TOR are normally prepared as an output of the scoping exercise. A suggested format for the TOR is shown in Table 3.6.

Step 4.1 Preparation and Approval of EIA Work Schedule

Before proceeding with an EIA, the EPR requires that the project office prepare a work schedule in the format prescribed in Schedule 4 of the EPR and summarised in Table 3.7 below. This work schedule must be approved by MOPE.

Table 3.6 Suggested Format for TOR

No.	Contents
1	<p>Introduction</p> <p>Purpose of terms of reference</p> <p>Responsible party for preparing the EIA report</p>
2	<p>EIA Guidelines</p> <p>General guidelines to be followed</p> <p>Procedure to be used in preparing the EIA report</p>
2	<p>Background Information</p> <p>General background studies and relevant reports should be described</p> <p>Specific background studies and reports related to the project and location should be listed or described</p> <p>Relevant policies and legislation should be mentioned</p> <p>The relevance to local planning perspectives should be discussed</p>
4	<p>Specific EIA Guidance</p> <p>The environmental components which need detailed or further study should be listed. The indicators of each listed component to be measured or assessed might be specified.</p> <p>Action required to minimise possible adverse impact (relocation, increased taxes, compensation, etc.)</p> <p>Cost- benefit analysis of project in terms of its environmental implications</p> <p>EIA reports should propose a monitoring programme for assessing the actual impacts during the project operation and beyond</p>
5	<p>The Following Tasks Should Be Mentioned in the EIA Study Proposal:</p> <p>Work tasks: each specific task to be done should be sufficiently described</p> <p>Study schedule: the proposed plan for carrying out the EIA study should be indicated</p> <p>Review sessions: periodic reviews of the work might be needed during study</p> <p>Study team: expertise and specialists needed for the proposed project</p> <p>Study team should be described.</p>
6	<p>Conclusion</p> <p>Whether the project should be implemented or whether it poses an unacceptable risk</p>
7	<p>Time Constraints</p> <p>The time required for the EIA report to be completed should be specified</p> <p>A description of EIA tasks and completion dates should be stated</p>
8	<p>Budget</p> <p>The estimated budget allocation for the EIA study and report preparation should be given</p>
9	<p>EIA Report Format</p>
10	<p>Other Relevant Information</p> <p>Reference List</p> <p>Annexes, Maps, Photographs, Figures, Tables, Chart Drawings, Checklist, etc</p>

Table 3.7 Work Schedule of EIA Requiring Approval (Ref. EPR Schedule 4)

No.	Required Outline of EIA Schedule
1	Name and address of the individual or institution preparing the report
2	General introduction of the proposal
3	Data needed for the preparation of the report, and procedure of collecting them
4	Policies, laws, rules and manuals to be taken into account while preparing the report
5	Preparation of the Report : (a) Time, (b) Estimated budget, (c) Necessary experts
6	Scope determined for the preparation of the report
7	Impact on the environment of the implementation of the report : (a) Social and economic, (b) Cultural and physical, (c) Chemical (d) Biological
8	Other alternatives for the implementation of the proposal : (a) Design (b) Project site (c) Technology, procedure of operation, time-schedule and raw materials to be used (d) Environment management system (e) Whether or not the risks resulting from the implementation of the proposal can be accepted (f) Other matters
9	Measures to remove any negative impact that may be noticed while implementing the proposal
10	Particulars of the cost and returns of the proposal
11	Matters to be monitored while implementing the proposal
12	Relevant information, reference lists, annexes, maps, photographs, tables and charts, graphs and questionnaires to be mentioned at the time of preparing the report.

Step 5. Baseline Data Collection

The term 'baseline' refers to the collection of background information on the biophysical, social and economic settings of a proposed project area. Information may be obtained from secondary sources when a database exists, or new information may be acquired through field samplings. Baseline data are collected for two main purposes:

- To provide a description of the status and trends of environmental factors against which predicted changes can be compared and evaluated in terms of importance.
- To provide a means of detecting actual changes through monitoring once a project has been initiated.

The environmental setting includes the characteristics of the project area which is defined as the area within which all impacts and potential compensation efforts would occur. The level of detail of the description of the project area should be sufficient to convey to reviewers the precise nature of the natural and human resources potentially affected by the proposed project and alternatives.

The following are the major environmental parameters of the project area for which the baseline information should be collected:

- Geology
- Topography
- Soils
- Groundwater resources
- Noise levels

- Surface water resources
- Terrestrial communities (botanical and zoological)
- Aquatic communities
- Environmentally sensitive areas
- Land use
- Demography
- Socio-economic
- Infrastructure services
- Transport
- Cultural resources
- Project economics.

When a project (and its anticipated effects) is a 'point' and essentially confined to a particular piece of property then it is generally appropriate to describe all natural and man-made features of the property and the vicinity. When a project covers a 'band' such as a transmission line, pipeline or canal, the discussion of existing environments may necessarily be less detailed and in certain categories only.

The EIA is often conducted under severe time constraints and EIA practitioners often spend too much time collecting baseline information. Only baseline data needed to assist in the prediction of the impacts contained in the TOR should be collected.

Step 6. Identify Environmental Impacts

Any development project, regardless of size and complexity, has some environmental impacts which may be beneficial or adverse. The main objective of impact identification is to specify areas that are likely to be affected by the implementation of a project and whether the impacts are beneficial or adverse. Impact identification starts at the early stage of scoping when data on both the project and surrounding environment are made available.

Step 6.1 Biophysical Impacts

Impacts in this category relate to effects on biological resources such as vegetation, wildlife, crops, and aquatic life. Impacts affecting soil and land forms, or creation of a propensity for soil erosion, floods and sedimentation and chemical impacts relate to project activities that cause a chemical change in air/water/soil quality are also included.

Step 6.2 Cultural Impacts

Project impacts on cultural resources should be considered. Cultural resources refer to archaeological, historical, religious, cultural and aesthetic values. Cultural resources are part of the resource base, it is therefore important that the development options, under consideration are screened for potential impact on cultural properties. It is essential to check whether or not the project area contains UNESCO World Heritage Sites which now number over 300 sites recognised as having outstanding universal value. The national inventories of cultural resources, which can provide important data along with the agencies such as museums, universities and departments of archaeology should be consulted.

Step 6.3 Health Impacts

Traditionally, health issues have been given little attention in EIAs. Even when social impacts were being investigated, the effects of a proposal on individual mental and physiological well-being (health status and trends) were often omitted or treated in an unsatisfactory manner. The World Health Organization (WHO) defines health as a state of social and individual well-being and not just the absence of disease. If this view is accepted, then the links between health and social impacts are apparent. Often health impacts depend on environmental impacts, such changes in habitat causing increased likelihood of contact between humans and sources of

diseases. In other cases project activities may introduce health hazards such as the increased incidence of sexually transmitted disease resulting from the influx of a large construction labour force.

Step 6.4 Other Impacts

Other impacts which are examined in coordination with the EIA are economic impacts (described in Part II Chapter 3 Feasibility Studies) and social impacts (described in Part II Chapter 3 Social Assessment).

Step 6.5 Hazards and Risk in EIA

The term 'hazard' is used commonly in EIA and project appraisal and can be defined as the inherent or intrinsic property of a system to cause damage. The likelihood of that damage or harm occurring is termed 'risk'. Risk assessment is the scientific process of assessing the probability of an adverse effect of defined characteristics caused by a hazardous event occurring. Risk assessment answers two basic questions:

- How likely is an event to occur?
- How harmful can it be in terms of deaths, injuries and property and ecosystem damage?

Risk assessment has been undertaken for proposed hazardous facilities such as pipelines transporting flammable materials and installations which use or produce hazardous materials. In the past, these have been undertaken separately from the EIA often because there were no EIA requirements. Risk assessment is based on engineering systems, their potential malfunction and relating the consequences of such an event to human health structural damage to buildings.

Step 6.6 Categories of Impacts

The types of impact should be categorised as direct, indirect and/or cumulative as indicated in the following descriptions:

Direct Impact: refers to an alteration of the existing environmental condition as a direct consequence of project activity. Construction of an irrigation diversion weir on a stream bank, for example, may have a direct impact on the aquatic ecosystem and stream valley vegetation and also directly cause erosion.

Indirect Impact: results when one component of the environment produces repercussions for other related components.

Cumulative Impact: while an environmental impact produced by a single activity may not be significant, a series of impacts created by more than one project, or by the combined effects of several impacts from the same project, may be significant. Consequently, an ecosystem may be dramatically affected through cumulative impacts. It is necessary to consider the cumulative impact of all projects that share mutual resources or affect the same area.

Step 6.7 Impact Identification Methods

In the history of EIA, an enormous variety of methods have been devised to help undertake EIAs and prepare EIA reports. These EIA methods are structured frameworks which allow impact data to be identified, manipulated and presented. Irrespective of particular methods employed at various stages, the overall approach to EIA should be based on fairness, openness, cost-effectiveness and efficiency. The methods should be:

- Comprehensive: recognized that EIA is multi-disciplinary subject.
- Selective: pinpoint the significant impact and eliminate non-significant issues that would dissipate the efforts and confuse the decision making process.
- Comparative: determine the environmental changes resulting from the project as distinct from changes that would otherwise occur under existing biophysical and social condition.
- Objective: provide unbiased measurement and prediction, free from political and external influences.

A variety of assessment tools are available for use by EIA practitioner. The successful utilisation of any of these tools depends upon the nature of the project. Some of the tools are described below.

Checklists: as one of the first EIA methods, checklists are still in use in many different forms. Usually checklists consist of list of environmental factors which may be affected by project activities. Checklists can range from simple lists of items to more complex variations which incorporate guidance on the scaling and weighting of impacts.

Geographic Information Systems (GIS): the term 'GIS' refers to a computer-based system incorporating the collection, storage, retrieval, transformation and display of spatial data.

Task-Specific Computer Model: when complex predictions are required computer models designed for specific purpose may being utilised in EIA analysis. Such models often incorporate mathematical representations of key processes and interactions. These models are used to predict the changes of resources to be affected over a period of time. Such models are only effective when environmental factors are quantifiable.

Step 6.8 Impact Prediction

Prediction should be based on the available environmental baseline data and may be described in quantitative or qualitative terms. The predictions should indicate:

- The initial baseline condition
- The estimated future state with the proposed project
- The estimated future state without the proposed project.

Impact prediction should consider:

Magnitude of Impact: the severity of each potential impact indicating whether the impact is irreversible or reversible and the estimated potential rate of recovery.

Extent of Impact: the spatial extent or the zone of influence of the impact should always be determined.

Duration of Impact: An impact that generally lasts for only three to nine years after project completion may be classified short-term. An impact which continues for 10 to 20 years may be defined as medium-term, and impacts that last beyond 20 years are considered long-term. The type of impacts produced during the construction phase are of generally short-term.

Step 7. Develop Mitigation Measures

Mitigation measures are actions which reduce, avoid or offset the potential adverse environmental consequence of development activities. The objective of mitigation measures is to maximise project benefits and minimise undesirable impacts. Although a wide range of mitigation measures may be proposed, the following are relevant to most development projects.

Step 7.1 Consideration of Alternatives

Consideration of alternatives to a proposed project is one of the key functions of an EIA, which involves an examination of alternative ways of achieving the objectives of a proposed project. The aim is to arrive at a development option which maximises the benefits while minimising unwanted impacts.

Step 7.2 Compensatory Measures

Compensatory measures are actions which compensate for adverse impacts that are unavoidable. Possible compensatory measures include : restoration of damaged resources; rehabilitating displaced settlements and compensation to affected persons.

Step 7.3 Corrective Measures

Corrective measures may be adopted to reduce adverse impacts to acceptable levels. These may include specific actions during construction (e.g. removal of spoil material) or provision of corrective facilities (e.g. fish ladder around a dam).

Step 7.4 Preventive Measures

Potential adverse impacts may be reduced or eliminated before their occurrence by introducing preventive measure. Examples include: implementation of a health education programme and initiation of a public awareness programme.

Step 7.5 Implementation of Mitigation Measures

Implementation of mitigation measures requires funding which should be estimated and included in the EIA report. All proposed mitigation measures should be integrated in the project design so that these measures may automatically form part of the construction and operational phases of the project. Where possible, corrective measures should be included in the construction contract documents.

Step 8. Public Consultation and Participation

The involvement of the public is vital to the success of the EIA and subsequent implementation of mitigation measures. Experience has shown that the following benefits are gained with stakeholder involvement in EIA process:

- Improved understanding of the potential impacts of the proposed project.
- Identification of alternative sites and designs and mitigation measures.
- Clarification of values and trade-offs associated with different alternatives.
- Identification of issues (and possible forum to resolve them).
- Creation of accountability and a sense of local ownership during project implementation.

As the term indicates, 'participation' requires shared involvement and responsibilities and it implies an element of joint analysis and control over decisions and their implementations. In participatory decision-making, there is no single source of ultimate control or authority. The participating parties must discuss and reach a decision by means of an agreed process, for example, through the process of mediation and consensus-building.

Step 8.1 Approaches to Stakeholder Involvement

It is very important that a plan for stakeholder involvement is prepared before EIA work begins. It is essential to have such a plan, because there is a tendency of EIA practitioners to focus their attention on the technical aspects of the EIA work only. This will occur even if an anthropologist or rural sociologist has been included in the team, as often such experts are marginalised in large teams of engineers, planners or environmental scientists.

There are numerous methods which can be utilized to involve stakeholders, especially the public, in EIA process:

- Public Meetings: these are open with no restriction as to who may attend.
- Advisory Panels; group of individuals chosen to represent stakeholders, and meet periodically to assess work done/results obtained and to advise on future works.
- Public Information Centre: a man made facility, in an accessible location, which contains an information and display on the project and the study. Members of the public can visit and obtain information and make their concerns and views.
- Interviews: structured series of open-ended interviews with selected community representatives to obtain information/ concerns/ views.
- Questionnaires: a written, structured series of questions issued to local people to assemble concerns/views/ideas.

- Participatory Appraisal Techniques: a systematic approach to appraisal based on group inquiry and analysis with multiple and varied inputs. The process may be assisted, but not controlled or directed, by external specialists.

The main challenge is to identify and involve those individuals and groups that are likely to be affected. Therefore, representative of the following groups are necessary:

- Local people and communities who are likely to be affected by the project.
- Project beneficiaries, not all of whom will be local.
- NGOs active in the project area or with an interest in natural resources and social welfare.
- Traditional authorities such as village headman, tribal elders and religious leaders.
- Voluntary organisations such as local community development or users' groups, kinship societies, recreational groups, neighbourhood associations, labour unions, gender groups, ethnic organisations and co-operatives.
- Private sector representatives such as business interest groups, trade associations or professional societies.

Step 9. Develop Environmental Management Action Plan (EMAP)

After the approval of EIA report, the implementing agency shall develop an Environmental Management Action Plan (EMAP) document based on the conditions given in the approved EIA report. The EMAP should be developed primarily with the purpose of :

- Identification of key environmental issues likely to arise from project implementation.
- Identification of the corresponding environmental mitigation measures to be integrated in the project design in order to minimise the adverse impacts.
- Development of monitoring and evaluation schedules to be implemented during project construction and operation.
- Estimation of costs that are required for implementing mitigation measures.

The EMAP should provide guidelines to the project construction contractors and the activities and the cost outlined in EMAP should be included in the Engineering Cost Estimate and BOQ document.

Step 10. Prepare EIA Report

A EIA report shall be prepared by the project office. The contents of the EIA Report as prescribed in Schedule 6 of the EPR are summarised in Table 3.8.

Table 3.8 Contents of EIA Report (Ref. EPR Schedule 6)

No.	Subject Matter Required in EIA Report
1	Name and address of the individual or institution preparing the report.
2	Summary of the proposal : (a) Objectives of the proposal, (b) Impact on land-use, (c) Adverse impact on the environment, impact on human life, and population pressure, (d) Damage to be suffered by local goods or objects (e) Other necessary matters.
3	Summary of the report.

4	Particulars of the proposal : (a) To specify the technical, geographical, environmental economic, social, cultural and physical aspects of the proposal, (b) To specify the objectives, working policies and work-schedules of the activities to be undertaken during each phase of the implementation of the proposal.
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No.	Subject Matter Required in EIA Report
5	Basic information relating to the proposal.
6	Identification of environmental impact : (a) Geographical areas likely to have positive or negative impact of the implementation of the project, and their time-schedule, (b) Impact of waste and pollution to be emitted through the implementation of the proposal, (c) Direct, indirect and cumulative impact of the implementation of the proposal on the environment.
7	Analysis of the alternatives for the proposal : (a) Matters concerning the design of the proposal, (b) Comparison is to be made on the basis of the fixed and working capital, local suitability, institutional training and supervision needed for the implementation of the proposal, and the environmental cost and returns and economic significance of each alternative measures are to be analysed as far as possible, (c) Short, medium and long-term adverse impact of the implementation of the proposal, (d) Sources of energy to be used, (e) Analysis of the consequences of the non-implementation of the proposal.
8	Measures to reduce environmental impact : (a) Mention practical preventive measures to be adopted, (b) In case the environmental impact cannot be fully avoided through preventive measures, arrangements made for payments of compensation shall be mentioned, (c) The effectiveness of the preventive measures shall be analysed from the viewpoint of their cost on the basis of a comparison with other possible alternative.
9	Matters concerning environmental management plans.
10	Review of policy and legal provisions.
11	Monitoring of the proposal/project.
12	To mention the format and relevancy of environmental examinations.
13	Reference materials.
14	<p>Include the following particulars in the Annexes:</p> <ul style="list-style-type: none"> (a) Maps (b) Aerial photographs (c) Questionnaires (d) Charts and Photographs (e) Hydrological and climatic data (f) Data relating to flora and fauna (g) Geological and risk evaluation data (h) Information relating to the quality of air and water and the noise level (i) Matrix or serial graphs (j) Audio-visual supports (k) Cropping techniques, and data relating to livestock farming, soil features, and quantity of chemical fertilizers used (l) List of reference materials (m) List of invitees and participants, and records of discussion and meetings (n) List of names of individuals and institutions comprising the study team (o) Names, address and telephone numbers of individuals and institutions contacted in the course of the study.

Step 11. Approval of EIA Report

The approval process is described in detail in the EPR and summarised in Figure 3.1. The key stages are:

- The concerned agency shall submit the draft EIA Report to MOPE for review and approval.
- MOPE shall make the draft EIA Report available for review by the public.
- If there are no substantial adverse impacts MOPE shall approve the EIA Report.
- If there are substantial impacts MOPE shall require the concerned agency to incorporate appropriate mitigation measures before giving approval, or it may recommend that new alternatives to achieve the project objectives are considered.

Step 12. Environmental Monitoring

Environmental monitoring is defined as an action-oriented activity to determine the extent to which environmental regulation is working. It is one of the most important components of the EIA process and is essential to:

- Ensure that impacts do not exceed the legal standards.
- Check implementation of mitigation measures in the manner described in the EIA report.
- Provide early warning of potential environmental damages.

Step 12.1 Principles of Monitoring

If the EIA monitoring process is to generate meaningful information and improve implementation of mitigation measures, it must accomplish the following:

- Determine the indicators to be used in monitoring activities.
- Collect meaningful and relevant information.
- Apply measurable criteria in relation to chosen indicators.
- Review objective judgments made on the information collected.
- Draw tangible conclusions based on the processing of information.
- Make rational decisions based on the conclusions drawn.
- Recommend improved mitigation measures to be undertaken where necessary.

Step 12.2 Types of Monitoring

Various types of monitoring activity are currently in practice, and each has some degree of relevance to an EIA study. The main types are briefly described below:

Baseline Monitoring: a survey should be conducted on basic environmental parameters in the area surrounding the proposed project before construction begins (pre-audit study). Subsequent monitoring can assess the changes in those parameters over time against the baseline.

Impact Monitoring: the biophysical and socio-economic (including public health) parameters within the project area should be measured during the project construction and operational phases in order to detect environmental changes, which may have occurred as a result of project implementation.

Compliance Monitoring: this form of monitoring employs periodic sampling or continuous recording of specific environmental quality indicators or pollution levels to ensure project compliance with recommended environmental protection standards.

Monitoring should be regular and performed over a long period. Interruptions in monitoring may result in generating insufficient data to draw accurate conclusions concerning project impact.

Step 12.3 Development of Monitoring Indicators

For each of the impacts and corresponding mitigation measures indicators to be measured during project construction should be developed. The indicators selected should reflect the condition of that particular component upon the measurement.

Step 12.4 Institutional Aspect

Institutional factors determining the effectiveness of monitoring should not be underestimated. There needs to be a firm institutional commitment by the agencies responsible for the monitoring process, EIA monitoring responsibility should be given to monitoring section within the planning divisions of concerned ministries. The costs involved in EIA monitoring should be borne by the project or the Executing/Implementing agency.

Step 13. Environmental Auditing

The terms 'audit' refers to the examination and assessment of a certain type of performance. In the case of an EIA, an audit assesses the actual environmental impact, the accuracy of prediction, the effectiveness of environmental impact mitigation and enhancement measures, and the functioning of monitoring mechanisms. The audit is usually once or twice in the project cycle: (1) immediately following completion of construction and (2) two years after project completion.

Responsibility of audit lies with MOPE, although the cooperation of the Executing Agency/Implementing Agency will be required.

Step 13.1 Types of Audit

The following types of audit that are recommended in different phases of the EIA process:

Decision Point Audit: examines the effectiveness of EIA as a decision-making tool.

Implementation Audit: ensures that approved conditions have been met.

Performance Audit: examines the responses of agencies concerned with project management.

Project Impact Audit: examines environmental changes arising from project implementation.

Predictive Technique Audit: examines the accuracy and utility of predictive techniques by comparing actual against predicted environmental effects.

EIA Procedures Audit: critically examines the methods and approach adopted during the EIA study.

Not all the audit types mentioned above are required in the EIA process. However, at the project approval stage, both the Executing Agency and MOPE should consider whether an application of a particular audit technique is likely to result in new information or an improvement in management practices. Particular attention should be given to cost-effectiveness of any proposed audit and to the technical difficulties likely to be encountered.

Since the EIA concept is a relatively recent, the use of environmental audits will play a significant role in evolving a systematic approach of the application of EIA. Environmental auditing should compare monitoring results with information generated during the pre-project period. Comparisons can be made with similar projects or against standard norms. Relating actual impacts with predicted impacts, help in evaluating the accuracy and adequacy of EIA predictions.

Step 13.2 Environmental Audit Plan

Environmental audit should be carried out upon the completion of project construction and after 2 years of project operation in order to obtain information on:

- The condition of natural/social/economical resources prior to project implementation after the project construction is completed.

- Whether or not, all the mitigation measures implemented are effective to control adverse impact, or enhance beneficial impacts.
- Whether or not mitigation measures implemented are effective to control adverse impact, or enhance beneficial impact.
- Whether or not all degraded landscape due to project implementation have been restored into original condition.
- What are the impacts of boom-bust scenario among the workforce involved in project implementation and the local economy.
- The effect on the local economy of project implementation.

3.5 References

1. Environmental Protection Act, 2053 (1997), HMG/N, Nepal
2. Environmental Protection Regulation (First Amendment) 2055 (1999), HMG/N, Nepal
3. National Environmental Impact Assessment Guidelines 1993, National Planning Commission, Nepal
4. Environmental Assessment in the Road Sector in Nepal; A Policy Document (2000); Geo-Environment Unit, Department of Roads
5. Environmental Guidelines for Selected Infrastructure Projects, 1990, office of Environment, ADB, Manila
6. Environmental Impact Assessment for Developing Countries - Vol I and II, B.N. Lohani.