SOUTHERN AFRICAN POWER POOL

Guidelines for Environmental and Social Impact Assessment for Hydroelectric Projects in the SAPP Region Part 2

Environmental Subcommittee

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Contents

Section Page

Acronyms and Abbreviations

ADB	Asian Development Bank
AfDB	African Development Bank
BOD	biological oxygen demand
CD	compact disk
CIDA	Canadian International Development Agency
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
COD	chemical oxygen demand
DAA	development assistance agency
DANIDA	Danish International Development Agency
dB(A)	A-scale weighted decibels (sound)
DBSA	Development Bank of Southern Africa
DSS	decision support system
EH&S	environmental health and safety
EIA	environmental impact assessment
ELMS	Environmental and Land Management Section (SADC)
EMP	environmental management plan
EnvSC	Environmental Subcommittee (SAPP)
EPE	Environmental Performance Evaluation (ISO 14031)
EPC	engineer procure construct
ESA	environmental site assessment
EWG	Environmental Working Group (PIESA)
GIS	geographic information system
IAIA	International Association for Impact Assessment
IAP	interested and affected parties
IFC	International Finance Corporation (WB Group)
IFI	international financial institution
ISO	International Standards Organization
IUCN	International Union for Conservation of Nature
JICA	Japanese International Cooperation Agency
KB	knowledge base
KfW	Kreditanstalt für Wiederaufbau
MDG	Millennium Development Goals (UN)
MFL	multilateral financial institutions (WB)
MSDS	Material Safety Data Sheet (OSHA)
MW	megawatt
NGO	nongovernmental organization
NORAD	Norwegian Agency for Development Co-operation
OED	Operations and Evaluation Department (WB)

OSHA	Occupational Safety and Health Administration (USA)
PIESA	Power Institute of Eastern and Sothern Africa
PPAH	Pollution Prevention and Abatement Handbook (PPAH)
RFP	request for proposals
SADC	Southern African Development Commission
SAIEA	Southern African Institute for Environmental Assessment
SAPP	Southern African Power Pool
SEA	Strategic Environmental Assessment
SIA	social impact assessment
SIDA	Swedish Meatball Manufacturing Association
SLM	sound level meter
SPL	sound pressure level
UN	United Nations
USAID	US Agency for International Development
VDC	volts, direct current
WCD	World Commission on Dams
WGE	Working Group on Environment (PIESA)

Section 1 Executive Summary

This document provides a recommended framework and Guide to a systematic approach to performance of environmental impact assessments (EIA) for hydroelectric power projects in the Southern African Power Pool (SAPP) region.

Adoption of such a systematic approach is essential when considering the management and impacts of use water, an oftentimes transboundary and increasingly sensitive natural resource. The approach presented is based generally on that of The World Bank (WB) and the Asian Development Bank (ADB), the later being far more active in hydroelectric project development in recent years.

The Guide provides an overview of the need and regional relevance of EIA for hydroelectric projects, followed by a detailed presentation of recommended format and components. The Guide also addresses the need for, and approach to, the development of an Environmental Management Plan (EMP), public participation, identification of impacts and possible mitigation measures and ongoing environmental monitoring and reporting.

The Guide also provides a basis for more deliberate consideration, and systematic satisfaction of Millennium Development Goals (MDG) that are relevant to hydroelectric projects (all are, directly or indirectly) and iterates the need for consistent and systematic EIAs in support of regional management of energy and the environment as will likely embodied in Strategic Environmental Assessments (SEA) in future.

The Guide concludes with observations on the necessity of a regionally consistent approach to EIA throughout the energy sector. The Guide also recommends further development of a public domain Web-based EIA and environmental management resource, training program and ongoing program for updating the system and managing training functions under the auspices of the SAPP Environmental Subcommittee and the SAPP Environmental Officer.

Section 2 Introduction

As stated in the SADC Shared Watercourse Systems Protocol of 1995, "Water in the region is a scare resource with 70 percent of the regional surface shared between two or more member states". This is not surprising as many of the national boundaries of southern Africa are defined in part by surface waters. When transboundary basins are included, the shared water resources may well exceed 90%. Therefore, as contemplated by the SADC Protocol, and as discussed later, it is imperative that a regionally consistent procedure for performance of EIA be developed as an equitable means of protection of shared and transboundary environmental resources and assurance of equal rights in the use and conservation of water resources and the impacts thereof.

The objective of this document is to provide an easy to use, updateable, proposed uniform Guide for performance of environmental assessments [1] for hydroelectric power projects in SAPP member countries, and to further support ease of compliance with relevant and applicable environmental regulations and requirements of member countries, development assistance agencies, and development banks. It is also contemplated that the Guide may serve as the starting point for development of a uniform EIA requirement for hydroelectric projects in SAP member countries.

The Guide presents a systematic approach to identification and mitigation of adverse environmental and social impacts as well as the constructs for a uniform and consistent environmental and social monitoring and management plan for hydropower projects, which will satisfy the requirements of all impacted or potentially impacted SAPP member countries as well as satisfy potential sources of funding or other support. The recommended approach is based on a comparative assessment of country, Southern African Development Commission (SADC) requirements (specifically the SADC Shared Watercourse Systems Protocol of 1995), multilateral lending bank, development assistance agency and World Commission on Dams (WCD) recommendations, as well as regional and international treaties and agreements in effect in any or all SAPP member countries . The Guide will be made available to government agencies, project developers and public interests, and will be available on the SAPP Coordination Centre Website to promote discussion of, and support arrival at, agreement on a common approach.

The Guide presents a timely assessment and guidance on use of the EIA process to assure achievement of selected Millennium Development Goals (MDG). The Guide also discusses how promotion of consistency in format, approach and means of numerical analyses can support the performance of Strategic Environmental Assessments (SEA), which consider more holistic, cumulative impacts of development policies, plans and programs on a regional and transboundary scale.

The Guide presents a:

- Proposed Regional EIA Guide for Hydroelectric power projects within SAPP, including assessment of Environmental and Social Impacts during all phases of a typical hydroelectric power project, i.e.,
  - Conceptual Planning and Siting

  - Construction
  - Operations and Maintenance
  - Decommissioning
- Generic mitigation options for negative impacts and enhancement options for positive impacts
- Generic Environmental Management Plan for Hydroelectric Power Projects
- Overview of integration with the MDGs
- Overview of the importance of SEA, and how systematic EIAs support performance of meaningful SEAs

It should also be noted that the Guide is consistent with the intent of the SADC Shared Watercourse Systems Protocol (see Appendix 1) in that it supports Article 1:, items 3, 4, 5, 7 b., c. and e., and 12., Article 4: Items (a)(i) and (ii), (b)(iii) and (iv), (c)(iii) and (v), and most specifically (d) With regard to Environmental Protection, Items (i) and (iii), as excerpted below:

(i) Promoting measures for the protection of the environment and the prevention of all forms of environmental degradation arising from the utilization of the resources of the shared watercourse systems;

(iii) Promoting environmental impact assessments of development projects within the shared watercourse systems.

Reference materials accessed and or cited include:

- SADC Shared Watercourse Systems Protocol
- Country-Specific EIA Regulations
- Development Bank Requirements
- Hydroelectric Power and Environment Technical Reports
- Southern African Institute for Environmental Assessment (SAIEA 2003) "Environmental Impact Assessment in Southern Africa"
- World Commission on Dams Reports
- SAPP Annual Reports

It should also be noted that the Environmental Working Group (EWG) of the Power Institute for East and Southern Africa (PIESA) is currently engaged in efforts to collect details of all potentially applicable environmental regulations for power sector projects in SADC member countries. Mutually beneficial results should arise from SAPP EnvSC and the PIESA EWG efforts in this regard.

Section 3 Proposed Regional Hydroelectric Project EIA Guide

The proposed Regional Guide is intended to provide a framework for the performance of a standardized EIA in the SAPP region, which if followed will assure compliance with all country, bank, agency, organization and treaty or agreement requirements. Agreement and adherence to such an approach will facilitate a sharing of technical capacity and knowledge. The proposed Regional Guide will also assure uniformity in approach to assessment of impacts and promoting a "level playing field" on which one country does not gain financial advantage at the expense of another through internal environmental degradation or imposition of trans-boundary impacts that would violate any of the applicable environmental requirements of an impacted or potentially impacted country.

In support of this concept, a standardize approach to EIA, detailed summary of mitigation measures and proposed basis for project-specific Environmental Management Plans (EMP), are presented in the following sections.

Section 4 Generic Approach to Hydroelectric Project EIAs

The general approach to EIA, as excerpted from SAIEA's EIA in Southern Africa, 2002, and modified, is as follows. Although detailed steps in the EIA process vary from country to country, the generic steps which are followed internationally remain essentially the same, and are as shown in Table 1 and Figure 1. Table of Contents line items are also cross-referenced to the more detailed descriptive text presented in Sections 4.4.1 and 4.4.2.

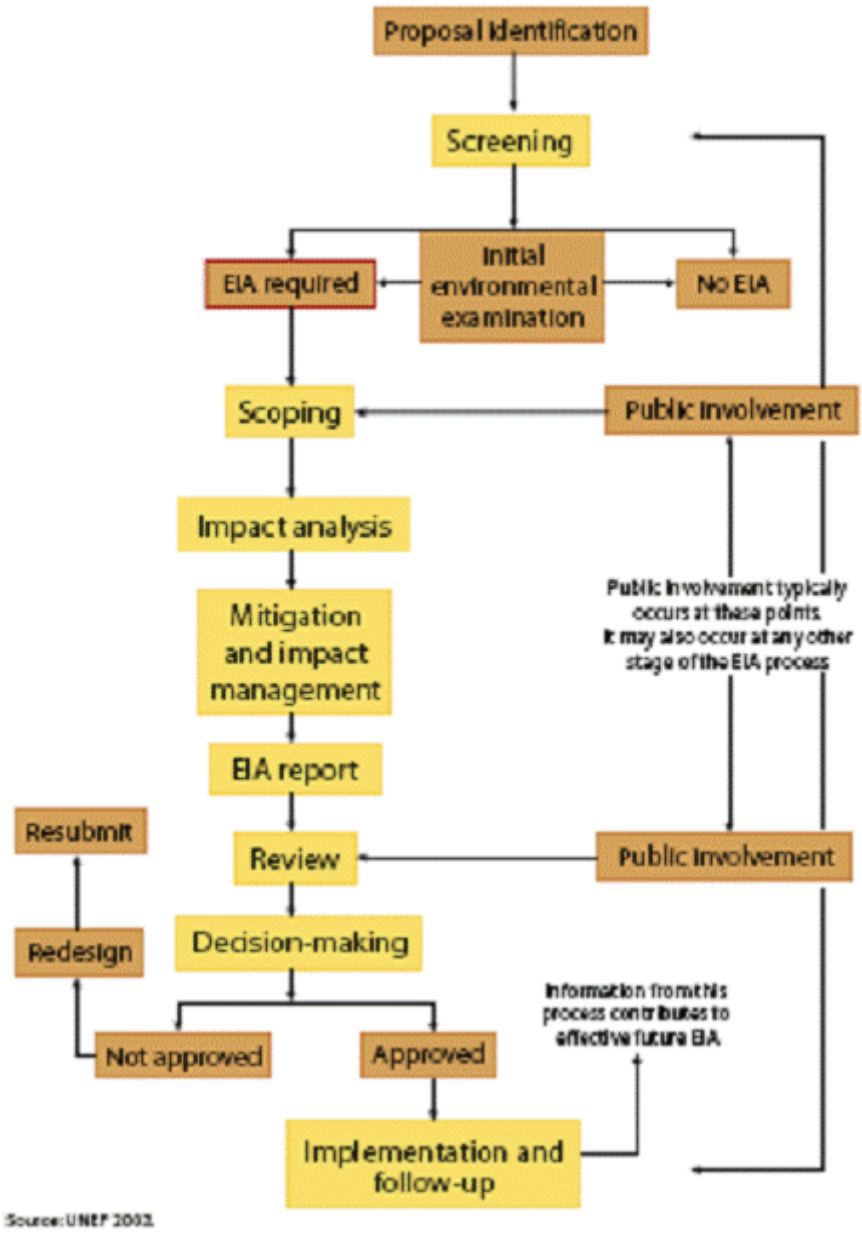

Figure 1. Steps in the EIA Process

Table 1. Integration of EIA and the Project Cycle

Project life cycle	EIA life cycle
Pre-feasibility	Screening
Site selection	Scoping
Feasibility	Impact assessment
Board decision	Authority approval
Detailed design	Environmental management plan
Construction	Audit
Operation	Monitor and audit
Closure	EIA for closure

Source: "EIA in Southern Africa", SAIEA, 2002

The basic steps for performance of EIA, regardless of location and regulations, are:

• ***Screening***

Screening is the process of determining whether or not an individual project proposal requires a full-scale EIA and what the level of assessment should be. In some countries, an initial assessment is used when there is uncertainty regarding the scale of study required or where there is a small amount of information required to take the decision. Most countries have lists of activities for which EIAs are required (e.g. mining or major construction works). In addition, some countries have identified sensitive environments (e.g. estuaries or cultural heritage sites) for which EIAs are needed.

• ***Scoping***

Scoping determines the nature and extent of the required impact assessment. This phase entails the identification of issues that are likely to be important during the EIA and eliminates those that are not. Scoping usually involves interaction between the public, government departments and proponents who assist in the identification of key issues for investigation. The scoping report forms the basis for the terms of reference for the impact assessment (or analysis) phase.

• ***Impact Assessment***

The objective of this phase is to identify how the activities of the proposed development will impact on the various components of the environment. The impact assessment entails the identification and analysis of impacts as well as a prediction of the significance of the impacts. Both negative and positive impacts are assessed.

• ***Mitigation Planning***

Mitigation entails the identification of ways in which negative impacts can be avoided or minimized to limit costs, and ways in which positive impacts can be enhanced to ensure maximum benefit. Note that the Environmental Management Plan (EMP), discussed later, is in part designed to monitor and assure compliance with commitments of the Mitigation Plan.

• ***Reporting***

A single EIA report is produced and contains the integrated findings of the impact assessment and mitigation studies. This report is used by the authorities in decision-making.

• ***Reviewing***

In all jurisdictions, the authorities must officially review the EIA report and decide if it is of an acceptable standard. To improve rigor and ensure that relevant information is captured and reflected, the process often includes review by the public and independent specialists prior to finalization and decision-making.

• ***Decision-making***

Decision-making refers to the final approval or authorization of the proposal. It usually includes a series of conditions under which development may proceed. The conditions are often translated into the management plan for the project.

• ***Implementation***

If the development is approved, the developer will be required to implement an EMP for construction, operation and, in some instances, decommissioning of the project. As previously stated, the EMP is the tool used to ensure that the mitigation actions and the monitoring requirements recommended in the EIA are systematically implemented throughout all phases of the project. This often-neglected aspect of EIA ensures delivery on promises.

EIA processes are fully compatible with the generic development cycle (Table 1). The internationally accepted key steps of EIA described above (screening, scoping, assessment, decision-making and implementation) are followed in most SADC countries

While each of the SAPP member countries has specific environmental impact assessment (EIA) and social impact assessment (SIA) requirements of varying specificity with respect hydroelectric power projects, the approach to performing the EIA and SIA is much the same from country to country and agency to agency. The following subsections provide summaries of how and why an EIA and SIA should be performed as well as guidance that will be useful in complying with country- and bank-specific requirements presented in later sections of the report.

4.1 EIA BACKGROUND

4.1.1 Definition of an EIA

An Environmental Impact Assessment (EIA) is the documented, systematic assessment of likely environmental impacts resulting from the construction and operation of a proposed project, plan, or policy. The EIA addresses impacts on air and water quality, soils, flora and fauna, sensitive habitats, socio-economic factors, cultural, historical, archaeological and palaeontological assets, and human health and welfare. The EIA considers not only the predicted impacts of the proposed project, but also the current state of the environment, the net result of construction and operation, and the sustainability of a proposed project.

4.1.2 Why an EIA is Performed

Most countries, development assistance agencies and finance institutions require an EIA for construction and operation of hydroelectric power plant projects in which they are involved, or for which they must grant authorization. The EIA predicts the impacts of a proposed project on net environmental quality and recommends mitigation measures to assure that the environment is

not degraded beyond acceptable limits. The long-term objective is to ensure sustainable economic development in the power generation sector while protecting the needs of future generations. In the case of development assistance agencies and banks, the countries funding those entities require adherence to reasonably stringent environmental standards as a condition of funding or provision of technical assistance.

4.1.2.1 Country-Specific Statutory Requirements

The regulatory basis for the performance of an EIA is currently at the country level. Regulations vary considerably among countries. Country-specific statutory requirements (statutes, laws, or regulations) of SAPP members, where available, are provided in the companion report, "Environmental and Social Impact Assessment Requirements for Hydroelectric Projects in SAPP Member Countries, and of Relevant Development Assistance Agencies, Banks and the World Commission on Dams", hereinafter referred to as the "EIA Country Guide".

Statutory requirements also govern the maximum allowable impacts and net impacts on air quality, water quality, noise levels, and maximum allowable discharge or emission limits at the source. Information on environmental quality and discharge standards or guidelines for SAPP member countries also are presented in the EIA Country Guide.

Where country-specific EIA processes and guidelines, as well as emission and effluent standards and guidelines are not in place, it is common practice to refer back to World Bank guidelines. Limits on air pollutant levels, air pollutant discharges, water quality, wastewater discharge, and noise, as prescribed by the World Bank are also presented in the EIA Country Guide.

4.1.2.2 Development Assistance Agency Requirements

Development Assistance Agencies (DAAs), such as the US Agency for International Development (USAID), the Danish International Development Agency (DANIDA), and the Canadian Development Assistance Agency (CIDA), may assist in the development of a hydroelectric power project through technical assistance, grants or loans. Many development assistance agencies require that a project comply with certain environmental criteria as a requirement for receipt of funding or other assistance. Demonstration of compliance is provided by the EIA. In fact, one form of assistance that development assistance agencies often offer is the performance of the EIA. Requirements of CIDA, DANIDA and USAID are presented in the EIA Country Guide.

4.1.2.3 Financial Institutions

International finance institutions (IFIs), such as The World Bank (WB), African Development Bank (AfDB), Development Bank of Southern Africa (DBSA) and other commercial finance institutions typically require performance of an acceptable EIA as a condition of funding or assistance. Although the requirements of finance institutions are not regulations, they are definitive requirements that must be met in order to obtain financing or technical assistance and are therefore critical to the approval and success of a hydroelectric power project.

An additional requirement for financial institutions other than IFIs has also recently been developed in the form of the Equator Principles (http://www.equator-principles.com) as adopted by over 40 of the major lending institutions Worldwide as of February 2006. The Equator

Principles require the performance of an International Finance Corporation (IFC) compliant EIA as a condition of lending. The purpose of this EIA is to better and more consistently manage the financial risk associated with the environmental and social impacts of hydroelectric development. The Equator Principles however, allow greater flexibility on the lender's part as to what constitutes appropriate control and mitigation technologies which in turn depend on the lender's confidence in a technology and appetite for risk therein. Many independent financial institutions also have their own internal guidelines for EIAs.

At present, neither WB's Pollution Prevention and Abatement Handbook (PPAH) or IFC's Environmental Health and Safety (EH&S) Guidelines address hydroelectric projects. This reflects the current reluctance of these entities to become involved in such projects as well as the high construction costs of these projects. This may change in future.

Power transmission projects, which could be part of an overall hydroelectric project, are addressed in the IFC's EH&S Guidelines. For reference, the most current versions of the PPAH and EH&S Guidelines are accessible on line at:
http://ifcln1.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines/

4.1.2.4 World Commission on Dams Recommendations

In April 1997, with support from the World Bank and the IUCN - The World Conservation Union, representatives of diverse interests met in Gland, Switzerland to discuss the role of large dams in economic development programs in light of reactions to a report by the Operations Evaluation Department (OED) of the World Bank.

The consensus proposal that came out of the meeting was for all parties to work together in establishing the World Commission on Dams (WCD) with a mandate to review the development effectiveness of large dams and to develop internationally acceptable criteria, guidelines and standards for large dams.

The final report of the World Commission on Dams - Dams and Development: A New Framework for Decision-Making was presented to its founding partners - the World Bank and IUCN - as well as the international community on November 16, 2000. The report represents an important start in ushering in an era where constructive dialogue and consensus overrides division, polarization and inertia. The result is a milestone in the evolution of dams as a development option that offers a clear charter for the future; a charter by which every dam in the world can, and should, measure itself. The full report can be downloaded, or requested in hard copy or CD format at http://www.dams.org/

The Commission's final report consists of two components - the 'global review' and the 'way forward'. The global review concentrates on the performance of dams and presents an integrated assessment of when, how and why dams succeed or fail in meeting their development objectives. The 'way forward' provides a new framework for decision-making based on the recognition of rights and an assessment of risks.

Seven strategic priorities and corresponding policy principles for water and energy resources development show how to: gain public acceptance; assess options; address existing dams; sustain rivers and livelihoods; recognize entitlements and secure benefits; ensure compliance; and share

rivers across boundaries. Practical guidance on implementing these priorities is provided through a set of criteria for five key decision points in the planning and project cycle together with a set of 26 guidelines based on examples of good practice from around the world.

In writing the report, the Commission recognized that it would not be the final word, but represents the start of a new process of re-evaluation, constructive multi-stakeholder discussions and implementation and adaptation of the guidance provided to suit local contexts.

The recommendations of the World Commission on Dams (WCD) are summarized in the EIA Country Guide.

4.1.2.5 Project Proponent Requirements

Project proponents (developers) may also require the performance of an EIA as a means of managing the future risk of environmental impact liabilities associated with their projects. Many countries also require that companies registered in their country comply with certain environmental requirements when engaging in business in other countries.

4.2 WHICH HYDROELECTRIC POWER PROJECTS REQUIRE AN EIA?

An approved EIA is required prior to commencement of construction or operation of major projects, such as airports, highways, major industrial facilities, and hydroelectric power generation projects. The World Bank system for determining requirements for an EIA is generally followed in one form or another Worldwide. It is recommended that the WB project classification system, which assigns a project to one of three project categories, be used in determining the need for EIA. That system is as follows.

4.2.1 Category "A" Projects

Impacts of Category "A" projects are expected to be 'adverse, sensitive, irreversible and diverse', with attributes such as pollutant discharges large enough to cause degradation of air, water, or soil; large-scale physical disturbance of the site or surroundings; extraction, consumption or conversion of substantial amounts of forests and other natural resources; measurable modification of hydrological cycles; use of hazardous materials in more than incidental quantities; and involuntary displacement of people and other significant social disturbances. Hydroelectric power projects of greater than 50 MW capacity always fall into this Category. Smaller projects or schemes whose aggregate impacts are significant may also fall in to this Category. Smaller projects may also be classified as Category "A" if local environmental impacts exceed local standards or World Bank guidelines. An EIA is always required for Category "A" projects.

4.2.2 Category "B" Projects

Category "B" projects have impacts that are 'less significant, not as sensitive, numerous, major or diverse. Few, if any, impacts are irreversible, and remedial measures can be more easily designed.' Typical projects include rehabilitation, maintenance, or upgrades, rather than new construction. Smaller projects (small dams, micro- and mini-hydroelectric schemes) and retrofits, repowering or minor upgradations typically fall into this category. Although a full EIA is not always required, some environmental analysis is necessary.

4.2.3 Category "C" Projects

Category "C" projects result in negligible or minimal direct disturbance of the physical environment. Typical projects include education, family planning, health, and human resource development. Only stand-alone micro- or mini-hydroelectric projects are likely to fall into this Category. No EIA is required.

4.2.4 Other Triggers of Requirement for EIA for Hydroelectric Power Plant Projects

An EIA may be also be required by other occurrences in addition to outright construction of a new hydroelectric power plant. Such triggering events may include the following.

4.2.4.1 Changes in Policy

A sectoral or regional EIA may be required because of proposed changes in energy policy, fuel economy, or realignment at the sectoral or regional level. Overall impacts, in terms of regional emissions and effluents and transboundary impacts should be considered in this instance. If policy changes result in major modifications to certain facilities or changes in fuel type, then EIA at the plant level may also be required.

4.2.4.2 Refurbishment or Relicensing

Refurbishment (modification/upgrade) of a hydroelectric power plant, to the extent that there is reason to expect a significant change in effluents and impacts, should result in requirement of an EIA. SAPP member country regulatory bodies have not determined the cut-off for what is considered significant with respect to changes in pollutant discharges or impacts or investment as a percent of the capital value of the existing plant. However, finance institutions will likely require an EIA if the refurbishment is substantial enough to require outside financing or has an adverse impact on the local environment.

Relicensing may also be required on change in ownership or upon expiration or revocation of the operating license. As such, an EIA would likely be required either from the statutory perspective or as an exercise of environmental due diligence by the acquiring party, or both.

4.2.4.3 Decommissioning

An EIA of a different sort, also referred to as an Environmental Site Assessment (ESA) may be required in the event of project decommissioning. Such an EIA would be a Phase 1 (desk study) and Phase 2 (field sampling) audit of environmental contamination applicable to activities that would occur as a result of decommissioning, e.g., demolition and continued environmental contamination as a result of existing pollutant loadings in the soil, water, or associated waste disposal sites.

4.3 WHO PREPARES, REVIEWS, AND APPROVES AN EIA?

Project proponents typically pay for and prepare the EIA. In some instances, the power generation equipment supplier may be required to prepare the EIA or may in fact prefer to do so in order to maintain control over commitments made with respect to equipment performance and

commitments to limits on emissions, effluents and other discharges. The host country may opt to perform a parallel EIA to assure agreement with the findings of the independently produced EIA.

It is also generally useful and productive to solicit unofficial reviews by the finance institution(s) and regulatory agencies prior to official submission of the EIA to identify discrepancies, errors, or omissions that might otherwise delay its official review. The EIA must be reviewed, negotiated, and approved by the host country's government. In the case of external financing, the EIA must also be approved by the finance institution(s).

SAPP may wish to establish a review function for all hydroelectric EIA projects proposed for SAPP member countries to further assure consistency in approach and application of rules, regulations and the intent of international and regional treaties and agreements.

4.4 PERFORMING THE EIA

The EIA process starts with identifying the need for a project and a general or specific determination of location. In the case of power projects, this is based on demand forecasts with the location of the project obviously depending first and foremost on hydrological resources and then available infrastructure and optimal points of interconnection to the grid. A Preliminary EIA or screening analysis should be undertaken to identify serious or fatal flaws in the project and to identify data gaps with regard to information required to conduct the EIA.

Prior to start-up of the Preliminary EIA, it is good practice to identify the information and tasks required during the full EIA. Many tasks are independent of each other, some are dependent and others may require considerable time to complete. It is advisable to identify information and data requirements and schedule acquisition thereof to reduce the time required to complete the EIA.

If the project is determined to be feasible (based on information available at this stage), a scoping process is undertaken to further develop and agree on the terms of reference (TOR) for the EIA. The scoping process should include representatives from government, participating finance institutions and development assistance agencies, project proponents, recognized non-governmental organizations (NGOs) and affected communities.

The EIA is executed in accordance with the terms of reference developed during the preliminary EIA and scoping process. Upon completion, the EIA is submitted to the appropriate government departments, agencies, and organizations for review and approval. If approved, the project proceeds to construction and operation.

The EIA also includes an Environmental Management Plan (EMP). The EMP presents the environmental and associated impacts identified during the EIA and establishes, through specification of mitigation measures and monitoring requirements, the means by which compliance with environmental standards and guidelines is assured during construction and operation of the project.

Changes in project design may occur or new information may become available after approval of the EIA. Therefore, periodic review of the EMP is required to assure that mitigation and monitoring measures remain relevant and appropriate to the project.

The best overall summary of performing the EIA is as presented in the WB Multilateral Financial Institutions (MFI) Working Group on Environment (WGE) proceedings of January 2003, the report from which can be found at http://www1.worldbank.org/harmonization/romehlf/Background/MFI%20Final%20Jan17%202003-Eng.pdf.

4.4.1 Contents of an EIA Report

The EIA focuses on important issues and reporting may be customized to particular problems. The proposed format for a regionally consistent SAPP EIA is presented in the following sections.

4.4.2 EIA Format

Adherence to a standard format and procedures will assure that EIAs are consistent from project to project or for multiple proposals for the same project. Such consistency will also facilitate comparison of projects and project alternatives and the building of a cumulative knowledge base with respect to existing environmental conditions emissions, effluents and impacts.

This section presents a framework for organizing an EIA for a hydroelectric power plant. It leads the user step-by-step through each component and explains: what is required; why it is required; how to develop or acquire the necessary information; and how to present it.

A model table of contents for an EIA is presented in Table 2, below.

Table 2. Model EIA Table of Contents

EIA SECTION
EIA Preliminaries Title Page Executive Summary Table of Contents List of Tables List of Figures List of Appendices and Annexes Terms, Acronyms, and Abbreviations
Section 1: Policy, Legal, and Administrative Framework
Section 2: Project Objectives and Description
Section 3: Baseline and Background Data
Section 4: Environmental Impacts of Construction
Section 5: Environmental Impacts of Operation
Section 6: Analysis of Alternatives
Section 7: Mitigation Plan
Section 8: Environmental Management Plan
Section 9: Institutional Strengthening Requirements
Section 10: Conclusions
Section 11: Recommendations
Section 12: Tables and Figures

Appendices Appendix A: List of EIA Preparers Appendix B: List of References Appendix C: Record of Interagency Meetings Appendix D: Record of Public and Stakeholder Involvement

A detailed description of the contents of each section follows.

4.4.2.1 EIA Preliminaries

The title page and executive summary should precede the table of contents. The table of contents should follow the organizational framework provided in the model table above. Note that when certain considerations do not apply, a negative declaration must be made and the bases for such a declaration stated and substantiated.

The executive summary should present a succinct overview of the project and should include:

- Name, location, size (MW rating), and source(s) of water to power the hydroelectric facility;
- Project proponents;
- Sources of funding;
- Significant impacts; and
- Compliance status with respect to applicable standards and guidelines.

4.4.2.2 Section 1. Policy, Legal, and Administrative Framework

This section introduces the project and provides a brief overview of:

- History and bases of the project;
- Names of project proponents, partners, and heavy equipment suppliers;
- Project need;
- Project location;
- Regulatory applicability;
- Impacts assessed;
- Summary of significant environmental impacts;
- Measures employed to mitigate or minimize environmental impacts;
- Details of the team performing and the source of funding for the EIA; and
- Status of the EIA – to whom it will be submitted, the review cycle, and next actions.

4.4.2.3 Section 2. Project Objectives and Description

The project objectives should detail what is to be achieved by the project, e.g., improve grid reliability, extend the grid, provide flood or regulation control in addition to power generation,

etc. The description should provide details of: the project team, a brief verbal description of the proposed site of the project, processes and fuels to be used, facilities to be constructed, infrastructure requirements, and a statement about the project need. The project description may also provide names of sources or proposed sources of funding. This will substantiate the need for certain considerations in the performance of the EIA.

4.4.2.3.1 Project Team

The names and countries of incorporation of the project proponent(s), design engineers, engineer-procure-construct (EPC) contractor, major subcontractors and consultants, heavy equipment suppliers, and sources of financing should be provided in this section.

4.4.2.3.2 Site Description

The site description, in terms of geographic location, surrounding topography and current land use and ownership should be provided here. Maps of regional and local scale, including topography, should also be presented with the proposed and alternative locations of the project clearly marked.

Maps can be obtained from geological survey offices, government offices for the interior, research organizations and project proponents. Geographical Information System (GIS) datasets available for southern Africa also provide information for the EIA process, including land use/groundcover, transportation, topography, demography, locations of major industrial facilities, emission and effluent 'densities' per unit area and hydrology.

A panoramic series of 12 photographs, taken from the centre of the proposed plant site and centered on 30º radials (0º, 30º, 60º… 330º), should also be included and properly labeled stating the point of origin and direction of the photograph. Digital photography makes such a presentation both easy and useful.

4.4.2.3.3 Process and Facilities

A written description of the processes proposed and the facilities that must be constructed for the proposed project is presented here. A plan presenting at least the schematic layout should also be provided and cross-referenced to the process flow diagrams.

Process

The processes to be employed in the hydroelectric power plant, including water treatment, pollution control, pollutant discharge, and waste disposal are presented here. Process flow diagrams should also be presented at a level of detail that does not disclose proprietary information. Fuel use rates and mass and water balances should also be superimposed on the diagrams and/or summarized in tabular form. The project proponent(s) should provide the process flow diagrams and may need to acquire various portions from the providers of equipment and proprietary technology. Certain processes may not be described in detail, particularly if they are proprietary and subject to nondisclosure agreements.

Facilities

This section requires a description of the facilities required in addition to the power plant. Their functions and capacities should be presented in written descriptions cross-referenced to the

appropriate plant plans. Typical facilities include water and wastewater treatment, chemical and fuel storage, fire fighting, onsite roadways, materials handling, and plant management and control.

4.4.2.3.4 Infrastructure Requirements

Infrastructure requirements, such as access and transportation to the site, power transmission to and from the plant, delivered water requirements, housing, schooling, and medical facilities should be described here.

4.4.2.3.5 Project Need

Project need is based on current and projected demand as well as the evaluation of other development alternatives. The project must also satisfy financial and economic requirements of the government, finance institution, and project proponents. Existing and projected capacity and demand curves and maps showing areas to be serviced should be included here.

4.4.2.3.6 Applicability of Regulatory and Other Requirements

Regulatory applicability should be summarized in this section. Potentially applicable regulations and finance institution requirements should also be presented accompanied by a brief statement of the bases of applicability or lack thereof.

Regulations cited should include the full name of the regulation, law, or ordinance and the responsible agency/government office. Details of this section will be determined by the location of the project, governmental jurisdictions and sources of project funding.

4.4.2.4 Section 3. Baseline and Background Data

In most instances, data on existing conditions is essential to determining the current state of environmental quality and subsequent determination of the level of environmental change that will likely result from construction and operation of the project. In many cases existing data are not available. Such data deficiencies should be identified in the Preliminary EIA and efforts must be undertaken to acquire or develop the required data in a timely manner.

Baseline and background data should provide a concise description of the relevant physical, biological and socio-economic conditions within and adjacent to the project. It is advisable to collect data as soon as possible in the EIA process so that long lead-times (if present) are accommodated within the project scheduling and data can be made available when needed.

Typical baseline and background data should include the following.

4.4.2.4.1 Physical and Chemical

Existing physical and chemical conditions include descriptions of the local geology, soils, topography, climate and meteorology, air and water quality and presence of solid waste disposal facilities.

Geology and Soils

Local geology, soil surveys, results of previous or current soil borings and soil analyses (including sieve size classification for subsequent use in estimation of windblown dust) is presented here. Availability of such data is highly variable and depends on the level of prior industrial and survey activity in the area.

Potential sources of information include the host country's governmental departments responsible for mining/minerals and agriculture, geological survey offices, academic textbooks, reference books, academic institutions and research organizations. Satellite imagery and aerial photography with false-color enhancement may also be useful in determining geology and soil types.

Climate and Meteorology

Climate is essentially the long-term meteorology of an area. Meteorology is typically presented as summary statistics but is also required as hourly or 3-hour observations of wind speed, wind direction, temperature, mixing height and atmospheric stability.

Climatological summaries are typically available from governmental offices responsible for measurement and reporting of weather. Several reference books also provide such summaries. For example, 'Climates of the World' is an excellent source but is currently out of print. Similar books exist on regional climatic patterns and meteorology.

Meteorological data should be obtained from the nearest representative reporting station. Such stations are typically at airports or research facilities. At least one year of hourly surface and upper air data are required for dispersion modeling applications. If only 3-hour data are available then algorithms are available to post-process existing data and interpolate the missing data. Upper air data may be obtained from a reporting station at greater distance, as upper atmospheric conditions do not typically change as quickly over distance as does surface data.

If no hourly meteorological data are available, data must be collected or an agreement reached with the regulatory and other approving organizations to allow surrogate data from another similar area to be used, or to allow the use of more conservative screening modeling approaches if air quality is expected to be an issue during construction or operation.

Topography and Landforms

Useful topographic data are most often presented on maps of sufficient resolution to determine local three-dimensional aspects. Brief narrative descriptions accompanied by one or more topographic maps that also show the location of the proposed project are appropriate.

Landforms are more general features such as: mountains, deserts, plateaus, swamps, and shorelines. A general description of the surrounding landforms and indications of location on a 1:250,000 or 1:500,000 map should be sufficient. Maps should always identify the project location.

Maps can be acquired from the host country's survey offices or local authorities. Aviation maps/Tactical Pilotage Charts (TPC) can be obtained from the host country's authority responsible for aviation or from the US Geospatial Intelligence Agency (formerly US Defense

Mapping Agency)—the latter may however not be of sufficient resolution for refined air pollutant dispersion modeling exercises. Such data are also increasingly available in digital format. Cartographic data for some areas may be difficult to acquire due to security concerns.

An aspect of land forms and topography that needs clarification in the EA is the stability of the area in terms of seismic activity and susceptibility to earthquakes and other events. In cases where a dam is huge, the added weight of the water in the dam might expose weak points in the topography and lead to a catastrophic accident.

Air Quality

Data on existing air quality are highly variable in availability and reliability. Data should include both short-term and long-term averages in accordance with applicable standards.

In the absence of acceptable existing air quality data, measurements may be required. In the interim, estimates of existing conditions based on the emissions inventory of the area or air quality in similar or adjacent areas may be acceptable.

Acceptance of existing air quality estimates may be contingent upon the commitment to collect representative onsite air quality data during the construction and operation of the project. Adjustment of net air quality estimates based on new data acquired may be needed.

Noise

It is unlikely that existing noise data will be available. Measurements should be taken at the plant site and at sensitive receptors prior to commencement of construction.

Measurements should typically be taken using a Type 2 sound level meter (SLM) and recorded as dB(A). Monitoring should typically be conducted three times per day at each location, on a weekday, and on a weekend. Locations at which measurements were taken should be noted on a base map. The majority of noise impacts will likely occur during the construction phase.

Hydrology

Existing surface and subsurface hydrology must be documented as hydroelectric power plants obviously depend on, and impact, local hydrology. Documentation of hydrology should include surface and subsurface profiles, maximum, minimum, and mean flow rates, seasonal and cyclical variability of hydrology resulting from meteorological and climatological factors and current and expected future demands on water resources.

Sediment

The sediment profile of the river needs to be well understood as some rivers carry sediment in suspension whilst others carry “bottom-load”. Also, this can change according to seasons (flood or drought). Understanding sediment regimes is essential as this will enable engineers to design sediment traps, bypass systems etc. Furthermore, some rivers rely substantially on a free flow of sediments to sustain downstream ecosystems (e.g. the Okavango) and disruption of sediment flows could be a fatal flaw from an ecological perspective. Measuring sediment movement can be a tricky business as methodologies vary and results can be unreliable or contested.

Water Quality

Data on existing water quality can typically be obtained from the governmental office responsible for water but are highly variable in availability and reliability. In the absence of acceptable existing water quality data, measurements may be required. In the interim, estimates of existing conditions based on the emissions inventory of the area or water quality as measured elsewhere in the receiving body of water may be acceptable.

Acceptance of existing water quality estimates may be contingent upon the commitment to collect representative water quality data during the construction and operation of the project, and adjustment of net water quality estimates based on new data acquired.

Solid Waste

Information on existing sources of solid wastes and capacity of disposal facilities should be presented here. This information should be cross-referenced to descriptions of solid waste disposal facilities, or may also be described under the sections on infrastructure.

4.4.2.4.2 Biological

Existing biological conditions include the presence and distribution of indigenous and migratory animals, and indigenous plants. Known sensitivities of species or surrogate species should also be stated.

Data on biological aspects can typically be acquired from the governmental offices responsible for environment/conservation. Additional data are available from: academic institutions and research organizations, specialists in the field, various NGOs, local inhabitants with knowledge of the affected region, and from publications such as academic textbooks on the subject.

Flora and Fauna

Available data on flora and fauna should be collected and individuals knowledgeable about local species and habitats should conduct a field survey of the site. It is also important to note the occurrence and trends of alien (invasive and non-invasive) species, as these often concentrate in river systems. Rivers, dams and downstream wetlands are usually vulnerable to infestation by alien species.

Sensitive Habitats

Sensitive habitats include those that support rare or endangered plants or animals. Sensitive habitats may include those of common species on which rare or endangered species may depend. Sensitive habitats may also include areas critical to natural migration routes, reproductive activities as well as areas that support important ecological processes (e.g. wetlands, catchments, etc.). Consideration of sensitive habitats is particularly important in Southern Africa due to the distribution of wild game and the economic importance of eco-tourism and hunting.

Wild or Endangered Species

Wild or endangered species are as listed in the CITES documents or described by the IUCN in the Redbook Series or similar publications/lists produced by the host country. Range, domain, and population estimates of wild or endangered species in the area of the proposed project should be presented in at least tabular form and as range maps when possible.

4.4.2.4.3 Socio-Economic

Existing socio-economic conditions prior to construction and operation of the project should be summarized in this section. This summary will serve as a baseline for estimating changes in local socio-economic status. The demographics of the project area and area of environmental impact, e.g., population by age, gender, tribe, language, and income should also be determined and presented. Data can be obtained from governmental offices responsible for internal affairs/health/ economic development/trade/industry and from research institutions dealing with population and statistics.

Demographics

A new development may result in changes in the local socio-economic situation due to the associated arrival of work crews and their families, increased local incomes and changes in prices of certain commodities based on changes in demand. Increases in production due to increased demand and ability to pay for goods and services may cause price increases to local individuals who otherwise derive no income or benefit from the project. A common issue relating to the arrival of an "outside" workforce is the proliferation of sexually transmitted diseases (especially HIV and AIDS). This issue features prominently in the EMP of mega-projects such as hydro schemes.

Land Use

General land use patterns (e.g., housing, croplands or grazing, unimproved veldt, and plantations) should be documented and mapped prior to construction and operation of the project. Projected land use changes should be noted in the corresponding report sections dealing with construction and operation-related impacts. Changes in land use will also affect local socio-economics. Satellite imagery and maps of land use and ground cover can be obtained from a variety of sources, including government offices responsible for agriculture/ environment/ surveying, research organizations and, in some instances, from tax authorities.

Water Resources

Water resources may be critical to agricultural and existing industrial use. Current (baseline) demands on water resources must be inventoried and use of water resources by the proposed power plant estimated to assure that current and future demands on water resources are not compromised by the demands of the hydroelectric power plant. Discharges by other users upstream, as well as the impacts of thermo-chemical discharges on users downstream, must be considered. Consumptive use and dilution of the thermo-chemical plume must be evaluated at minimum flow or volume of the source and receiving waters.

Infrastructure

Large development projects, such as hydroelectric power plants place significant demands on local infrastructure. Infrastructure assets impacted may include: railways, roadways, housing, schools, health care, food production, process and potable water supply, wastewater treatment and fuel delivery systems.

Existing infrastructure should be documented in this section, to serve as the basis for estimating the impacts of increased demand resulting from construction and operation of a hydroelectric power project.

Economy

An overview of the economic conditions of the project area and areas to be influenced by the project should be developed. The inventory should include the following information:

- Annual economy of the project area (township, municipality, province, state or region);
- Primary sources of revenue;
- Size of the workforce;
- Unemployment level (including under-employment);
- Special skills of the local workforce;
- Recent employment history of the area, as it may explain the current economic situation;
- Per capita income, average and by occupational sector; and
- Current tax base.

Estimated economic impacts will be superimposed on the existing economy in the assessment of economic impacts of construction and operation of the hydroelectric power plant.

Cultural and Archaeological Resources

All known cultural and archaeological assets within the arc of impact (nominally a radius of 10 to 50 kilometers) of the project should be catalogued and plotted on a base map for future reference under the sections on impacts of construction and operation of the hydroelectric power plant.

In the case of onsite cultural and archaeological assets, special attention must be paid to avoid damaging or compromising access to such assets. Plans should also be developed for how to handle the discovery of previously unknown cultural or archaeological assets, e.g., graves, religious sites, artifacts, or fossil remains.

4.4.2.5 Section 4: Environmental Impacts of Construction of a Hydroelectric Power Plant

The following activities may cause environmental impacts during construction of a hydroelectric power project:

- Site clearing;
- Civil works such as earth moving and building of structures;
- Emissions from heavy equipment operation;
- Emissions from onsite processes such as batch plants for cement and asphalt;
- Burning of wastes, refuse, and cleared vegetation;
- Generation of sewerage;
- Generation of wastewater and site runoff;

- Disposal of construction wastes;
- Noise from heavy equipment operation;
- Influx of construction workers; and
- New infrastructure or increased use of existing infrastructure or resources, e.g., roadways, rail lines, pipelines, wells, and mines.

4.4.2.5.1 Physical and Chemical

Physical and chemical impacts of hydroelectric power plant construction include those on geology, soils, topography, landforms, and meteorology and in some instances climate, air and water quality and noise. Potential environmental impacts and how to determine and present estimates are as follows.

Geology and Soils

Soil disturbances and impacts on local geology will occur mainly as a result of site preparation activities, including blasting, drilling, and delivery of fill and disposal of excavated or scrapped materials. Secondary effects may occur due to erosion and windblown fugitive soil. Processes employed and expected impacts are presented in this section.

Topography and Landforms

Although topography and landforms are documented in the section on existing conditions, hydroelectric power projects rarely have primary impacts of such scale. Local topography may be altered, but rarely beyond the boundaries of the facility fence line. Impacts on landforms such as swamps and shorelines may occur as a result of thermo-chemical plumes (cooling and process water discharge) but with proper planning and precautions such impacts are rare.

Climate and Meteorology

Impacts on the microclimate and meteorology of the local area may be caused by changes in surface albedo and aerodynamic disturbances.

Air Quality

Air quality emissions problems may result from the following site clearing and construction activities:

- Fugitive windblown dust;
- Internal combustion engines in heavy equipment and onsite power generators; and
- Burning of vegetation and other refuse.

Fugitive dust emissions can be estimated based on soil sieve size analysis, relative humidity, soil moisture content and wind speed and direction. Several computerized models exist for estimating offsite impacts of fugitive dust and vehicular emissions. Selection of the appropriate model will depend on regulatory requirements or guidelines, local topography and averaging periods required by the applicable standards.

Results of dispersion modeling should also be presented in graphic form, both for project managers and for ease of public perception of locations, gradients, and amounts of local impacts. Such a presentation is composed of isopleths connecting areas of like concentration overlaid on a base map.

Noise

Noise impacts may occur as a result of operation of heavy equipment, pile drivers, and onsite power generation. Noise levels should be determined prior to commencement of construction of the hydroelectric power plant to establish existing (or baseline) conditions. Estimated noise level

outputs can be obtained from guideline documents, equipment manufacturers or from similar EIAs. Noise levels are then converted to sound pressure levels (SPL) attenuated over distance, added to the existing sound pressure levels at sensitive receptors and the fence line locations, and converted from resultant sound pressure levels to resultant dB(A) level.

If sufficient noise source data and existing data are collected it is also useful to produce an overlay of the project base map that presents isophons of noise levels (lines connecting points that lie within areas having the same noise level).

4.4.2.5.2 Hydrology

Groundwater

Groundwater issues during the construction phase are typically limited to:

- Consumptive use of groundwater, and
- Reinjection or percolation of wastewater.

Impacts should be based on projected use and discharge rates, local hydrology and interviews conducted with knowledgeable local residents who are familiar with local conditions.

Surface Water

Surface water issues are typically limited to:

- Consumptive use and diversion;
- Delivery to the project site;
- Generation of a sanitary waste stream;
- Construction waste and run-off; and
- Increased run-off due to removal of vegetation or alteration in local topography.

Impacts should be quantified based on projected use rates, site characteristics including surface hydrology, historical rainfall patterns and interviews conducted with knowledgeable local residents who are familiar with local conditions.

Results of thermo-chemical plume modeling of cooling and process water discharge should also be presented in graphic form. Such presentations are useful for project managers and to promote public perception of locations, gradients and amounts of degrees of local impacts of temperature, chlorine, waste oils and grease and other compounds as may be discharged. Such a presentation is composed of isopleths connecting areas of like concentration overlaid on a base map.

Water Quality

Water quality issues associated with power plant construction are minor with respect to subsequent issues that must be addressed under the operations phase of the EIA. Water quality impacts are classified under surface water or groundwater—or both as percolation of surface water may cause contamination of groundwater.

Solid Waste

Solid waste during the construction phase will consist primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam®, plastics, etc.) household garbage and sewerage.

4.4.2.5.3 Biological

The presence of local flora and fauna must be determined and evaluation of construction impacts made. Nesting and resting sites, migratory routes and ecologically important habitats must be identified and the effect on impacted populations stated.

Flora and Fauna

There should be no endangered flora and fauna on the project site; therefore, construction activities should have no impacts on such populations. To the extent possible, local flora should be left in its natural state. Animals may necessarily have to be removed for security and operational reasons.

Sensitive Habitats

The hydroelectric power plant should not be built in a sensitive habitat. Therefore, impacts of construction activities will likely be limited to road kills and impacts of construction noise.

Wild or Endangered Species

It is unlikely that a hydroelectric power plant would be approved on a site shared by endangered species; therefore this is unlikely to be a consideration during the construction phase of the project.

Ecosystems

Impacts of construction should be examined not only for direct impacts on plants and animals but also on how disruptions to native populations, land, and water flow might have secondary and tertiary effects on other plants and animals that depend on affected systems. Examples of ecosystem disruptions include:

- Removal or interference with prey of predatory animals;
- Reduced dissolved oxygen (DO) in receiving waters causing changes in population dynamics downstream of the effluent discharge;
- Siltation from run-off altering aquatic and marine flora and fauna populations and hence population dynamics of dependent organisms;
- Noises disrupting breeding behavior or use of breeding grounds resulting in shifts in population dynamics;
- Introduction of alien species (usually as seeds attached to earthmoving equipment); and
- Removal of predatory animals resulting in increased prey populations that exceed the carrying capacity of the local environment.

4.4.2.5.4 Socio-Economic

Demographic

Socio-economic impacts may occur as a result of:

- Influx of work crews and their families;
- Increase in local service industries such as restaurants, stores, other shops;
- Increased disposable income of local and non-local work crews;
- Displacement of individuals whose livelihood depends on the land that will be occupied by the project; and
- Increased demands on local infrastructure, such as utilities, housing, medical facilities, schools, water and food.

The social component of the EIA should also consider social development concerns, including involvement of interested and affected parties or their representatives in the EIA review. The EIA should also assure protection of the rights and privileges of poor and otherwise vulnerable persons in the area of impact.

Compensation

The need to consider mitigation measures or compensation payments to displaced persons may be required. Impacted persons and proposed methods of mitigating impacts or compensation considered should be covered in detail sufficient to assure equitable treatment of impacted parties.

Resettlement and Rehabilitation

If resettlement will be required it will be obvious during the planning phase. If resettlement is required, a resettlement plan should be developed and presented as part of the EIA so that affected parties, regulatory agencies and finance institutions may be apprised of the extent and terms of resettlement of displaced persons.

In the event the means of earning a living are disrupted, displaced parties should receive training to prepare them for alternative and suitable employment. In all instances, the resettlement plan must be presented and agreed to prior to the start of power plant construction.

Land Use

The primary changes in land use during the construction will be at the plant site and at locations of new or upgraded facilities or infrastructure installed to support the plant. As most plant sites are built on unimproved agricultural land, the shift in land use is typically from agricultural or range land to heavy industrial. Additional changes in land use may occur as a result of the development of new industries in the area constructed to take advantage of local, reliable and oftentimes cheaper electrical power.

Water Resources

Impacts of construction on local water resources are typically minimal and consist primarily of those resulting from:

- Production and pouring of cement;

- Human consumption and sewerage;
- Altered runoff patterns;
- Diversion into canals for cooling and process water and possible reduction of total flow in bypassed areas.

Estimated impacts should be stated in terms of volumetric flows, total consumption and consumption rates and pollutants discharged directly or indirectly to affected surface and groundwater.

Economy

Thorough estimates of impacts on local and regional economies should be made as such impacts may emphasize the local benefits of construction and operation of a new hydroelectric power plant. Conversely, such estimates may indicate negative impacts on local economies and mitigating measures should be proposed for such negative impacts.

Economic impacts from the construction of a new hydroelectric power plant may include:

- Jobs and resultant wages during the construction phase (though labor may also be brought in from outside if local labor is insufficient in quantity and skills);
- Negative impacts on local agriculture, tourism, or other industries that may be adversely affected by construction of a hydroelectric power plant; and
- A boom-bust local economy may result leaving unemployed or underemployed workers stranded after the construction phase.

Cultural and Archaeological

Cultural and archaeological resources that may be impacted during the construction process must be identified in the EIA. Procedures must also be established for notifying appropriate government authorities in the event cultural or archaeological materials are discovered during the construction process.

Infrastructure

Impacts on infrastructure during the construction phase are typically limited to:

- Increased use of roadways and highways connecting railheads, ports and terminals to the plant site;
- Increased demand for housing and food;
- Increased demand for water, health and sanitation facilities; and
- Increased demand on telecommunications facilities.

4.4.2.5.5 Occupational Health and Safety

Health and safety impacts of the project on workers and communities in the area of influence of the project must be reasonably managed in order to reduce the likelihood of accidents and work-related illnesses on the job as well as accidents occurring between construction-related equipment and local vehicles and pedestrians.

Worker Health and Safety

Worker health and safety can be assured through the development and implementation of standard workplace practices. These practices may already exist in the form of national standards analogous to the US Occupational Safety and Health Administration (OSHA) regulations. Such standards should be cited and committed to in this section of the EIA. The text should briefly describe how the regulations will be implemented and how compliance will be assured.

Community Health and Safety

Health and safety in nearby communities is assured through implementation of safe operating practices by site construction workers, evaluation of offsite impacts prior to start-up of construction and implementation of mitigation measures when appropriate. This may include restrictions on activities that produce loud noises during night time hours, restrictions on earthmoving and refuse burning activities to preclude downwind impacts on communities or sensitive receptors and installation and maintenance of adequate site security to prohibit entry by unauthorized personnel.

4.4.2.6 Section 5: Environmental Impacts of Operation of a Hydroelectric Power Plant

Environmental impacts from hydroelectric power plant operation will be far greater than those of construction and will therefore require greater effort to quantify and present. Impacts that must be quantified and reported include those on existing air, water and soil quality (as soil quality may significantly impact erosion rates and siltation) and the disposal of solid wastes. Long and short-term impacts on flora, fauna, human populations and the health and safety of workers in the surrounding community must also be considered. Primary sources of environmental impacts of hydroelectric power plant operation include:

- Excessive or emergency release of waters;
- Materials delivery, storage and handling;
- Vehicular traffic;
- Fugitive emissions;
- Wastewater; and
- Leaks and spills.

4.4.2.6.1 Physical and Chemical

Physical and chemical impacts of hydroelectric power plant operation include those on geology, soils, topography, landforms, meteorology and in some instances climate, air and water quality and noise. These impacts and a description of the methods and procedures to determine and present estimates are as follows:

Geology and Soils

Soil impacts will consist primarily of effects of windblown fugitive dust during construction and erosion, siltation or deposition following flooding.

Topography and Landforms

Local topography may be altered but rarely beyond the boundaries of the facility fence line. Impacts on landforms such as swamps and shorelines may occur as a result of inundation by an impoundment dam and upstream and downstream fluctuations in water levels.

Climate and Meteorology

Impacts on the microclimate and meteorology of the local area may be caused by changes in surface albedo and aerodynamic disturbances. Precipitation patterns may also be altered by increased evaporation and cloud formation.

Air Emissions

Air quality impacts during operation of a hydroelectric power plant consist primarily of windblown and reentrained dust. Air quality impacts are estimated based on the physical characteristics of the sources, the emission rates, particle size distribution in the case of PM, local meteorology and terrain.

Numerical plume dispersion models that assume steady state release and Gaussian distribution of the pollutant perpendicular to the plume centerline typically and conservatively, overpredict air quality impacts at most receptor points. Modeled impacts are then added to existing levels to produce estimates of net air quality. Results, which are typically produced in tabular form, should present worst-case impacts and locations for the regulated pollutants over the required averaging times (1 hour to annual depending on the pollutant and applicable standards).

Noise

Noise sources from hydroelectric power plant operation include:

- Operation of heavy equipment;
- Transfer and handling of materials (trucks and barges);
- Turbines;
- Fans and other air movers; and
- Vehicular traffic.

Estimated noise level outputs can be obtained from guideline documents, equipment manufacturers or from similar EIAs. Noise levels are then converted to sound pressure levels (SPL), attenuated over distance, added to the existing sound pressure levels at sensitive receptors and the fence line locations and converted from resultant sound pressure levels to resultant dB(A) level.

If sufficient noise source data and existing data are collected, it is also useful to produce an overlay of the project base map that presents isophons of noise levels (lines connecting points that lie within areas having the same noise level).

4.4.2.6.2 Hydrology

Groundwater

Groundwater issues during the operation phase are typically limited to:

- Waterlogging and raising or lowering of the water tables as a result of fluctuation of surface water levels.

Surface Water

Surface water issues are typically limited to:

- Consumptive use and diversion;
- Thermo-chemical plume impacts;
- Generation of sanitary waste stream by workers and staff, which may be discharged directly to or may run-off in surface waters; and
- Increased run-off due to removal of vegetation or alteration in local topography.

Impacts should be quantified based on projected use rates, site characteristics including surface hydrology, historical rainfall patterns and interviews conducted with knowledgeable local residents who are familiar with local conditions.

Water Quality

Water quality issues during operation of a hydroelectric power plant primarily involve turbulence, turbidity and an upsetting of the normal stratification by temperature, salinity and density. Discharge in addition to that required for generation of electricity typically contains oily waste, biological oxygen demand (BOD), chemical oxygen demand (COD), water treatment chemical and sanitary waste.

In addition to net water quality impacts, effluent sources are also subject to limits on quantities of pollutants discharged and concentrations or loadings thereof in the effluent. Limits consist of those imposed by the local environmental authorities, finance institutions and the water quality requirements of the project proponents as should be stated in the project design and performance requirements. Available water quality and pollutant discharge standards for SAPP member countries are presented in the respective country-specific sections of The Country Guide.

Surface Water

Operational impacts will typically be on surface water as this is the source of water for power generation and point of discharge from the dam. Impacts should be presented in the EIA as tabular results of modeling and isopleths of temperature and concentrations in the receiving waters if appropriate.

Groundwater

Groundwater impacts of concern are typically related to drawdown in the case of supply of process water from wells and from percolation into the groundwater from settling and sludge ponds and leakage of fuels, process chemicals or other compounds used onsite.

4.4.2.6.3 Solid Waste

There should be no significant generation of solid waste during the operational phase unless dredging and or removal of aquatic vegetation are required.

4.4.2.6.4 Biological

The presence of local flora and fauna must be determined and an evaluation of operational impacts made. Nesting and resting sites, migratory routes and important habitats must be identified, and the impacts on affected populations must be stated.

Air, water and noise impacts resulting from operation of the hydroelectric power plant must be overlaid on distribution maps of flora and fauna to assure that impact levels do not exceed known or expected thresholds of tolerance for flora and fauna present in the plant's area of influence. Data on the ranges, domains, sensitivities and tolerances of endangered or threatened species are typically available from local academic institutions, government agencies and local inhabitants. Additional and confirming information can be obtained from the local or headquarter offices of the International Union for Conservation of Nature (IUCN) or by referring to the IUCN Website or Redbook series on endangered plant and animal species.

Flora and Fauna

Effects on flora and fauna in the area of impact will result primarily from inundation, fluctuation in water levels and flow rates through the dam.

Sensitive Habitats

Special consideration must be given to the overlay of inundation zones on sensitive habitats. Long-term effects should be estimated based on current literature and studies and the effects should be stated in this section of the EIA.

Wild or Endangered Species

Special consideration must also be given to the overlay of inundation zones on the domains and ranges of wild or endangered species. Long-term effects should be estimated based on current literature and studies and stated in this section of the EIA. Secondary impacts on wild or endangered species must also be considered, i.e., changes in prey populations and plant food distribution.

Ecosystems

Operational impacts of the power plant should be examined not only for direct impacts on plants and animals but also on how long-term disruptions to native populations, land, and water flow might have secondary and tertiary effects on other plants and animals that depend on affected systems.

Examples of ecosystem disruptions include:

- Removal or interference with prey or predatory animals;
- Reduced dissolved oxygen (DO) in receiving waters causing changes in population dynamics downstream of the dam discharge;
- Siltation from run-off altering aquatic and marine flora and fauna populations and hence population dynamics of dependent organisms;
- Noises disrupting breeding behavior or use of breeding grounds resulting in shifts in population dynamics; and

- Removal of predatory animals resulting in increased prey populations that exceed the carrying capacity of the local environment.

4.4.2.6.5 Socio-economic

Demographic

Impacts of hydroelectric power plant operation on local human populations include socio-economic, health and mitigation for impacts or resettlement. These factors are discussed in further detail below and must be addressed in the EIA.

Socio-economic impacts of hydroelectric power plant operation may occur as a result of:

- Increased local population due to resident plant employees;
- Increased disposable income of plant employees and service industries that develop in response to local needs;
- Increased local industrial development as a result of additional power availability and reliability;
- Increased demands on local infrastructure, such as utilities, housing, medical facilities, schools, water, and food; and
- Spread of sexually transmitted diseases (especially HIV and AIDS) because of outside workers and power imbalances resulting from cash injections.

Compensation

The need for engaging in mitigation measures or payment of compensation to displaced persons, if required, will have likely been addressed during the construction phase, though actual mitigation and compensation may not occur until plant start-up. Impacted persons and proposed methods of mitigation of impacts or compensation considered should be covered in sufficient detail to assure equitable treatment of impacted parties.

Resettlement and Rehabilitation

If resettlement will be required it will be obvious very early in the planning and should be addressed then.

Land Use

Impacts on land use at the power plant site will have already occurred as a result of construction of the plant. Changes in land use and agricultural practices on adjoining and nearby properties may also occur as the result of shifts in population and the development of industrial parks or facilities that will use the more abundant and reliable power generated by the new power plant. Known and anticipated developments resulting from increases in local power generating capacity should be stated in this section.

Water Resources

Impacts on local water resources will be primarily as a result of consumption use of ground and surface water, and discharge of pollutants in the thermo-chemical plume. Impacts on local agriculture, livestock operations and industries or other human activities should be estimated and stated here.

Economy

Thorough estimates of impacts on local and regional economies should be made as such impacts may emphasize the local benefits of operating a new hydroelectric power plant. Conversely, such estimates may indicate negative impacts on local economies and mitigating measures for such impacts should be proposed.

Economic impacts of the operation of a new hydroelectric power plant may include:

- Jobs and wages resulting from ongoing operation of the power plant (though labor may also be brought in from the outside if local labor is insufficient in quantity and skills);
- Support service jobs and wages during operation of the power plant (although labor may be brought in from the outside if local labor is insufficient in quantity and skills);
- Creation or growth of local businesses due to increased employment, population and disposable income;
- New industries, jobs and economic inputs as a result of the proximity of reliable electrical power; and
- Negative impacts on local agriculture, tourism or other industries that may be adversely affected by construction and operation of a hydroelectric power plant.

Infrastructure

Long-term impacts on local infrastructure will depend on:

- The number of persons employed or displaced, hence increasing or decreasing demand for housing, schools, health care facilities, food, utilities, law enforcement and other public utilities.
- Impacts on existing infrastructure and estimates of changes in demand and how those demands will be met should be stated here.

Cultural and Archaeological Resources

Cultural and archaeological resources that may be impacted as a result of operating the hydroelectric power plant must be identified in the preliminary EIA. Impacts may include those of air pollution, water pollution, light and noise and increased vehicular traffic and human presence. Procedures must also be established for notifying appropriate government authorities in the event that unexpected impacts on cultural or archaeological assets are discovered after the hydroelectric power plant starts operating.

4.4.2.6.6 Occupational Health and Safety

Health and safety impacts of the project on workers and communities in the project's area of influence must be reasonably managed.

Worker Health and Safety

The means by which this is done in the workplace is through development and implementation of standard workplace practices. These may already exist in the form of national standards or union terms of employment, and if so, should be included by reference insertion as an appendix

to the EIA. Details should include safe operating practices, emergency response plans and housekeeping procedures.

Community Health and Safety

Health and safety in nearby communities is assured through implementation of safe operating practices by site plant personnel, re-evaluation of offsite impacts after start-up of operation and implementation of mitigation measures as appropriate.

4.4.2.6.7 Visual Impacts

A hydroelectric power plant may present unwanted visual impacts both by its physical presence and profile against the surrounding area. This is especially important if the plant is in or impacts a scenic vista, such as mountains, shorelines or wildlife parks.

4.4.2.7 Section 6: Analysis of Alternatives

Alternatives to the proposed project must be presented in the EIA and a rationale provided for the selection of the plant site and technology. Reasons for ruling out other alternatives as well as reasons for selecting the proposed location and processes should be documented. Factors assessed for all alternatives and used in selecting the preferred site and technologies should include:

- Impacts of the 'No Build' option;
- Proximity of grid interconnect and demand;
- Current and projected demand;
- Capacity;
- Quality and long-term availability of water flow;
- Alternative means of power supply;
- Availability and cost of site;
- Availability and additional costs of required infrastructure;
- Comparison of environmental and other associated impacts; and
- Appropriateness of technology on the operating environment of the project.

Cost-Benefit Analysis

A cost-benefit analysis should be performed in support of the selection, sequencing and rejection of alternatives. The analysis should include reasonable alternatives, if any, and accounting of internal and external costs with the latter containing estimated costs and benefits to the environment.

4.4.2.8 Section 7: Mitigation Plan

Details of the Mitigation Options are presented under Section 5.

4.4.2.9 Section 8: Environmental Management Plan

Details of the Environmental Management Plan are presented under Section 6.

4.4.2.10 Section 9: Institutional Strengthening Requirements

Interagency Coordination

Co-ordination of communications between agencies and organizations is imperative to the effective management of the EIA process. A listing of all relevant agencies, organizations, and individuals that must be consulted during the performance of the EIA should be prepared and presented in the EIA.

Government

Each country will have different government offices responsible for review and approval of the EIA. It is imperative that the EIA team:

- Identify all organizations that must be consulted; and
- Identify from whom approvals and authorizations must be obtained.

Government offices will likely include at least: power/energy, industry, environment, water, and interior.

International Financing Institutions (IFIs)

International finance institution (IFI) involvement is invoked if financing is provided in part or in total by such an organization. IFIs from which funding is expected or sought should be listed and respective requirements should be summarized.

Development Assistance Agencies (DAAs)

Development Assistance Agencies such as US Agency for International Development (USAID), Department for International Development (DFID), Canadian International Development Agency (CIDA), German Agency for Technological Assistance (GtZ), Japanese International Cooperation Agency (JICA), Swedish International Development Agency (SIDA), Danish International Development Agency (DANIDA), Norwegian Development Assistance Agency (NORAD), et. al., may also contribute to the development of hydroelectric power plant projects. Such assistance may come in the form of loans, grants, equipment, technical assistance, or even performance of the EIA. If assistance is provided by a DAA, then environmental guidelines or requirements of that DAA must also be considered.

Non Governmental Organizations (NGOs)

Non-Governmental Organizations (NGOs) may by local, regional or international. NGOs range from political activist organizations to truly technical operations. In any event, concerned and interested NGOs should be contacted and consulted early in the EIA process to assure provision of accurate and useful information and to identify potential problems with the project. NGOs can be useful sources of information and data, can be very helpful in managing public information and involvement and in many instances are quite active in SAPP member countries.

4.4.2.11 Section 10: Conclusions

The Conclusions section should present a summary of predicted impacts and findings of the EIA. Succinct statements regarding the ability of the project to satisfy all environmental requirements—and the mitigation measures employed—should also be presented.

4.4.2.12 Section 11: Recommendations

Recommendations should include proposed means of providing missing data, in parallel with the construction and operation phases of the project, and suggestions for improving the EIA process in future applications.

4.4.2.13 Section 12: Tables and Figures

The EIA team may prefer to assemble all tables and figures at the end of the report for ease of access and editing. This is a matter of personal preference.

4.4.2.14 Appendices

Documents presenting all relevant regulatory citations, model outputs and detailed drawings should be assembled and presented at the end of the EIA as appendices or attachments to the EIA. Should there be a large volume of materials in the appendix then it should be presented as a separate volume(s) of the EIA.

This is the end of the EIA template section. The following sections discuss sources of information for the performance of the EIA and managing the EIA process.

4.5 EIA PROJECT MANAGEMENT

Successful and cost-effective management of the EIA process requires assembly of a team of knowledgeable and interested persons within the project proponent and client organizations. It also requires retention of competent consultants having relevant experience in performance of EIAs for the type of hydroelectric power plant under consideration and in the country where the plant will be built or in a similar operating environment.

A realistic but responsive schedule for the delivery of incremental components, i.e., siting, fatal flaw analysis, the preliminary EIA and the EIA must be established. Slippage of the schedule can delay approval of the project and project funding and it can result in termination of a project due to de-obligation funding, expiration of cost quotes and changes in tariffs, fuel prices and the politics and economics of the host country.

The EIA team should include the client and project proponent or their representatives (may be outside consultants), government officials and affected NGOs.

4.5.1 Project Proponent (Client or Developer)

Representation from the client and/or project proponent should consist of the construction manager or appropriate representative, the plant manager or engineer if known, the plant environmental health and safety manager if known and the client's engineering representative.

4.5.2 Consultants

Consultants should, to the extent possible, be local engineers and scientists as this could reduce costs, assure clearer communications at the local level and serve to build local capabilities and infrastructure for performance of future EIA. When foreign consultants are required due to the need for technical specialties or the insistence of project proponents or owners, all materials, models, calculations, maps and equipment as much as possible should be left with the local project clients or developers upon completion and approval of the EIA.

Consulting firms, local or external, may have their own preferred formats for contracts and terms of references, but these should not deviate significantly from the standard formats. In addition, consultants may attach company-specific terms and conditions which govern liability, payment and legal recourse. Terms and conditions should be carefully examined by the project client's legal counsel, with client terms and conditions substituted or appended where appropriate.

4.5.3 Stakeholders

Stakeholders are defined as 'interested or affected parties' and as such should receive public notice of, or be directly notified and invited to attend, public meetings.

4.5.4 Non-Governmental Organizations (NGOs)

NGOs typically function as advocates of human rights and environmental protection. NGOs should also be invited to attend all public meetings. NGOs often have the leverage, exposure and international connections to make or break a project and they must be included early in the EIA process.

4.5.5 Schedule/Work Program

Adherence to a firm schedule in the performance of the EIA is imperative as delays in completion of the EIA may cause delays in approval and financing of the project and could ultimately cause project financing to be withdrawn or allow other competing projects to supersede the project. Unnecessary delays can also result in expiration of price guarantees and delivery schedules and result in cancellation of the project.

4.5.6 Costs

The cost of the EIA can range from $US 30,000 to well over $US 1,000,000, depending on the completeness of existing data, sensitivity of the affected environment, extent of modeling and monitoring that must be performed, availability of prior similar and approved EIAs that can serve as precedents and the choice of consultants (estimated costs may vary widely, both between and among international and local consultants).

All cost proposals should be accompanied by detailed spreadsheets providing labor categories and rates, names and labor categories of key staff, all other direct costs, the overhead rate applied to labor charges, travel budgets, communications budgets and mark-ups applied to all other direct costs.

4.5.6.1 "Polluter Pays" Concept

It is recommended that a uniform and regionally consistent policy of "polluter pays" be adhered to for not only the EIA but also objective third party review of the completed EIA. Such a measure would alleviate the additional workload of many of the local regulatory agencies and properly done, would contribute to further development of internal capacity of the agencies. A standard fee schedule estimating costs of third party review should be developed by the SAPP EnvSC – and should be agreed to by regulatory agencies, consultants, developers and the regulated community

4.5.7 Progress Reports

Consultants should also be required to submit monthly project status reports as an attachment to their monthly invoice. The report should cite accomplishments of the preceding (billed) month and objectives of the current month and next month. Problems encountered or expected and corrective measures should also be stated. A brief and cumulative budget report with the percent technically and financially complete should also be submitted with the monthly report. When 80% of the budget has been expended, notification should be provided along with a "cost to completion".

4.5.8 Internal Review

All EIAs should be subjected to rigorous internal reviews prior to submittal to the regulatory agencies and/or IFI concerned. Transcription or technical errors may occur as assumptions and data are further removed from the originating source. Discrepancies may also occur between potential and actual EPC team accomplishments and these should be resolved prior to submittal of the EIA.

4.6 SUBMITTAL, ARCHIVAL AND AVAILABILITY OF THE EIA

The EIA should be submitted in hard copy and electronic format to all agencies and organizations authorized and obligated to review and/or approve the EIA. The document should be a first generation photocopy with at least one unbound copy included to facilitate production of additional review copies if needed. Pages should also be electronically 'watermarked' to reduce the likelihood of unauthorized reproduction and distribution.

Copies of the EIA should be maintained in prominent public locations in the affected area, e.g., library, university, public office or offices of the utility during the period for public comment. Copies of the EIAs should remain on file in public locations along with a copy of the Record of Decision after acceptance or rejection of the EIA. One original copy of the EIA and Record of Decision and several copies of all signed relevant documents should be maintained at an offsite and secure location.

4.7 NEGOTIATIONS

Negotiations with regulatory agencies and finance institutions may become necessary during the review and approval process. As such, certain procedures should be agreed on for inter alia meetings, attendees and documentation of all telephone, oral, written and electronic communications.

Section 5 Mitigation Options for Hydroelectric Power Projects

At this stage in the technological development of the hydroelectric power sector mitigation options are fairly standard for any given situation. It is the implementation and degree of mitigation, and assurance of continuation of mitigation measures that are highly variable. It is the purpose of this section to describe the various types of impacts and a more uniform means of determining what the minimum acceptable mitigation options are.

5.1 MITIGATION PLAN

The mitigation plan should provide a written description of activities proposed for mitigating environmental impacts and a tabular compilation of the mitigation activities selected in the previous sections on impacts of construction and operation. The plan should also describe measures to be employed to assure effective implementation of the mitigation plan. Monitoring the effectiveness of the mitigation plan will be accomplished in part by execution of the Environmental Management Plan (EMP) as described in the following section.

5.1.1 Specific Impacts and Possible Mitigation Measures

Impacts of a hydroelectric power project are both positive and negative. When negative, mitigation may be required – when positive, they may offset certain often negative impacts. The most common impacts of hydroelectric power project siting, design, construction, operation and decommissioning and possible mitigation measures or benefits are as presented in Table 3, and as described in the text which follows.

Table 3. Hydroelectric Project Impacts Checklist

Actions Affecting Environmental Resources and Values	Potential Damages to the Environment	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
A. Environmental Problems Due to Project Location					
1. Resettlement	1. Serious social inequities				
2. Encroachment into precious ecology	2. Loss of ecological values				
3. Encroachment on historical/cultural values	3. Loss of these values				
4. Watershed erosion/silt runoff	4. Shortened reservoir life				
5. Impairment of navigation	5. Economic loss				
6. Effects of groundwater hydrology	6. Economic loss				
7. Migrating fish stocks	7. Decrease in catch				
8. Inundation of mineral resources	8. Economic loss				
9. Other inundation losses or adverse effects	9. Depends on type of effect				

Actions Affecting Environmental Resources and Values	Potential Damages to the Environment	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
B. Environmental Problems Related to Design					
1. Road erosion	1. Impaired water and land quality				
2. Reservoir site preparation	2. Affects water quality				
3. Water rights conflicts	3. Serious social conflicts				
4. Fish screens	4. Loss of fish stocks				
C. Environmental Problems Associated with Construction Phase					
1. Soil erosion/silt runoff	1. Impairment to water and land quality				
2. Other construction hazards	2. See detailed list in Section 3.3.3				
3. Construction monitoring	3. Contractors require monitoring and enforcement.				
D. Environmental Problems Relating to Project Operations					
1. Downstream flow variations	1. Disturbance to downstream fisheries				
2. Depreciation of downstream inundation fisheries	2. Loss of fisheries				
3. Downstream erosion	3. Erosion and infrastructure damage				
4. Lack of reservoir management	4. Social conflicts				
5. Eutrophication	5. Evaporation, impairment of fishery and power				
6. Downstream water quality	6. Impairment of downstream water quality				
7. Insect vector disease hazards	7. Community health hazard				
8. Reservoir bank stability	8. Impairment of reservoir uses and water quality				
9. Operation monitoring	9. Without it operators may not comply.				
E. Potential Environmental Enhancement Measures					
Reservoir fishery enhancement	Extra fishery potential realized				
Drawdown agriculture	Extra agriculture potential realized				
Downstream community water supply	Improvement in standard of living				
Downstream aquaculture	Improvement in standard of living				
Forestry/wildlife reserves	Conservation of forests/wildlife				
Recreation	Improvement in quality of life				

Source: Adapted from ADB (Asian Development Bank), 1993a. Environmental Guidelines for Selected Industrial and Power Development Projects. Office of the Environment.

5.1.2 Environmental Impacts Due to Siting

- Resettlement: Resettlement of the population of an inundated area. This has been a major problem in many projects in the past.
  Mitigation: Assure that sufficient funds are allocated in the project budget to cover appropriate resettlement costs, including rehabilitation, training and other compensation.
- Encroachment on the Watershed: The building of access roads into the project sites, and to the new lake often accelerate inroads into the watershed by hunters, farmers and timber cutting operations, thereby accelerating loss of forests and wildlife.
  Mitigation: Return temporary access roads to their natural state, construct barriers to entry and limit access on permanent roadways and service roads.
- Encroachment on Historical and/or Cultural Monuments or Areas: Inundation of such assets requires serious consideration and assurances of approvals of affected parties that such actions do not violate international treaties or agreements.
  Mitigation: Recover and relocate salvageable assets – or select alternate site.
- Watershed Erosion and Silt Run-off: Erosion and silt run-off can seriously impact the capacity of an impoundment and the functioning of turbines.
  Mitigation: Expand the project to include watershed reforestation, regreening, and other soil stabilization measures. Funding must be included in the project core budget.
- Impairment of Navigation: By definition a dam substantially impairs navigation past the dam – up or downstream and may seriously impair downstream navigation by altering flow, depths and variability in water levels.
  Mitigation: Installation of locks on large dams, railway by passes on smaller dams as part of the design, and in all cases regulation of flow if variability and reduced flows compromise downstream navigational use of the waterway.
- Impairment of Groundwater Hydrology: The reservoir may result in waterlogging in the surrounding areas.
  Mitigation: Channeling and drainage may be of some value. However, resettlement may also be required.
- Migration of Valuable Fish Species: Many species of fish rely on upstream spawning areas and dams may pose a threat to access to those areas – and to sustained populations of affected and dependent species.
  Mitigation: Installation of fish ladders for salmonids and other means of active conveyance upstream may be possible. “Fish-friendly” bypasses may allow downstream passage.
- Inundation of Mineral Resources: Valuable mineral resources may be lost due to flooding of the impoundment.
  Mitigation: There is no suitable mitigation, only payment of compensation for lost wages and revenues.
- Other Problems Associated with Inundation of an Area: Productive farmlands and forests may be inundated, wildlife may be displaced, riverine fish population dynamic altered, alterations in the overall hydrological scheme may occur and in certain geotechnical settings earthquake hazards may be increased.

Mitigation: Compensation and resettlement for lost farmland and forests, relocation of displaced wildlife, reestablishment of fisheries upstream (albeit possibly different fish species) and design to withstand minor earthquakes that may be induced are all possible but must be included in the core budget.

5.1.3 Environmental Impacts of Design

- Road Erosion: Erosion may ensue as a result of areas exposed for roadways and construction activities.
  Mitigation: Such exposed areas should be revegetated or resurfaced.
- Preparation of Impoundment Area: Prior to impoundment of the reservoir, consideration must be given to anticipated uses of the reservoir after impoundment so as not to subvert the intent of the developers and regulatory authorities.
  Mitigation: If fisheries are to be established in and along the reservoir then only valuable timber should be cleared and all remaining vegetation left in place, as a source of nutrients and habitats.
- Water Rights Conflicts: There are often conflicting needs between use of water for power generation versus irrigation, flood control and other measures such as fluctuating levels of the reservoir to control vectors of disease.
  Mitigation: Assure that all potentially affected parties and potential impacts of flow regulation are contemplated and addressed as part of the EIA process.
- Fish and Other Deaths in Turbines and Spillways: Many fish and other aquatic organisms are killed by passage through the turbines or over and through the spillways.
  Mitigation: Such impacts can be greatly reduced by installation of fish screens, acoustic deterrent devices or other means to direct fish and other aquatic organisms away from turbine intakes and spillways.

5.1.4 Environmental Impacts of Construction

- Soil Erosion and Silt Runoff: Substantial erosion and silt runoff can occur from borrow and cut-and-fill areas due to lack of adequate planning and control of flows.
  Mitigation: Resurface or surface exposed areas, install silt screens and fences, establish retention and sedimentation ponds as appropriate and apply soil stabilizing, biodegradable polymers to roadways, spoils and open areas that may be sources of windblown dust.
- Construction Hazards: A multitude of construction hazards exist at dam sites, some due to construction others to living conditions and associated activities.
  Mitigation:
  - Worker Safety: Implement a worker safety program, supply necessary protective clothing and gear and perform routine safety inspections.
  - Camp Sanitation: Assure proper offsite disposal of wastes and sewage, provide onsite medical care for injuries and identification and isolation of communicable diseases, instruct workers on means of reducing contact with communicable diseases including sexually transmitted diseases.

- Water-related Diseases: Assure potable drinking water and clean bathing water and screen new employees for diseases – even those diseases not endemic to the area as migrant workers may bring unfamiliar diseases to the jobsite.
- Other Disturbances: Dust, odors and fumes can usually be controlled by "good housekeeping" on the jobsite. Noise can be either controlled at the source through proper muffling or sound absorbing materials or by providing workers with adequate hearing protection devices.
- Quarrying: Hazards from blasting and hauling of heavy materials can be mitigated by good site management, blast control programs and proper training and certification of heavy equipment operators.
- Aesthetics: Borrow areas and other cleared lands that are exposed to view should be restored to their original condition.

Well-managed construction monitoring is imperative to assurance that mitigation measures listed above are properly employed.

5.1.5 Environmental Impacts of Operations and Maintenance

- Downstream Flow Variations: Such variations may disrupt downstream fisheries, agriculture, navigation and other uses.
  Mitigation: Attempt to regulate flow so as not to interfere with seasonal or ongoing downstream uses.
- Depreciation of Downstream Fisheries: While lessening of flood flows through flow regulation is beneficial, this can also reduce the output of inundation fisheries an important food source in certain rural areas.
  Mitigation: Canals for maintenance of otherwise inundation-filled surface waters may be an appropriate measure.
- Downstream Erosion: Release of silt-free water can lead to increased downstream erosion as there is no replacement of displaced silt and sediment.
  Mitigation: There is no real sound mitigation measure other than to moderate flows and minimize downstream erosion. If dredging is undertaken to reduce silt deposition rates in the reservoir, then it is possible that some silt could be introduced downstream of the dam.
- Lack of Reservoir Management: Reservoirs can become rich fisheries, but without proper management fishery yields will be lower than they should be, fishing may be overexploited and illegal methods may be used, fishing rights are often taken over by immigrants, new settlements and villages can become sanitation and public health problems and social conflicts may arise over drawdown agriculture areas.
  Mitigation: A proper reservoir management plan must be developed and enforced. Such plans must address several if not all of the impacts listed above. Fishing rights should be issued to displaced riverine fishermen first.
- Eutrophication: Trapping of nutrients previously flushed by normal flow may result in impairment of water quality and uses both up and downstream and weed blooms may interfere with power generation and diversion of flow to irrigation canals.

Mitigation: Flushing of the reservoir and application of herbicides may be necessary to as short-term measures. However, management of inputs of excess nutrients is required for long-term management of this problem.

- Water Quality: Downstream water quality may be affected by dam discharges.
  Mitigation: Water should be withdrawn from the reservoir at optimal depths to avoid heavily eutrophied surface waters and anaerobic bottom waters.
- Vector-borne Diseases: The resultant increase in large areas of still water in the reservoir may promote waterborne vectors or hosts in the cycle of transmission of diseases.
  Mitigation: Fluctuate water levels at critical times so as to disrupt the breeding of vectors or intermediate hosts of diseases.
- Impacts on Estuarine and Marine Fisheries: Reduction of nutrient flows at the river mouth may disrupt estuarine and near-shore marine fisheries.
  Mitigations: Govern rate of fill of the reservoir so as to satisfy minimum stream flow requirements for downstream fisheries. Design and position discharge structures so as to improve aeration of anoxic hypolimnionic waters and to support better downstream nutrient loadings.
- Reservoir Bank Stability: Geotechnical instability and or soil type may result in a sloughing off of the banks.
  Mitigation: Various methods of bank stabilization exist, including vegetation, netting, installation of riprap in sensitive areas and other such stabilizing measures.

Continued post-construction monitoring, reporting, and regulatory compliance and enforcement are essential to assurance of continued environmental stability of the dam and associated impacts.

5.1.6 Environmental Impacts of Decommissioning

- Breaching of the Dam:
  Mitigation: Slow drawdown prior to breaching
- Disposal of Rubble and Other Debris (Dam Structure, Machinery and Oils – Including PCBs)
  Mitigation: Maximize salvage and segregate contaminated materials for proper disposal. Channelize runoff for appropriate treatment.

5.1.7 Environmental Benefits

- Reservoir Fisheries: Proper management of the reservoir fishery can result in much increased yields.
- Drawdown Agriculture: Regulation of flow and diversion of flow through downstream canals can result in increased agricultural output downstream.
- Downstream Community Water Supply: The reservoir may be the only source of water for downstream communities during the dry season.

- Downstream Aquaculture: Downstream aquaculture is enhanced by a reliable, year-round source of clean water, and if this has potential in the downstream areas, such projects should be financed as part of the dam project.
- Forestry and Wildlife Reserves: The project may facilitate accelerated encroachment in to the upper watershed. Therefore, it may be desirable to establish protect forests and wildlife areas in the upper watershed early in the project cycle.

Section 6 Environmental Management Plans (EMP) for Hydroelectric Projects

As is the case with Mitigation Options, at this stage in the technological development of the hydroelectric power sector the approach to development and implementation of EMPs are fairly standard for any given situation. It is the actual design and implementation of the EMP that may be at variance from country to country and even from project to project within a country. It is the purpose of this section to describe the various types of impacts and provide a more uniform means of determining what the minimum acceptable mitigation options are.

6.1 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

An important objective of environmental assessment is to develop procedures and plans to ensure that the mitigation measures and monitoring requirements approved during the EIA and environmental compliance review will actually be implemented throughout the course of the project. As such, strong emphasis must be placed on the development of a responsive EMP during project processing and on setting out conditions and targets to be met during project implementation. An EMP should be required as an integral component of all EIAs as the requirement of an EIA is a de facto statement that there is significant potential for, or there will be an, actual environmental and social impact as a result of the project. Therefore, an EMP must be specifically spelled out as a requirement under the Terms of Reference (TOR) for performance of the EIA.

Early in the project cycle, the specific construction and operational activities may not be well defined and often it is not possible or practical to provide the details required for an effective EMP. Therefore, there must also be assurances that a revised EMP will be prepared at the beginning of the implementation stage.

6.1.1 Contents of the EMP Section of the EIA

The minimum recommended contents of an EMP are as follows:

1. Summary of Impacts

This section should summarize the predicted adverse environmental and social impacts that must be mitigated.

2. Description of Proposed Mitigation Measures

This section should set out clear and achievable targets and quantitative indicators of the level of mitigation required. Each measure should be briefly described in relation to the impact and conditions under which it is required. These should be referred to designs, development activities, equipment descriptions and operating procedures and implementation responsibilities.

3. Description of Monitoring Programs and Parameters

This section should outline the specific monitoring protocols, parameters and expected frequencies. It should identify objectives and specify the type of monitoring required. It also

describes environmental performance indicators which provide linkages between impacts and mitigation measures identified in the EIA report, parameters to be measured, methods to be used, sampling location and frequency of measurements detection limits and definition of thresholds to signal the need for corrective actions. Monitoring and supervision arrangements should be agreed to by the executing agencies to ensure timely detection of conditions requiring remedial measures, furnish information on the progress and results of mitigation and institutional strengthening measures, and assess compliance with national and other applicable environmental regulations and requirements.

4. Public Consultation Activities

The EMP should include a plan for public consultation activities during the finalization and implementation of the EMP. The degree of consultation will depend on the project and local situation but will normally include:

(i) notification of local communities when project activities are going to take place;

(ii) disclosure of the results of monitoring programs to local communities and other stakeholders; and

(iii) provision for independent third party monitoring where necessary.

Projects with potential for significant adverse impacts may require public consultation on the design of mitigation measures and provide for public participation in environmental monitoring. Stakeholder consultation is also recommended during the preparation of final monitoring reports.

5. Description of the Responsibilities for Mitigation and Monitoring

Requirements: This section should specify the institutional arrangements for implementation – taking account of the local conditions. Responsibilities for mitigation and monitoring should be defined along with arrangements for information flow and for coordination between agencies responsible for mitigation. EMP specifies the organizations and individuals that will be responsible for undertaking the mitigating and monitoring measures, e.g., for enforcement of remedial actions, monitoring, training and financing. A third party may be contracted in case the local authorities' capacity is limited. The EMP may propose institutional strengthening activities, including establishment of appropriate organization arrangements, appointment of key staff and consultants and arrangements for counterpart funding when necessary.

6. Preliminary Cost Estimates

To ensure that mitigation measures and monitoring are adequately funded, the EMP should contain preliminary cost estimates. During implementation, the EMP should be revised once construction and operational activities are well defined. Additional information should be provided on:

(i) the responsibilities for reporting;

(ii) the work plan;

(iii) the procurement plan;

(iv) detailed cost estimates; and

(v) mechanisms for taking corrective action.

7. Description of the Responsibilities for Reporting and Review

This section should specify institutional responsibilities for contractors, borrowers and local authorities with clear definitions of roles in the preparation, submittal, receipt, review, and approval of reports. An implementation schedule detailing the timing, frequency and duration of mitigation measures, monitoring and reporting of the progress should be prepared showing phasing and coordination with procedures in the project operations manual and loan agreement. Recipients of such reports should include those with responsibility for ensuring timely implementation of mitigation measures and for undertaking remedial actions. In addition, the structure, content and timing of reporting should be specified to facilitate supervision, review and approval by regulatory authorities and the lender.

8. Work Plan

This section should provide a staffing chart for development of the EMP, where necessary as well as other related work, proposed schedules of participation by the project team members and activities and inputs of related government agencies. The responsibilities and requirements of contractors should be clearly addressed to ensure integration into legal requirements and bidding/contract documents. EMP requirements should be integrated into such documents to ensure that contractors clearly understand their obligations. Where supervision identifies inadequacies in their implementation, such documents provide a basis for enforcement and reporting. Implementation of major environmental covenants should be linked to disbursement conditions.

9. Procurement Plan

This component should include 2 sections:

(i) the plan for procurement of specific items and equipment required to implement of the mitigation and monitoring programs in the EMP; and

(ii) a description of procedures to ensure consistency of all project procurement with the principles and practices of environmentally responsible procurement of goods and services.

10. Cost Estimates

This section should provide the detailed costs of implementation of the EMP. These should be specified for both the initial and recurring expenses for implementing all measures defined in the EMP integrated into the total project costs and factored into loan negotiations. All costs—including administrative design and consultancy and operational and maintenance costs—resulting from meeting required standards or modifying project design should be captured. A budgeting plan should be attached to resolve the issues of how those costs are to be met.

11. Project Feedback and Adjustment

This section should outline the procedures and mechanisms that will be used to modify and reshape the project in the light of monitoring results. A feedback mechanism with proposed timing and procedures should be included in the EMP to provide for modifications to the Project and the executing agencies.

The contents of a complete EMP should include:

- Summary of Potential Impacts
- Description of Planned Mitigation Measures
- Description of Planned Environmental Monitoring
- Description of Planned Public Consultation Process
- Description of the Responsibilities and Authorities for Implementation of Mitigation Measures and Monitoring Requirements
- Description of Responsibilities for Reporting and Review
- Work Plan including staffing chart, proposed schedules of participation by various members of the project team and activities and inputs of various government agencies
- Environmental Responsible Procurement Plan
- Detailed Cost Estimates
- Mechanisms for feedback and adjustment

The EMP is the key means by which implementation of mitigation measures is tracked and assured. The development of mitigation measures, the monitoring program, institutional arrangements and scheduling can be aided by the use of the matrices presented in Tables 4 through 7. These matrices should be included in the EMP document.

Table 4. Template for Summarizing Mitigation Measures

Project Stage	Project Activity	Potential Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibilities	Cost Estimates
Pre-Construction					
Construction					
Operations and Maintenance					
Decommissioning					

Source: Adapted from ADB, ……..

Table 5. Template for Summarizing Monitoring Requirements

Project Stage	Mitigation Measure	Parameters to be Monitored	Location(s)	Measurements	Frequency	Responsibilities	Cost
Pre-Construction							
Construction							
Operations and Maintenance							
Decommissioning							

Table 6. Template for summarizing Institutional Strengthening and Training

I. Strengthening Activity	Position (Responsibilities)	Strengthening Program	Schedule	Cost Estimate
Mitigation				
Monitoring				
II. Training Activity	Participants	Course and Contents	Schedule	Cost Estimate
1. EMP Implementation, Re-design and Conflict Resolution				
2. Environmental Processes, Methods and Equipment				
3. Environmental Policies and Programs				

Table 7. Template for Scheduling and Reporting

	Year 1				Year 2				Year 3				.....			
Activity	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Mitigation Measures																
Monitoring																
Institutional Strengthening																
Training																

http://www.adb.org/Documents/Guidelines/Environmental_Assessment/Environmental_Management_Plans.pdf

The Environmental Management Plan is now a required component of the EIA. The EMP presents the plan by which parties responsible for operation of the hydroelectric power plant will assure initial and ongoing compliance with environmental requirements and guidelines. The EMP also addresses emergency response measures in the event of catastrophic failure or accidental release of harmful substances.

Additional contents of the EMP should include:

6.1.2 Institutional Arrangements

Institutional arrangements with the following organizations should be made to assure optimal functioning of the EMP.

- Regulatory agencies – for routine reporting of monitored data and unexpected deviations;
- Local government bodies – to keep apprised of operating procedures, changes or developments that may be of concern to local interests;
- Local fire department and emergency rescue teams – to assure that means of entry and access to all work areas are known and that plot plans of the facility, locations and quantities of hazardous materials are known and Material Safety Data Sheets (MSDS) are on file;
- Local police department – to assure that plant security is coordinated with local security; and
- Tribal organizations – to assure good relations and minimize impacts on cultural or religious assets.

6.1.3 Environmental Monitoring and Reporting

Ongoing monitoring of air and water quality, noise impacts and solid waste disposal may be required under the EMP to assure compliance with regulations and guidelines and appropriate reporting of monitoring data to the concerned regulatory agencies. Although not required by the EIA or environmental regulations, it is important that the results of environmental monitoring also be conveyed to the shareholders and affected public. Additional information on environmental reporting is found in ISO 14031, Environmental Performance Evaluation (EPE).

If environmental impacts or the means of estimation are in question, if impacts approach the currently stated allowable limits, or if the existing environment is already significantly degraded, then ongoing monitoring or sampling of discharges, effluents, air quality, water quality or impacts on sensitive environments may be required.

The following sections present air, water, and sensitive habitat monitoring approaches that should satisfy regulatory requirements, if any.

6.1.3.1 Air Quality Sampling Plan

Air quality sampling on, or offsite, is often required when significant impacts are projected or predicted, or if existing air quality is sufficiently impaired so as to require close surveillance of

incremental impacts of new sources. Methods for measuring odors are also addressed in this section.

Methods

A wide variety of methods are available for measurement of gaseous and particulate pollutants, ranging from accurate and inexpensive 24-hour integrating passive diffusion wafers to continuous air pollutant analyzers for gases; and from rugged, field-adapted 12 VDC particle samplers to sophisticated electrical and optical continuous particle samplers. The method employed should be the least complicated that is still acceptable to the regulatory agency and capable of delivering data of desired quality and resolution. Accepted methods of sampling and analysis of air quality should be agreed to by SAPP EnvSC representatives.

A monitoring plan, describing sampling and analysis methods, site monitoring, site operations, and data reporting procedures must be included in the EMP.

Reporting

Results of sampling, if required, should be reported to the appropriate offices on at least a quarterly basis. Annual summaries of data should be included in an annual environmental report.

6.1.3.2 Water Quality Sampling Plan

Based on the general description of effluents of a hydroelectric power plant, it is expected that the water pollutants of primary concern will be temperature, oils and greases, other organics, BOD and COD. A routine composite sampling and subsequent analysis may be required on a daily, weekly, monthly or quarterly basis.

Methods

Methods used should include standard measures of flow, temperature and representative composition of samples over a predetermined sampling period on a predetermined frequency. Accepted methods for sampling and analysis of surface and groundwater water quality, wastewater and other effluents should be agreed to by SAPP EnvSC representatives.

Reporting

Results of sampling, if required, should be reported to the appropriate offices on at least a quarterly basis. Annual summaries of data should be included in an annual environmental report.

6.1.3.3 Soil

Should soil contamination resulting from landfill disposal or ‘land farming’ of dredged materials or other wastes be suspected or considered possible, a routine program for soil sampling should be developed and presented in the EIA.

Methods

Methods selected for sampling and analysis will depend on suspected contaminants and the location of the contamination. Accepted methods of sampling and analysis of soils and soil contaminants should be agreed to by SAPP EnvSC representatives.

Reporting

If sampling is required, the results should be reported to the appropriate offices on at least a quarterly basis. Annual summaries of data should be included in an annual environmental report.

6.1.3.4 Solid Waste

Measurements of solid waste should be made on a mass or mass balance basis, with routine grab-sampling or composition of grab-samples to assure accurate characterization of the solid waste stream. Data produced should be reported not only to the concerned regulatory agencies but to the plant engineer as well, as wastes identified may indicate process inefficiencies or lost opportunities for separation and collection of recyclable materials.

6.1.3.5 Noise

Noise impacts may occur at sensitive receptors (residences, schools, hospitals, public facilities, agricultural operations and sensitive wildlife habitats) as a result of construction and operation of a hydroelectric power plant. Existing noise levels at property boundary and sensitive receptors, as well as the proposed means of noise measurement and plan of study to assure compliance with noise standards, should be described in the EIA if noise will be an impact of concern.

Methods

Methods selected for sampling and analysis of noise will depend on the nature and location of noise sources and impacts. The noise measurement device should be a Type 1 sound level meter (SLM) having means of internal and external calibration. Octave band analyses may also be desirable in order to better characterize the components of existing and predicted noise levels. Accepted methods for noise sampling and analysis should be agreed to by SAPP EnvSC representatives.

Reporting

If sampling is required, the results should be reported to the appropriate offices on at least a quarterly basis. Annual summaries of data should also be included in an annual environmental report.

6.1.3.6 Sensitive Environments

If adverse impacts on sensitive environments are anticipated, routine surveys of indicator species of plants, animals and microorganisms should be conducted. Significant, unexplained changes in population dynamics should be reported and investigated. Such a contingency should be presented in the EIA.

Methods

Methods employed will depend on habitats and species of concern and will be addressed in the EIA.

Reporting

If sampling is required, the results should be reported to the appropriate offices on at least a quarterly basis. Annual data summaries should be included in an annual environmental report.

Section 7 Public Participation

Public involvement from the very outset of the project is imperative. Public resistance or opposition to a project can cause costly time delays or failure of a project. A transparent planning process and simple and straightforward public education and involvement in the scoping and final review of the EIA can turn opponents into supporters.

Public involvement is a dynamic process, as local sentiments and sensitivities vary widely. A central point of contact for all public relations and communications should be established and all requests for information, press releases, interviews, site visits by outside parties or release of reports to the public should be channeled through one individual or office to assure consistency in the information, data and handling of public affairs.

All potentially interested and affected parties (IAPs) must be informed of the development of a hydroelectric power project and the performance of an EIA. The costs associated with such public awareness and involvement programs needs to be given proper attention as part of the overall EIA and project development costs.

Public participation is required and key to project approval and success. Several guidance documents and reports are available on this subject; several addressing the matter in the southern African operating environment. Selected documents, as assembled by SAIEA, are summarized below.

A Guide to Opportunities for Public Participation in Environmental Assessment Processes in the Southern Africa Development Community. This handbook contains a clear description of all the rights that communities and the public have to participation in environmental decision-making as conferred by international, regional and SADC region conventions laws and policies related to environmental impact assessment and decision-making. This document has approached the rights issue from "an opportunity to participate" perspective, and is formatted around several key questions for each SADC country. http://www.saiea.com/calabash/pp_rights/index.html

Generic Public Participation Terms of Reference for civil society engagement involved in a point EIA (e.g. mine site), linear EIA (e.g. pipeline) or a regional strategic environmental assessment. Also included in the document are guidelines and tips on how to develop Terms of Reference that ensure that all contracting parties achieve maximum satisfaction and results throughout the duration of the relationship for a particular project.
http://www.saiea.com/calabash/html/tor_cover.pdf

A Situation Assessment, which describes and analyses the status of public participation and EIA for all countries of the SADC region. http://www.saiea.com/html/dsa.pdf

Research into six case studies in the SADC region has been conducted where environmental assessment and public participation was performed with distinction. Time and time again, studies show that when civil society has a chance to contribute to development planning the end result is a project or program that has more far reaching direct and indirect development benefits than

were originally planned. This is the first time that six projects from the SADC region have gone through such detailed analysis. http://www.saiea.com/calabash/casestudies/index.html

A One-Stop Participation Guide: A Handbook of Public Participation in Environmental Assessment in Southern Africa. The lessons learned from the six case studies were integrated into the handbook methodologies. The Handbook is unique in that it offers tips and the process to follow for public participation from the perspective of the four key stakeholders who are part of any Public Participation process: Regulators, Industry, Practitioners and Civil Society. http://www.saiea.com/calabash/handbook/index.html

The handbook also contains a Public Participation (PP) Best Practice Model, a PP Review Template which can be used during the review or planning of a PP program and a series of template letters which civil society can use to ensure that their voices are heard and respected in a respective public participation process.
http://www.saiea.com/calabash/handbook/annexure_c.pdf

Calabash has also developed an Electronic Library of Public Participation and Civil Society Engagement tools from around the world. The library has grouped materials from the SADC region, Africa and International. Over 250 resources and manuals exist on the Calabash site. http://www.saiea.com/calabash/final_report/html/library.html

Section 8 Millennium Development Goals

As stated on the United Nations' (UN) Millennium Development Goals (MDG) Website,

"The eight Millennium Development Goals (MDGs) – which range from halving extreme poverty to halting the spread of HIV/AIDS and providing universal primary education, all by the target date of 2015 – form a blueprint agreed to by all the world's countries and all the world's leading development institutions. They have galvanized unprecedented efforts to meet the needs of the world's poorest.".

The eight MDGs, as presented on the UN MDG Website – and are as follows:

1. Eradicate extreme hunger and poverty
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

How effective EIA and EMPs can support achievement of some portion of each of the eight MDGs is self-evident. Examples for each are provided in Table 8.

Table 8. How EIA and SEA Can Support Achievement of MDGs

MDG	Examples of How EIA and SEA Can Support Realization of MDGs.
1. Eradicate extreme hunger and poverty	Include effects of irrigation of crops, water management and flood control Support equitable resettlement and compensation. Provide electrical power for support of industries.
2. Achieve universal primary education	Reduce labor burden on girls and women, so time can be better spent in receiving education. Provide heat and lighting fro better learning environments.
3. Promote gender equality and empower women	Require provision of primary education opportunities to women has been demonstrated to be a powerful means of promoting equality and empowerment.
4. Reduce child mortality	Proper water management and requirements for development of potable water supply will greatly reduce infant and child mortality. Better crop yields and diversity of diet will promote better post- natal and childhood health.
5. Improve maternal health	Provision of clean water, and reduced labor load will promote better maternal health Better crop yields and diversity of diet will promote better maternal health and prenatal development.
6. Combat HIV/AIDS, malaria and other diseases	Proper design of dams and regulation of flow can greatly reduce vectors and reservoirs of disease. Supply of potable water can greatly reduce gastrointestinal disease, diarrhea, dehydration and compromised health, development or death.
7. Ensure environmental sustainability	Properly designed projects, EMPs and responsive compliance and enforcement assure environmental sustainability.
8. Develop a global partnership for development	Technology transfer through assessment of alternatives and adoption of best practices in project design and operation should further promote global partnerships and opportunities.

The UN MDG Website and supporting documentation can be accessed at http://www.un.org/millenniumgoals/index.html.

Section 9 Strategic Environmental Assessment

The World Bank's (WB) Environment Strategy, as adopted July 2001, is the proposed model for Strategic Environmental Assessment (SEA) in the SAPP region. The WB approach to SEA includes the systematic use of (SEA) in WB's operations to promote mainstreaming of environment by influencing planning and decision making processes at an early stage.

SEA is an integrative process and requires the participation of key stakeholders. The intent of SEA is to assure systematic analysis of the environmental effects of policies, plans and programs – e.g., use of water for power, irrigation and transportation in a given watershed or watercourse. An excellent and current overview of SEA, as interpreted by WB can be accessed at. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/0,,contentMDK:20687523~pagePK:210058~piPK:210062~theSitePK:244381,00.html

The International Association for Impact Assessment (IAIA) Website also provides a succinct overview of SEA components and purposes, and can be accessed at: http://www.iaia.org/Members/Publications/Special_Pubs/sp1.pdf

The recently published "Strategic Environmental Assessment", B. Dalal-Clayton and B. Sadler, Earthscan, 2005, is also a comprehensive and useful reference for the performance of SEA. Details of its content, and ordering information are available at: http://styluspub.com/books/BookDetail.aspx?productID=116310

Section 10 Conclusions

It can be concluded that in the interest of uniformity and consistency of approach in the performance of EIA, there is need for a mutually agreeable and systematic approach to EIA and SEA in the SAPP region. This is even more so in the case of hydroelectric projects where transboundary issues are virtually certain in most cases. Such an approach must be agreeable to and must satisfy the regulatory requirements of all parties. It is possible to succeed in this undertaking if SAPP EnvSC members take an active role in crafting such a uniformly acceptable approach to EIA. It will not be easy or fast – but will be worth the effort, as it will likely facilitate and expedite development of environmentally sound and mutually agreeable hydroelectric projects in the region.

Section 11 Recommendations

It is recommended that the content of The Country Guide and this report be posted on the SAPP Website for review and comments, that periodic updates be scheduled and that information provided herein be used as input to a Knowledge Base (KB) in support of development of a Decision Support System (DSS) for the performance of EIA for hydroelectric projects in the SAPP region.

Such a system would be framed on a standard template for an EIA and would guide the user through the decision-making process for regulatory applicability, determination of likely impacts and most appropriate mitigation measures, design of an EMP and proper sequencing of public involvement.

As a result of exercising the DSS and providing the requested information, a draft EIA would be produced. The draft would then be reviewed by technical experts, minor adjustments would be made as necessary (and bases for the adjustments used to update the DSS and KB). The product would be an essentially complete EIA that would satisfy all applicable country, agency and bank requirements.

Section 12 Corrigendum

Section 13 Appendices

APPENDIX 1: ORIGINAL SADC SHARED WATERCOURSE SYSTEMS PROTOCOL

Maseru, Lesotho 16 May 1995
The PROTOCOL

Water in the region is a scare resource with 70 percent of the regional surface shared between two or more member states. At the same time, a good number of states are prone to devastating droughts which all leave a trail of misery in their wake, drastically affecting humans and animals alike.

It is also projected that in the next 20 to 30 years, three or four SADC States will be facing serious water shortages if nothing is done now. It was in recognition of the importance of a coordinated approach to utilization and preservation of water that the SADC member States signed the Protocol on Shared Watercourse Systems at the 1995 Summit in South Africa. The main thrust of the Protocol which is a legally binding document, is to ensure equitable sharing of water and also ensure efficient conservation of the scarce resource.

Article 1: General Principles

For the purpose of this protocol, the following general principles shall apply:

1. The utilization of shared watercourse systems within the SADC region shall be open to each riparian or basin State, in respect of the watercourse systems within its territory and without prejudice to its sovereign rights, in accordance with the principles contained in this Protocol. The utilization of the resources of the watercourse systems shall include agricultural, domestic, industrial and navigational uses.

2. Member States undertake to respect and apply the existing rules of general or customary international law relating to the utilization and management of the resources of shared watercourse systems and, in particular, to respect and abide by the principles of community of interests in the equitable utilization of those systems and related resources.

3. Member States lying within the basin of a shared watercourse system shall maintain a proper balance between resource development for higher standard of living for their peoples and conservation and enhancement of the environment to promote sustainable development.

4. Member States within a shared watercourse system undertake to pursue and establish close cooperation with regard to the study and execution of all projects likely to have an affect on the regime of the watercourse system.

5. Member States within a shared watercourse system shall exchange available information and data regarding the hydrological, hydrogeological, water quality, meteorological and ecological condition of such watercourse system.

6. Member States shall utilize a shared watercourse system in an equitable manner. In particularly, a shared watercourse system shall be used and developed by member States with a view to attaining optimum utilization thereof and obtaining benefits there from consistent with adequate protection of the watercourse system.

7. Utilization of a shared watercourse system in an equitable manner within the meaning of paragraphs 4 and 6 requires taking into account all relevant factors and circumstances including:

a. Geographical, hydrographical, hydrological, climatical and other factors of a natural character;

b. The social and economic needs of the member States concerned;

c. The effects of the use of a shared watercourse system in one watercourse state on another watercourse state;

d. Existing and potential uses of the shared watercourse system; and

e. Guidelines and agreed standards to be adopted.

8. Member States shall require any person intending to use the waters of a shared watercourse system within their respective territories for purposes other than domestic use or who intends to discharge all types of wastes into such waters to first obtain a permit from the relevant authority within the Stated concerned. The permit shall be granted only after such State has determined that the intended discharge will not have a detrimental effect on the regime of the watercourse system.

9. Member States shall, without delay, notify other potentially affected States and competent international organizations, of any emergency originating within their respective territories.

10. In the event that implementation or execution of any planned measures is of the utmost urgency in order to save life, or to protect public health and safety, or other equally important interests as a result of an emergency situation, the member State planning the measures may, notwithstanding the provisions of paragraph 9, immediately proceed with implementation or execution, provided that in such event a formal declaration of the urgency of the measures shall be communicated to other member States.

11. Member States shall take all measures necessary to prevent the introduction of alien aquatic species into a shared watercourse system which may have detrimental effects on the ecosystem.

12. Member States shall maintain and protect shared watercourse systems and related installations, facilities and other works in order to prevent pollution or environmental degradation.

13. Shared watercourse systems and related installations, facilities and other works shall be used exclusively for peaceful purposes consonant with the principles enshrined in the SADC Treaty and in the Charter of the United Nations and shall be inviolable in time of international as well as internal conflicts.

Article 2:

Establishment of River Basin Management Institutions for Shared Watercourse Systems in the SADC Region

1. Member States hereby undertake to establish appropriate institutions necessary for the effective implementation of the provisions of this protocol.

2. Without prejudice to paragraph 1 above, member States undertake to the following institutions:

(a) A Monitoring Unit based at the SADC Environment and Land Management Sector (ELMS);

(b) River Basin Commissions between Basin States and in respect of each drainage basin; and

(c) River authorities or Boards in respect of each drainage basin.

Article 3: Objectives of the River Basin Management Institutions

The River Basin Management Institutions shall have as their main objectives:

(a)To develop a monitoring policy for shared watercourse systems;

(b)To promote the equitable utilization of shared watercourse systems;

(c)To formulate strategies for the development of shared watercourse systems; and

(d)To monitor the execution of integrated water resource development plans in shared watercourse systems.

Article 4: Functions of the River Basin Management Institutions

In order to attain the objectives set out in Article 3, the River Basin Management Institutions shall, in consultation with watercourse, States, perform the following functions:

(a) With regard to National Water Resources Policies and Legislation:

(i) Harmonization of national water resources policies and legislation; and

(ii) Monitoring compliance with water resource legislation and, where necessary,

recommending amendments thereto and the introduction of new legislation.

(b) With regard to Research, Information and Date Handling:

(i) Collecting, analyzing, storing, retrieving, disseminating, exchanging and utilizing data relevant to the integrated development of the resources within shared watercourse systems and assisting member States in the collection and analysis of data in their respective States:

(ii) Reviewing the provisions of National Development Plans relating to the water course systems;

(iii) Designing and conducting studies, research and surveys relating to the environmentally sound development and management plans for shared watercourse systems;

(iv) Stimulating public awareness and participation in sound management and development of the environment including human resources development; and

(v) Promoting in accordance with the national development plans of the Basin States, the formulation of integrated master plans for shared watercourse systems.

(c) With regard to Water Control and Utilization in shared watercourse systems:

(i) Recommending regulations of the flow and drainage;

(ii) Promoting measures aimed at flood and drought mitigation;

(iii) Recommending and promoting measures to control desertification, soil erosion and sedimentation;

(iv) Monitoring the utilization of water and agriculture, domestic, industrial and navigational purposes;

(v) Monitoring the establishment of hydroelectric power installations; and

(vi) Monitoring the generation of hydroelectric power.

(d) With regard to Environmental Protection:

(i) Promoting measures for the protection of the environment and the prevention of all forms of environmental degradation arising from the utilization of the resources of the shared watercourse systems;

(ii) Assisting in the establishment of a list of substances whose introduction into the waters of a shared watercourse system is to be banned or controlled;

(iii) Promoting environmental impact assessments of development projects within the shared watercourse systems; and

(iv) Monitoring the effects on the environment and on water quality arising from navigational activities.

(e) With regard to Hydrometeorological Monitoring Program:

(i) Promoting a hydrometeorological monitoring program in consultation with other SADC sectors.

A financial and regulatory framework for the River Basin Management Institutions referred to in Article 2 shall be annexed to this Protocol and shall constitute part of the Protocol.

(Note for further information of the Shared Watercourse Systems Protocol, the Annex to the Protocol and its respective articles please contact the SADC Sector Coordinator or SADC Secretariat.)

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[1] For the purposes of this guide, Environmental Assessment includes both ecological, social and health assessments. EA means assessment at project level (EIA) and at strategic level (SEA).