EIA Technical Review Guidelines: Tourism-Related Projects

Volume I

Regional Document prepared under CAFTA DR Environmental Cooperation Program to Strengthen Environmental Impact Assessment (EIA) Reviews

PHOTOS of TOURISM RELATED PROJECTS:

Resort
Cruise ships and marinas
Golf Courses
Ecotourism—zip lines?
Snorkeling shacks?

Prepared by CAFTA-DR and U.S. EPA Country EIA and Tourism Experts with support from:

USAID ENVIRONMENT AND LABOR EXCELLENCE FOR CAFTA-DR PROGRAM

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EIA Technical Review Guidelines: Tourism-Related Projects

Volume I

The EIA Technical Review Guidelines for Tourism-Related Projects were developed as part of a regional collaboration to better ensure proposed tourism-related projects undergoing review by government officials, non-governmental organizations and the general public successfully identify, avoid, prevent and/or mitigate potential adverse impacts and enhance potential beneficial impacts throughout the life of the projects. The guidelines are part of a broader program to strengthen environmental impact assessment (EIA) review under environmental cooperation agreements associated with the "CAFTA-DR" free trade agreement between the United States and five countries in Central America and the Dominican Republic.

The guidelines and example terms of reference were prepared by regional experts from the CAFTA-DR countries and the United States in government organizations responsible for the environment and tourism and leading academic institutions, designated by the respective Ministers, supported by the U.S. Agency for International Development (U.S. AID) contract for the Environment and Labor Excellence Program and a grant with the Central America Commission for Environment and Development (CCAD). The guidelines draw upon existing materials from CAFTA-DR countries, other countries outside the region, and international organizations. The guidelines do not represent the policies or practices of any one country or organization.

The guidelines are available from U.S. Environmental Protection Agency (U.S. EPA) in English and from the Central American Commission on Environment and Development (CCAD) in Spanish. Volume 1 contains the guidelines with a glossary and references which track with internationally recognized elements of environmental impact assessment; Volume 2 contains Appendices with detailed information on tourism, requirements and standards, predictive tools, and international codes; and Volume 1 Part 2 contains example Terms of Reference cross-linked to Volumes 1 and 2 for resort/hotel/condo developments, concessions, and coastal and marine projects respectively for use by the countries as they prepare their own EIA program requirements.

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CCAD COMISIÓN CENTROAMERICANA DE AMBIENTE Y DESARROLLO

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A. INTRODUCTION

These regional Environmental Impact Assessment (EIA) Technical Review Guidelines and associated Example Terms of Reference for tourism-related projects were developed as an outgrowth of the Environmental Cooperation Agreement developed in conjunction with the free trade agreements between the United States, the Central American countries of Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua and the Dominican Republic (CAFTA-DR). Developed by designated experts from all of the countries, it will be used as a basis for country-specific adaptation to their EIA programs.

Figure A- 1: CAFTA-DR countries

1 BACKGROUND

The CAFTA-DR "Program to Strengthen Environmental Impact Assessment (EIA) Review" was initiated as a priority for environmental cooperation undertaken and funded in conjunction with the free trade agreements. Designed to build on related references developed for the region or for individual countries, the Program included: a) sustainable training to build skills in the preparation and review of EIA documents and processes for all participants in the process, including government officials, consultants, industry project proponents, academic institutions, NGOs and the public; b) development of EIA Technical Review Guidelines and Terms of Reference for priority sectors: mining, energy, and tourism; c) country-specific consultation to provide tools and reforms to improve the efficiency and effectiveness of EIA, including deployment of EPA's GIS-based analytical tool to support EIA project screening and administrative tracking systems; d) recommendations for strengthening EIA procedures, and where necessary, regional and country EIA legal frameworks; and e) regional meetings among EIA Directors to direct and support these activities and share experiences. Work programs developed by the U.S. Environmental Protection Agency (USEPA) and U.S. Agency for International Development (USAID), were designed to complement other work which had been undertaken with the Central American Commission for Sustainable Development (CCAD) and the Union for the Conservation of Nature (IUCN) under a grant from the government of Sweden, which focused on small scale and moderate sized tourist developments, excluding marinas, piers and cruise line operations.

2 APPROACH

The guidelines were developed through a collaborative process consisting of two regional expert meetings for discussion followed by several rounds of review and comment on draft documents, and also benefitted from the overall guidance and active involvement of country EIA Directors. The work was supported by USAID and their consultants under the Environment and Labor Excellence Program (ELE). The overall approach to the development of the Tourism Sector EIA Review Guidelines and Terms of Reference was:

a. Creation of an expert team including the designation of senior experts by the Ministers of the Environment and for the Tourism Sector from each of the CAFTA-DR countries and the U.S. (drawn from U.S. EPA's senior expert EIA Reviewers and sector experts from within USEPA, the Department of the Interior's National Park Service, the Department of Commerce's National Oceanic and Atmospheric Administration particularly the national marine fishery service, the U.S. Army Corps of Engineers and Puerto Rico's Tourism Company, Environmental Quality Board and Department of Natural and Environmental Resources)
b. Organization of two regional expert meetings to review and guide all work products drafted with the assistance of a USAID's Environment and Labor Excellence contractor, Chemonics International
c. Identification of existing resource materials, standards, practices, laws and guidelines related to assessing the environmental impacts from tourism-related projects with particular emphasis on ensuring that we drew from guidelines developed for the CAFTA-DR region through CCAD, IUCN and USAID on tourism best practices and from international agreements, including in particular the Protocol Concerning Pollution from Land-Based Sources and Activities (LBS Protocol, 1999) under the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention, 1983), the International Convention for the Prevention of Pollution from Ships (MARPOL, 1973/1978), and the Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (London Convention, 1972)
d. Development of baseline information on current practice, anticipated growth, existing standards and guidance, norms, permits and mitigation requirements related to tourism in the CAFTA-DR countries and use this to assess the likely impact of adoption of the regional guidelines
e. Development of information on alternatives for pollution control and environmental protection drawn from benchmark organizations, development banks and countries including international practices established by industry, the World Bank, the Inter American Development Bank, the U.S., the European Union and other countries identified by the team of experts as being most relevant
f. Development of options to achieve the benefits of requiring siting, design, construction, operation, closure/reclamation, and site reuse approaches which eliminate, reduce, and/or mitigate the adverse direct, indirect and/or cumulative adverse environmental impacts related to tourism based on best international practice through EIA Review Guidelines and Terms of Reference
g. Adaptation of these Guidelines following regional training workshops to be held by the CCAD

3 OBJECTIVES OF PRIORITY SECTOR EIA GUIDELINES FOR TOURISM

Specific objectives of these Guidelines include:

a. Improve environmental performance in the sector
b. Improve EIA document quality and quality of EIA decision-making for the tourism sector
c. Improve efficiency and effectiveness of the EIA process for the tourism sector by clarifying expectations, providing detailed guidelines and aligning document preparation and review
d. Tailor guidelines to needs of CAFTA-DR countries
e. Provide technical guidelines for the identification of environmental, social and economic impacts of the tourism sector activities
f. Identify potential for avoidance and mitigation for adverse environmental, social and economic impacts from the tourism sector in relation to established requirements of law and industry best practice to empower options for consideration by industry and government officials
g. Encourage public participation throughout the process, a specific priority and request of CAFTA-DR country officials

4 SCOPE AND CONTENTS OF TOURISM GUIDELINES

The Guidelines address:

- Three groups of tourist related projects: a) hotel/resort development for the housing, care and feeding of tourists, b) concessions to support tourist recreational/adventure/specialty activities related to natural and cultural/historic sites and areas, and c) coastal and marine related projects such as marina operations, beach management, and cruise ship activities. It does not address highly specialized types of tourism such as "medical tourism". This guideline builds upon the work of IUCN tourism guideline which focuses on small and medium scale tourist developments. It also draws heavily upon the work of the International Network for Environmental Compliance and Enforcement (INECE) tourism support document.
- The full scope of tourism-related projects, including site assessments, selection of a preferred site, site preparation, mitigation plan to protect valuable and sensitive resources, construction, operation and maintenance, monitoring and site management, closure/reclamation, post-closure care, and foreseeable and related off-site activities
- Documentation of the proposed project and its alternatives to support impact assessment and improve decision making
- Identifying and evaluating potential environmental social, cultural and economic impacts
- Evaluating the full range of sustainable environmental measures to prevent, reduce and/or mitigate impacts
- The need for enforceable and auditable commitment language in an EIA to ensure that promised actions will be taken by a project proponent and that their adequacy can be determined over time and altered, as needed, to protect sensitive and valuable resources
- Example terms of reference for development of tourism related EIAs that are cross-linked to the details provided in the Guidelines

The Guidelines are organized around each aspect of what is typically required in an EIA document. The guidelines are divided into ten sections with accompanying appendices. The sections include:

A. Introduction
B. EIA Procedures and Public Participation
C. Project and Alternatives Description

D. Environmental Setting
E. Anticipated Impacts
F. Assessing Impacts
G. Mitigation and Monitoring Measures
H. Environmental Management Plans
I. References and Glossary of Terms
J. Example Terms of Reference for Tourism development, concessions, and coastal and marine related tourist projects (published in a separate Volume 1 Part 2)

The accompanying appendices (published in a separate Volume 2) include:

Appendix A: What is Tourism?
Appendix B: Overview of Tourism Activities in CAFTA-DR Countries
Appendix C: Requirements and Standards: CAFTA-DR Countries, US and Other Countries and International organizations
Appendix D: Rules of Thumb for Erosion and Sedimentation Control Measures
Appendix E: Sampling and Analysis Plan
Appendix F: Compensatory Mitigation for Losses of Aquatic Resources

5 ACKNOWLEDGEMENTS

The EIA Technical Review Guidelines for Tourism-Related Projects and associated Terms of Reference were developed by experts designated by their Ministers from the environmental and sector agencies of the United States and countries in Central America and the Dominican Republic that are parties to the CAFTA-DR Free Trade Agreements. Following development of the regional EIA tourism documents, the CCAD will host workshops in each of the CAFTA-DR countries and they will adapt these guidelines for their own use.

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B. EIA PROCESS AND PUBLIC PARTICIPATION

This section describes the general process and practices common to EIA procedures in CAFTA-DR countries, along with likely trends future directions of those programs as part of the evolution of the EIA process that has been seen internationally. Because these Guidelines and Terms of Reference were developed as regional products of designated experts from the CAFTA-DR countries they will be adapted to the unique features in each country's EIA laws and procedures.

1 EIA PROCEDURES

No work may begin, that is no site clearing, site preparation or construction, before the EIA process is complete and government agencies have either approved or provided conditioned approval of a proposed project. Early and frequent consultation with government agencies is highly desirable. All too often conflict is created when developers have gotten fairly far down the road with their project planning without appropriate consultation. Early consultation could have avoided many of those problems.

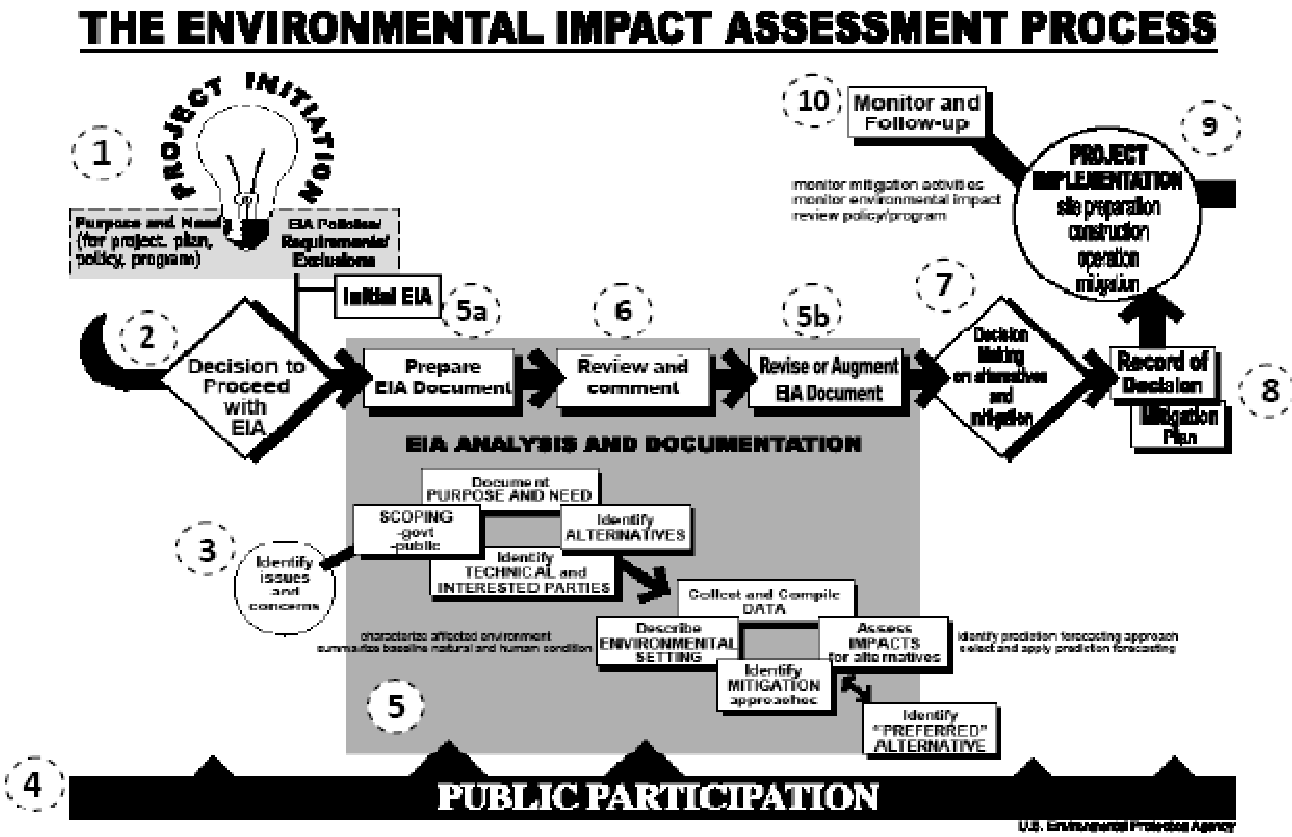
1.1 Project Proponents: From Project Initiation to the EIA Application

As illustrated in Figure B-1, a project proponent initiates the idea for a project based on a purpose and need for the action; in this instance some anticipated market for a particular tourist destination and expected profits from the. Between the idea and the application for EIA to the government for approval as defined in Table B-1 ("Responsibility" in the EIA Process), the project proponent will be exploring alternatives to meet the purpose and need of the project, as well as the economic and technical feasibility of the project and securing property rights if it is not already in their possession. It is during this early stage that environmental, social and economic impacts should be introduced, and alternatives developed -- even before an application is made for EIA. Many problems can be avoided through wise selection of the project location, site and operations design, and anticipation of issues such as closure taking the whole of the environmental setting into account early in the process. If environmental consultants or environmental impact expertise are brought in late in the process, at the stage when the proponent needs to prepare an application and an EIA document for approval, it limits the opportunities to build environmental, social and economic considerations into the project proposal as an integral part of developing project feasibility. This is universally considered to be a short sighted practice. Projects which require substantial financing often will have fatal flaw analyses of all sorts performed, including environmental. Some of the outcomes of such analyses also feed the narrative on project alternatives and why some of the alternatives were rejected.

1.2 EIA Application, Screening and Categorization

Each CAFTA-DR country has established its own EIA regulations and guidelines defining different circumstances and procedures for particular types of projects and situations. These regulations distinguish the size and nature of proposed projects or the types of projected impacts for which the full environmental impact assessment procedure and which types of projects or impacts might justify a streamlined procedure based on anticipated lower level of impact and nature of the proposed activity. Projects usually fall within one of three categories, some of which are further subdivided: A usually is high impact, B1 and B2, medium impact and C low impact but this varies by country. Screening is the process used by government officials to review an application for EIA to determine the appropriate categorization. For the most part, most but not all tourist related activities are usually considered among those projects with potentially high or high medium impact.

Figure B-1: The environmental impact assessment process



Source: Principles of Environmental Impact Assessment, U.S. Environmental Protection Agency, 1992.

Table B-1: "Responsibility" in the EIA process

	Project Proponent	Government
4 Public Participation throughout	1 Initiate Project	
	2 Prepare EIA Application	2 Screening: Review EIA Application and Categorization
	3 Scope EIA Issues	3 Prepare Terms of Reference and Scope EIA issues
	5a Prepare and Submit EIA Document	
		6 Review EIA Document
	5b Correct deficiencies and respond to comments	
		7 Decision on Project
		8 Incorporate commitments into legal agreements
	9 Implementation of project, environmental measures and financial assurance	
	10 Correct violations	10 Auditing, compliance monitoring and enforcement

Source: Wasserman, Cheryl, U.S. Environmental Protection Agency.

1.3 Scoping of EIA and Terms of Reference

Scoping is a process used to identify the important issues on which the EIA analysis should focus and those on which it would not be informative to focus. Although any preparer of an EIA would have to engage in a scoping process, the term often is used to describe a process of consultation with interested and affected stakeholders in the project, in the area and infrastructure potentially affected by the project and in the potentially affected resources. In CAFTA-DR countries of Central America and the Dominican Republic, government officials issue a Terms of Reference to help guide the preparation of an EIA document, in essence a form of scoping which usually includes a requirement for the project proponent to engage the public and stakeholders, including local governments and NGOs and tribal leaders, before proceeding to prepare the EIA document just for this purpose. In guidelines issued by the International Finance Corporation and as a practice in the U.S. and some CAFTA-DR countries, the project proponent would carry out public scoping early in the process for the most significant types of projects, presumably to be able to influence alternative project concept, design, operation and/or closure and influence the Terms of Reference for undertaking the EIA. Section B2 in this section of the guideline expands on public participation during the scoping process.

1.4 Public Participation throughout the Process

EIA is intended to be a transparent process with the opportunity for public involvement from the earliest stages of project development. It is customary for the Terms of Reference to include requirements for the project proponent to engage the public and to document the results of this outreach process in the EIA document. Countries should require a scoping meeting and will usually provide a formal opportunity for a public hearing after the EIA document is reviewed by government staff and determined to be complete. The Model Terms of Reference included in this guideline emphasizes the importance of involving the public as early as possible to ensure that opportunities for reconciling economic, social and environmental concerns can be considered. A special section on Public Participation is included in this guideline under Section B2.

1.5 Preparation and Submission of the EIA Document

The structure of EIA documentation of analysis has been fairly standardized over the many years it has been adopted as a practice. It includes:

- Cover sheet
- Executive Summary
- Table of Contents
- Project Description, Purpose and Need
- Alternatives, including the proposed action
- Environmental Setting
- Assessment of Impacts
- Mitigation and Monitoring Measures
- Commitment Document: Environmental Management Plan, which contains a facility-wide monitoring plan and a facility-wide mitigation plan, which addresses mitigation for environmental and socio-economic resources
- List of preparers
- List of Agencies, Organizations, and persons to whom copies of the statement are sent
- Index
- Appendices

In countries in Central America and the Dominican Republic, deficiencies in an EIA document are usually addressed through additional supplemental submissions of Annexes and correspondence. If deficiencies are sufficiently significant an EIA document might be rejected and the project proponent would restart the entire process. In the U.S. a draft EIA document is submitted for both government and public review and a final document is then submitted which includes the response to comments and any additional analysis that is needed. A Record of Decision follows the final EIA to inform the government and interested parties what alternative has been selected and that the project is moving forward.

1.6 EIA Document Review

Government EIA Reviewers have an independent review function to determine if an EIA submitted by a project proponent:

a. Complies with minimum requirements under country laws, regulations, and procedures,
b. Is complete
c. Is accurate
d. Is adequate for decision makers to be able to make informed decisions and choices, including alternatives that might serve to avoid adverse impacts, and reasonable commitments to mitigation for adverse impacts that cannot be avoided
e. Distinguishes what may be a significant concern from those that are less significant
f. Provides a sufficient basis for assuring that commitments to environmental measures will be met, taking into account not only the EIA but any additional supporting documents such as:
    - Environmental Management Plan
    - Mitigation measures which are integrated in the project design, operations and closure, and their maintenance

- Monitoring and reporting measures
- Pollution control measures and their maintenance
- Infrastructure investments

1.7 Decision on Project

In the decision making process which is informed by the EIA analysis, the actual decision on the project and its rationale are important, particularly if the EIA analysis is not just to be a paper exercise. It therefore is very important that the consideration of alternatives, impacts and their mitigation be written in a clear and accessible manner to the range of stakeholders who are making decisions related to the project. Part of the decision process is engagement of stakeholders within and outside government in a timely and constructive manner, allowing for the type of give and take needed to address and find acceptable solutions to diverse interests.

1.8 Commitment Language for Environmental Measures

Countries differ on the vehicles they use to establish and hold project proponents accountable for commitments made during the EIA process, ranging from reliance on the EIA document itself to a document from the government establishing project environmental feasibility which highlights commitments, the environmental management plan, a mitigation plan, an environmental permit, concession and/or contract.

1.9 Implementation of Environmental Measures

The EIA process objectives can only be achieved if promises and assumptions made in an approved EIA document are followed in practice. Commitments are usually secured with financial guarantees. The commitment to implement environmental measures runs throughout the process from site preparation to closure. It is the responsibility of the project proponent to implement measures unless the commitments are assigned and agreed to by other parties such as might be the case in the provision of adequate infrastructure to address needs to treat liquid and solid waste from a site, or to construct a road.

1.10 Auditing, Monitoring and Follow-up Enforcement of Commitments

Countries employ a mix of mechanisms to ensure that commitments in the EIA document are followed, including: including short and long term monitoring and reporting in the commitments by project proponents; creating and certifying third party auditors and defining their roles in the process; government inspection; and sometimes monitoring by the community or NGOs to assure compliance. It is not sufficient to monitor compliance with commitments, and failure to meet commitments should be followed by enforcement for failure to comply in order to compel actions needed to protect environmental, socio-economic and cultural interests. For this system to work, commitments in the EIA should be written in a manner which clearly provides the basis for an independent audit and also clarity for the project proponent to ensure it is clear what they will be undertaking and when. Special attention should be paid to monitoring and necessary actions to protect human health; sensitive biological, watershed or coastal resources; and sensitive cultural, historic or archaeological resources.

2 PUBLIC PARTICIPATION

2.1 Introduction

Section B2 addresses requirements for public participation. Included in this chapter are:

1. Requirements for participation;
2. Methods for identifying and engaging affected and interested publics; and
3. Reporting on and responsiveness to public comments.

Public participation and stakeholder involvement is an essential and integral part of the EIA process and CAFTA-DR countries have adopted policies, regulations and procedures to require that this occurs throughout the EIA process. Reviewers should ensure that minimum requirements are met, that key stakeholders and important issues have not been ignored or under-represented, and that opportunities for effectively resolving underlying conflicts are provided. The process for engaging the public and other stakeholders fails if it is undertaken as an afterthought or poorly implemented or viewed as a one-time event. Opening up real opportunities for engagement by the public, local governments, and interested and affected institutions requires a degree of openness and disclosure which can be uncomfortable for some who fear that it might open the door to unnecessary complication, higher costs and loss of control. However, the clear lessons from failed public participation processes are just the reverse: if the public is engaged early, and in an open and transparent manner, the process can help to avoid both unnecessary conflict and potential financial hardship due to project delays and occasionally even permit denial. This chapter will refer to public and stakeholder involvement interchangeably, but requirements for and the timing of participation for different subgroups may vary.

2.2 Requirements for Public Participation

Public participation requirements of individual countries should be identified and followed. Because there is no easy formula for describing what is required to be successful in a given situation, legal requirements for public participation are formulated as minimum requirements of law, and generally do not reflect best practices designed to meet the full goals of public participation as an ongoing process. To address the need to tailor a public participation plan to the circumstances some CAFTA DR countries require that the project proponent develop and implement such a plan. The EIA should document the steps taken to meet requirements and overall goals of public participation including: when, who was involved, what the comments were and how they were considered.

Public participation requirements may include:

- General Requirements to include the public in the EIA process
- Public Notification: Rules about the use of media to announce the EIA process and the points of participation for the public and requirements for the Ministry or the owner/developer to announce the public consultations in national and local media. Public participation and consultation ideally should be initiated at the scoping stage of the EIA process, before steps are taken to prepare the EIA document. This can be accomplished through a public notice of intent to prepare an EIA for a specific action. Such a notice of intent should include a description of the proposal and describe how the public may participate in the process
- Public Consultation: Rules about the consultations and observations that the public presents
- Public Disclosure: Requirements that the Ministry or the owner/developer publish the EIA for review during the public consultations
- Public Written Comment: Requirements for the public to have the opportunity to submit written comments to the Ministry and the owner/developer in addition to the consultations. Requirements may specify whether solicitation of comments from the public must take place in formal public hearings, or may allow or encourage informal workshops or information sessions
- Public Hearings: Most laws on public participation provide for the opportunity for a public hearing. This is a formal legal process with little opportunity, if at all, for give and take discussion on options, alternatives and assumptions. It is for that reason it is considered by most experts on public participation to be the least effective means for actual public involvement
- Consideration of Public Comments: Requirements for public comments to be considered in the review by the government if they have a sound basis
- Allocation of Costs: Rules about who needs to pay, i.e. the owner/developer generally must pay for the consultations with some exception where the Ministry pays.

Reviewers should carefully examine:

- Were requirements for public participation identified and complied with?
- Was timing of public notice sufficient to allow meaningful comment?
- What documents and information were disclosed and when?
- Are there obvious concerned public groups that were not involved and consulted?
- Were opportunities to address public concerns and information overlooked?

2.3 Methods for Identifying and Engaging Affected and Interested Public

Successful public participation processes are built upon plans developed and tailored to a specific project or program. This section addresses: (1) the identification of stakeholders, taking into account the goals and objectives of the specific project or program that is being analyzed in the assessment and the potential issues of concern; and (2) methods, or the tools and techniques to engage the identified stakeholders, when those tools are employed, including roles and responsibilities.

2.3.1 Stakeholder Identification

Project proponents and their consultants should make a diligent effort to identify and engage individuals and groups both within and outside of government who might either be affected by or interested in a proposed project and its potential impacts. The geographic scope should include the areas in and around the project, from the perspective of both political and natural resource boundaries, in other words, the full geographic scope of each of the natural and human resources potentially affected by the proposed action. Identifying the specific issues presented by a proposed project or program will help to reveal the key stakeholders, and the stakeholders also will help to identify issues for analysis. Additional stakeholders will be discovered throughout the entire assessment process and should be included in subsequent public participation activities.

Potential stakeholders to be considered:

- Persons living and working in the vicinity of the project
  - individual citizens with specific interests
  - local residents and property owners
  - local businesses and schools
- Local, provincial, tribal, and national governmental agencies, including regulators and those responsible for infrastructure such as roads, water, solid waste
- Citizen, civic, or religious groups representing affected communities
- NGOs with specific interests
- Environmentalists and conservation groups interested in protection and management of sensitive ecosystems and protected areas
- Recreational users and organizations
- Farmers, fishermen, and others who utilize a potentially affected resource
- Industry groups such as fisheries, forestry, and mining
- Technical experts
- Low income, minority, people who may be disproportionately affected
- Indigenous peoples

2.3.2 Engagement Methods and Timing

A variety of tools and techniques can be utilized during the public process depending upon the level of public participation sought, which can range from merely providing information to working in a collaborative relationship. Although laws and regulations might only require a formal public hearing, "talking at the public" is not a substitute for active listening. That is why public hearings are historically poor ways to engage the public, and it is best to augment formal procedures with other processes to enable the give and take of dialogue and discussion. Cultural nuances may make other types of outreach helpful and informative, such as home visits with elders or people who do not trust public meetings.

Three consistent lessons learned for effective public participation process are to:

- Adapt the process to meet the needs of the circumstances
- Reach out to and understand the audience
- Start early in the EIA process

To be effective, public participation should be tailored to the particular audiences and meet the goals of the specific public engagement or communication, and those goals should be clear. Communications which are early, clear and responsive both to information provided and concerns raised are essential to build trust. The selection and timing of methods used to engage stakeholders and the broader public should result in: a) encouragement to offer information important to assessing impacts and developing alternatives, b) transparency about what is proposed, its potential impacts and means of addressing them, and c) a clear message to all members of the public that their input is important and useful throughout the EIA process.

Public participation tools often used in an EIA process:

- Public meetings
- Public hearings
- Small group meetings or workshops
- Community advisory panels
- News releases, newsletters with public comment forms, fact sheet, flyers
- Media – feature stories, interviews, public service announcements
- Project/program web sites
- Public comment periods soliciting written comment letters
- Information repositories or clearinghouses
- Speakers bureaus
- Surveys
- Mailing lists
- Briefings by and for public officials
- Use of social networking such as Facebook, Twitter, etc.

There are several guidelines that have been developed by the CAFTA DR countries (e.g. Guatemala) and international organizations concerning the planning and implementation of public participation which are noted in the reference list. Public Participation Tool Kits are available from EPA in different languages at http://www.epa.gov/international/toolkit and from the International Association for Public Participation at http://iap2.affiniscape.com/associations/4748/files/06Dec_Toolbox.pdf Also see http://www.epa.gov/care/library/community_culture.pdf

Scoping occurs early in the EIA process to identify key issues, and to focus and specify the assessment process. Many of the CAFTA-DR countries require project proponents and their consultants to engage the public during this phase, before beginning work on the EIA. Scoping typically is conducted in a meeting or series of meetings involving the project proponent, the public, and the responsible government agencies. The structure of the meetings may vary depending on the nature and complexity of the proposed action and on the number of interested participants. Small-scale scoping meetings might be conducted like business conferences, with participants contributing in informal discussions of the issues. Large-scale scoping meetings might require a more formal atmosphere, like that of a public hearing, where interested parties are afforded the opportunity to present testimony.

Other types of scoping meetings could include "workshops," with participants in small work groups exploring different alternatives and designs. Meetings may need to include interpreters to translate information for people who do not speak the language in which the meeting is being conducted, as is the case with all procedural and analytical stages of the EIA process.

2.4 Reporting on and Responsiveness to Public Comments

Public input should be reflected in changes in the assessment, the project or program, or to commitments for mitigation. Project proponents should document specific steps taken to engage the public and other stakeholders, and the timing of those engagements, both before preparing the EIA and during its development. Included in the annexes of the EIA should be a summary of public outreach activities, audience, number of persons, organizations involved, concerns raised, responses to comments and, if required, actual copies of written comments received. Reporting on comments obtained through any of the methods identified above should be sufficiently clear to enable an EIA reviewer and the public to assess responsiveness to comments, including whether they were understood, whether they were found to be appropriate or not and why, and if appropriate, what actions were taken to respond to them and whether those actions are sufficient to fully address the concerns. Several approaches might be acceptable to summarize or include actual transcripts and copies of oral and written comments and to demonstrate responsiveness through narrative, tables and cross-references to specific changes.

C. PROJECT AND ALTERNATIVES DESCRIPTION

1 INTRODUCTION

Environmental Impact Assessment starts with the description of the proposed project with sufficient detail to support a credible assessment of impacts for both the proposed actions and reasonable and feasible alternatives. This section contains some of the most important information in the EIA since it provides the core data for forecasting potential environmental impacts, and for reducing, eliminating, mitigating or in limited circumstances compensating for those impacts.

The main elements of the description of the proposed project and alternatives should include:

- Purpose and need: A clear statement with supporting information on the project objectives and justification on the project objectives and justification (See C-2)
- Description of the proposed project detailing:
  - How it meets the purpose and need (See C- 2)
  - Facility, site and engineering design in sufficient detail to support an accurate identification and assessment of impacts (See C- 3)
  - Coverage of all phases of the project both in chronological time from site preparation to construction to operation to completion to monitoring and site management and also phases if there are plans to increase the capacity or add facilities and amenities at later points in time (see C- 4)
  - Expected releases into the environment (See C-4)
  - Expected demands on resources (e.g. water, energy, disturbed and permanent changes to land cover) and infrastructure (e.g. transportation, drinking water treatment and delivery, solid waste, waste water collection and treatment, energy and communications infrastructure) (See C-4)
- Alternatives: an identification of alternatives for meeting the purpose and need which are economically and technically feasible, and sufficient detail for the most appropriate alternatives to permit comparative assessment of impacts. This can include modifications to the proposed project, its design, location, site configuration, scope and/or operations, or entirely different projects to meet the purpose and need. (See C- 5)
- Documentation of the economic viability of the proposed project.

PROJECT DESIGN

Whether a resort, hotel, marina, dock, or concession, the appropriate environmental practices for construction and operation begin with appropriate facility, engineering and site designs. This design takes into account:

- Type of facilities, size and capacity
- Location (Siting) and site plan
- Erosion control and drainage plans
- Construction and area of disturbance
- Size of the project footprint
- Transportation and site access
- Emissions, effluents and other wastes resulting from construction and operations
- Support facilities and services required
- Use of local infrastructure and manpower
- Closure and restoration plans, if applicable
- Projected use and demand on local tourist attractions

The ultimate goal of the design is to provide a blueprint for the construction and operation of an environmentally and economically desirable project, from start to finish.

Maps and plan views must be developed to show the layout of the project and proximity of sensitive receptors of environmental impacts. The design must also describe size and capacity as well as demands on resources and for infrastructure.

2 DOCUMENTATION OF PURPOSE AND NEED

The description of a proposed project begins with description and supporting analysis of the underlying purpose and need for the project, sometimes referred to as the objectives and justification for the project. In describing the underlying purpose and need, the EIA should be more specific than assertions that more tourism and economic development might be needed. The assessment of impacts will be different based on the responses to several questions that need to be made clear in the EIA:

- What is drawing tourist activity to the proposed location?
- Who is served by the tourism-related project(s) and for what purpose(s)?
- What are the demographics of the target tourists and sources of information?
- Where is the tourism-related activity needed and what form must it take?
- How does the proposed project advance national and local policies and plans for attracting tourist activity and/or protecting sensitive ecosystems and cultural resources?
- How much support for tourism is needed and when are different quantities and quality of experience needed?
- What are the levels of uncertainty in the assessment of needs?
- Will local residents be displaced by the tourism development?

The purpose and need description also should help to explain whether the proposed project is a new project, an expansion or a replacement/maintenance of an existing project; whether, how and why the project might be phased in over time. It should also identify who is the intended audience, i.e. will it be for local use or for visitors coming to the area? Will it be used domestically or serve those traveling from other countries? Finally, as noted above in the questions, the project justification should elaborate on the consistency of the proposed project with any national, regional or local land use or economic development plans and related tourism sector incentives.

The purpose and need for the project will help to define the scope for purposes of the EIA. For example, if a harbor is being built, it is not necessarily a tourism project, but if a harbor is being expanded or relied upon for cruise ships which will be a means of access to the tourist destination, then its impact would be included in the tourism-related EIA preparation.

3 PROJECT DESCRIPTION

Information on the proposed project and alternatives should be sufficient not only to describe how it meets the purpose and need but as a basis for identifying and assessing its impacts. This project description should include the nature sizes and type of project and all related facilities and activities, its design, construction, operation, site design and land area, subsequent anticipated expansion and decommissioning or future use as well as the profile of direct releases into the environment, employment, resource and waste streams, related transportation and the like and usage of surrounding tourist attractions which are elaborated below for tourism facilities and activities.

3.1 General Information

The proposed project, general information will typically include:

- Project proponents
- Project team, including those financing, constructing and operating the project as well as the team preparing the EIA document
    - Names, contact information
    - Professions and experience/certifications
    - Experience with this type of project
    - Demonstrate the appropriate interdisciplinary makeup of the EIA team
- Legal and regulatory frameworks: information should include details about:
    - Land ownership (including if appropriate, any government authorizations, permits, leases, and maps showing the area boundaries)
    - Applicable laws (including land use requirements demonstrating conformity and compliance with applicable land use plans, applicable tourism strategies and plans
    - Applicable environmental standards, norms and requirements set forth at the international, national, regional and/or local levelsIn
    - Required regulatory approvals and/or permits for all stages and their status
    - Applicable land use requirements (demonstrate conformity and compliance with applicable plans)
    - Applicable tourism strategies and plans – national, regional, and local
    - Applicable natural resource management or protected area management plans and responsible agency(ies) (demonstrate conformity and compliance with all applicable plans)
- Voluntary certification programs related to best practices for which the project will be designed to comply with requirements for certification and plans for doing so
- Financial viability of the project

3.2 Overall Project Description Information

The overview of the proposed activities should include a general description of background information to place the proposed tourism project in context. Typically by the time an EIA is started much of the preliminary design work has been completed by the project proponent to prove economic feasibility and support bankability of the project. The designs and construction plans may not be entirely complete but most if not all of the details required for environmental impact assessment as noted above should be available.

The project should be described in terms of its location, size, layout, basic activities, and project lifecycle schedule (design, construction, operation, and closure stages) and pre-construction land uses with actions that will be taken to convert from a previous to a new land use. Overview information includes:

- Project location and access (shown on an overview map)
- A general description of the overall project including project type
- Identification of each component including support facilities and infrastructure with site layout, site plan, and schematic drawings
- Initial construction sequencing, monitoring and management assessment, and life of the operation through closure
- Project Facilities description, including:
    - Size

  - Plan-view or blue print drawings of buildings to be constructed, their dimensions and building materials
  - How each will be built, manpower, sources of materials, storage on or off site
  - Employment for the project, where it will be coming from, level of skills
  - Access rights
  - Dimensions and land area affected
  - Design on the site with maps and geospatial information (longitude and latitude)
- Project Operations: The description should elaborate:
  - Energy (fuel and renewable) sources
  - Processing of energy sources to produce electricity as appropriate
  - Technologies employed and their profile of air and water releases and waste streams
  - Infrastructure plans to manage water, air and waste and resulting levels of release into the environment
  - Emissions, effluents, wastes and other physical factors resulting from construction and operation of the power plant or transmission line
- Initial construction sequencing should be presented, including the scheduling of construction for the various components of the tourism project. This should include construction of:
  - Roads
  - Repair shops
  - Warehouses and other support facilities
  - Power sources
  - Pollution reduction and control systems
  - Transmission lines to be accessed or built
  - Water sources and conveyances
  - Material handling systems
  - Quantitative and qualitative information on the degree of site clearing and vegetation removed from the site at any point in time, plans for sequencing site clearing and resulting changes in plant cover, collection, storage and disposal of resulting debris
  - Protection of sensitive habitats and biological resources
  - Protection of cultural, historical, or archaeological resources
  - Extent and location of disturbed areas and any non-permeable surfaces throughout the project
- The project and its geographic, ecological, social, and temporal context includes any offsite investments that may be required, for example:
  - Dedicated and shared pipelines
  - Roads, airstrips or airports, water access, parking lots, and power generation facilities for the operation, including properly designed dredging plans and properly located dredged material disposal sites
  - Water supply, including drinking water treatment systems and drinking water treatment systems, and if necessary, desalination of seawater and discharge of the desalination brine
  - Housing
  - Raw material and product storage facilities
  - Wastewater collection and treatment, location of wastewater discharges into any water bodies as well as potential wastewater reuse opportunities on the site (i.e., landscaping, golf course, toilets, etc.)
  - Stormwater and nonpoint source runoff controls
  - Waste management, including any plans to reduce, reuse, recycle and/or reduce solid waste and any plans for waste that could become marine debris

  - Storage of fuels and hazardous materials
  - Resettlement plan or indigenous peoples development plan
- Detailed maps with site design and detailed topographical and special mapping relating the proposed project to the geology of the project area: This will of course be an important element of the "Environmental Setting" section of the EIA. Information presented should include, but not necessarily be limited to:
  - Local and regional geology
  - Soil characterizations
  - Geotechnical zone
  - Terrestrial, watershed, coastal, and marine habitats, including sensitive habitats that may be essential to endangered or threatened species, or nursery areas for terrestrial or aquatic species

  This information will be critical for superimposing on the baseline environment later to estimate or predict the net environmental and socio-economic impact, which may ultimately be positive, negative or neutral.
- Transportation Information including the mode of transport location and the intensity of transport from automobiles, bus, boat, rail,, ships, etc., including
  - Transport of raw materials and supplies
  - Transport of the tourists
  - Transport of the employees during construction and operations
- Details on architectural and engineering design

3.3 Project Scope: All Project Phases and Related or Connected Actions

All tourism projects include the following phases:

- Site location
- Site preparation
- Construction
- Operations and Maintenance
- Closure: restoration, abandonment or reuse

All phases and details about them should be provided.

All related or connected actions should be addressed in the EIA. There may be different entities and project proponents responsible for different aspects of proposed projects and alternatives. Even if there are different entities involved the test is whether a proposed tourism project X would still be proposed if another project Y were not also proposed. For example, a resort is proposed for a location near the coast with no beach and includes plans for creating a pocket beach. The pocket beach will be supplied with sand by dredging an adjacent beach. So, the two projects should be assessed at the same time either by cross referencing in separate EIA documents or within a single, integrated document.

3.4 Project Details

Project details should be provided for the proposed project and the alternatives that are included in the EIA. The project details should furnish sufficient detail to give a brief but clear picture of the elements and main activities that will take place during each stage in the project lifecycle, and should contain the following information on the proposed project and alternatives (see Section C.5):

- The location of the project should be presented using maps showing general location and specific location, elevation plan, project boundary, and project “area of influence.
- Each project component should be described, and shown on a diagram and/or map, including project layout, permanent and temporary structures, and major on-site and off-site project elements such as access roads, power and water supply, staff housing, storage facilities, etc.
- Detail of size of each component, including temporary structures and support facilities, of the proposed development should be provided. As above, these may best be described on diagrams and maps, with short written descriptions that refer to the visual aids.
- Description of standard best practices to be incorporated into the project. This should be consistently carried through in the calculations of environmental releases, resource and infrastructure demands and impact assessment and the environmental management plan and can be a more detailed and activity-specific discussion of the background information provided above.
- Expected resource use during construction and operation, including raw material inputs, emissions, and waste discharges. This should be provided for permanent, temporary, and support features.
- Proposed schedule for approval of all required permits, and for construction and project implementation.
- Relationships among the technical, economic, social, and environmental features of the proposal.
- Expected visitation and use of the proposed facilities and resources and expected seasonal fluctuations should be described. The demand may be determined by guest rooms if the development is primarily a hotel; but if it provides other amenities, a discussion of daily use and other types of patronage should be included. If the carrying capacity is expected to fluctuate by season, this should be described, and numbers of visitors estimated.

The above information should be provided in enough detail for impact prediction and for mitigation measures to be understood or additional measures to be developed. Not all the detailed engineering information developed for the project needs to be included in the EIA’s project description. The amount of detail is dependent on the extent of the development, and the information that is needed to conduct an accurate environmental review. More detail should be provided on those key aspects likely to cause environmental impacts as well as parameters that will guide the analysis of the nature, significance and extent of impacts.

If there is need for any resettlement, it should be explained and described. This should be linked to the information on land use, land ownership, resettlement policy).

3.5 Maps, Diagrams, Site Design and Plan

Wherever appropriate, maps, flow diagrams, and other visual aids should be used to summarize information, and to keep descriptions concise. Schematic representations of drawings from the feasibility study may be reproduced, but they should be drawings that will contribute to EIA reviewers’ understanding of the project and potential environmental impacts.

The actual number largely depends on the size, extent, and magnitude of the project. The description of the project ((a) above), should include at least an overview map and a detailed site plan.

- The general location of the development should be presented on an overview map, with detailed plan view drawings of the property which places the activity in its geographic context.

A short description of the location should complement the map. On the same map, the specific location, elevations, project boundary, and project "area of influence" may be shown. (Note, Section F defines area of influence).

- A *site plan*—a detailed diagram, or for smaller scale developments, a hand drawn schematic could do—should be used as the basis for describing the overall activity: project components, access points, and ancillary features. If there is no existing *site plan*, one should be prepared which shows the layout of the development and important features. If this is an expansion of an existing tourism development/facility, this should clearly be noted, and existing structures and proposed structures should be shown on the plan. Depending on the size and components of the project, one site plan may suffice or, for larger developments several will be needed to adequately display project components.

The *overview map* and the *site plan* should be presented at a scale that allows the reviewer to understand each component in relationship to the other components. The overview map and the site plan should show natural features such as topography, existing structures and communities, water bodies, wetlands, flood plains. This context helps in assessing the placement of proposed facilities and potential alternatives.

Especially for larger scale developments, a summary table showing the type, quantity, and size of each component can also be useful for understanding the general layout, footprint, and context of the development.

3.6 Details on Construction Procedures

The Project Description should present a condensed description of the construction phase. This section should describe when, how, and by whom the facilities are to be constructed. A construction schedule and construction sequencing should be included in the Project Description; this is important for determining the extent of environmental impacts. Elaboration of construction details and site preparation are particularly important to anticipate and address issues related to loss of habitat, mudslides, erosion, contamination of stream and river segments, negative impacts to endangered or threatened species and their habitats, and negative impacts to sensitive ecosystems.

Information on the construction phase should contain a brief description of construction plans for all physical features to be constructed or renovated, including temporary, ancillary, and permanent structures and their location relative to key natural features on and off-site. It should include:

- The type of construction material to be used.
- The type of machinery required and where it will be housed and how the site will be accessed.
- Locations from which fill material will be sourced.
- Locations where fill material will be placed on-site.
- Locations where fill and other construction material will be temporarily stockpiled/stored.
- Key areas (related to environmental sensitivity/importance) that will remain undisturbed during construction (waterways, wetlands, forested areas and other "green space," etc.).
- Temporary diversions for waterways, erosion control barriers, and other best practice/mitigation measures.
- For temporary structures (storage areas, construction employee housing including water, sewage, and power connections, water diversions, erosion control barriers, temporary access roadways), the decommissioning process, including measures for returning the area to pre-construction features.

- Disposal, recycling or disposition of debris, i.e. vegetation or other materials removed from the site to prepare for construction.
- New or existing roads, or alternative transportation to transport construction material, to dispose of construction debris, and/or transport construction workers (elaboration in section 3.7).

Often components of tourism development (or any construction project) are described as having a "footprint." A construction footprint, in terms of an EIA, is the area of disturbance. For example, a roadway may be only 4 meters wide, but the entire area disturbed may be 8 meters wide. A footprint can be described in terms of temporary (short-term) disturbance and permanent disturbance. Temporary disturbance is usually the area disturbed during the construction phase, some of which may be returned to pre-construction features once construction is complete. The permanent footprint is the area that has been permanently converted to its new use, usually a subset of the temporary footprint. Both of these are important for impact assessment and prediction, and should be clearly described in the Project Description section. Measures for restoring pre-construction contour, soil, vegetation, and other natural features should be described. A summary of details required for the construction phase of a project is provided in Table C-1.

Table C-1: Information to be included in the EIA for the construction phase

COMPONENT	PROJECT DESCRIPTION INFORMATION
Site Clearing	• Land area cleared and location of any clearance activity • Protection of sensitive terrestrial, aquatic or marine habitats and species resources • Protection of cultural, historical or archaeological sites • Equipment to be used and man-power requirement • Storage, removal and disposition of debris
Sediment and Water-Control Facility	• Description sediment and stormwater control practices to be incorporated into the project. • Temporary diversions for waterways • Erosion control barriers • Stormwater and nonpoint source runoff control
Temporary Ponds and Permanent Impoundments	• Location • Design criteria • Spillway and inlet designs • Constructed wetlands for wastewater or nonpoint source water management
Culverts, Dikes and Diversions	• Location • Size • Design criteria
Groundwater Management	• Number of wells • Location • Design • Pumping rates • Drawdown • Potential for saltwater intrusion
Landscaping: Hardscaping or Vegetation	• Green spaces/landscaping • Vegetation types • Avoid non-native invasive species • Vegetative management • Irrigation (including grey water systems if applicable) • Fertilization • Pest control • Fencing

COMPONENT	PROJECT DESCRIPTION INFORMATION

Construction Camp	Description of the camp including but not limited to:
	• A map showing all facilities at a legible scale appropriate to the size of the project
	  ○ Buildings by type (use) and size
	  ○ Roads
	  ○ Electrical transmission lines and/or substation
	  ○ Drainage
	• Water supply and distribution
	  ○ Distribution system
	  ○ Use (m3/day)
	  ○ Rights
	  ○ Sources

Fuel and Chemical Storage	• Include an inventory of chemical, toxic or hazardous substances, active elements, sites and storage means, safety aspects regarding transportation and handling and any other relevant information
Construction Material and Supplies Storage	• Give a complete list of the raw materials and construction materials to be used, indicating the amounts per day, month, and the storage means

Worker Housing	Number of rooms by:
	• Structure (if more than one structure will house rooms)
	  ○ Number and types of beds (single or double occupancy beds)
	  ○ In-room or shared bath/toilet facilities
	  ○ Other in-room facilities (kitchens, kitchenettes, pools, Jacuzzis, etc.)
	• Locations, sizes and types of common bath/toilet facilities
	• Cafeteria
	• Energy generation and use requirements
	• Closure or transition from construction camp to onsite employee housing
	• Sanitation

Worker Parking	• Location, size, surface, transportation requirements
Excavations	• Locations from which fill material will be sourced • Size and depth of excavations • Locations where fill material will be placed on-site and transported • Locations where fill and other construction material will be temporarily stockpiled/stored • Borrow and spoil disposal • Preservation of ground water resources
Equipment Storage and Maintenance	• Transportation mobilization and mobilization frequency • Machinery and equipment mobilization routes to be used, as well as the features of the ways on which they will be transported, including a map of routes, as applicable, and mobilization
Construction Waste Management	• Location • Distance to landfill • Trucking requirements • Traffic control
Environmentally Sound Sources and Suppliers	• Excavation material • Locations from which fill material will be sourced • Locations where fill material will be placed on-site • Locations where fill and other construction material will be temporarily stockpiled/stored
Dredging	• Dredging operations and dredged material disposal sites • Location (on-land or off shore) • Description of disposal site (new or existing, approved site) • Quantity of materials dredged and methods used • Location, capacity and distance to landfill or disposal site • Transportation requirements
Construction Techniques	• Location of pylons – quantity and location for buildings, docks, and piers • Use of techniques for climate change adaption such as stilts • Use of “Green” construction techniques

COMPONENT	PROJECT DESCRIPTION INFORMATION
Small Harbor or Marina	• Oceanographic conditions, water circulation and tidal flushing in the harbor/marina • Port reception facilities for wastes (oil, trash, hazmat, etc.) • Recycling facilities for waste • Location of sensitive marine or coastal habitats • Actions to be taken to avoid damage to groundwater resources • Oil spill plans

3.7 Transportation: Roads, Pathways, Air Strips, and Boat Facilities

Transportation to resorts can be via land, sea or air. Details in the EIA should be given the proposed locations, methods of transportation, and facilities. Of primary importance are roads. Access roads and internal roads are to be included in the site plans submitted with the EIA, and if access roads need to be constructed or rehabilitated, details are needed on the materials, methods and designs. In some cases, the tourism development may include an internal roadway system. For roads to constructed, the engineering design should include maps and specific design information including:

- Timing of construction
- Road surface and shoulder width and barriers
- Grade specifications
- Construction methods including clearing and grubbing
- Construction materials (if waste rock will be used, include geochemical specifications it must meet, e.g., net neutralizing potential to acid generating potential must be at least 3:1)
- Compaction specifications
- Stream crossings and associated designs
- Sedimentation and erosion prevention structures and practices
- Stabilization methods for cuts and fills
- Operations program with traffic volume, operating speeds and trip times

Typical elevations should be provided for each type and situation of road displaying construction materials, levels of compaction and erosion and sedimentation features. This section should also include the following general information about the road system:

- Dust control measures for construction and operation
- Maintenance measures
- Roster for construction and maintenance equipment, specifying type and quantity by: size, motor size, and fuel requirements for each type of equipment

The extent of information needed is affected by the type of environment the road traverses. However, even temporary roadways can create significant and permanent environmental damage. In already built or otherwise already disturbed areas, this section would be less detailed than for road rehabilitation or construction in areas that are undisturbed or that contain important environmental features. However, truck noise and use of roads may have adverse effects on their structure and on the nearby communities, so this detail is important. A summary of information required for other modes of transportation is provided in Table C-2.

Table C-2: Project detail Information for transportation needs

COMPONENT	PROJECT DESCRIPTION INFORMATION
General	• Site clearing • Protection of sensitive terrestrial, aquatic or marine habitats and species resources • Protection of cultural, historical or archaeological sites • Equipment to be used and man-power requirement • Storage, removal and disposition of debris • Sediment and water-control facility • Temporary ponds and permanent impoundments
On-site Walkways	• Location and design information • Provision for beach access
Public Roads Upgrades	• Location and design information • Primary material of construction (wood, brick, stone, etc.), layout and dimensions. • Design drawings should be provided for each facility, including: Plan (overhead view) • Elevations (front view), Profiles (side view) and Sections.
Rail Expansion with Feeder line	• Routes • Traffic control • Utilities • Design
Air Service Upgrades	• Widths and layout • Surface material • Lighting (if applicable) • Erosion control
Waterways Upgrades	• Identify all new and existing waterways to be used (including filled and closed canals and other waterways that will be reopened, if applicable), traffic volume, boat or barge (e.g. disposal of dredge material, operating speeds and trip times, closed waterway that will be reopened • Detailed information on any access, on-site and recreational activity waterways to be constructed or upgraded: Location, timing of construction, construction methods including clearing and grubbing, dredging and associated designs, animal crossings, disposal of dredged materials, sedimentation and erosion prevention structures and practices, location and size (area and volume of material) of canals and waterways, lighting (where applicable), operation, closure plan (if applicable) • Maintenance
On-Site Transportation Hubs Construction	• Tightest curves • Track construction materials • Turnouts and sidings • Railroad communications and signaling
Parking Lots	• Locations • Sizes • Lighting • Storm water management
Taxi/Bus Stops or Transfer Stations	• Location, design, construction and operation of docks • Rosters of boats, specifying type and quantity by: size, motor size, and fuel requirements • Maintenance and Dredging schedules • Breakwater needs
Fuel Stations	• Storm water management • Fuel storage tanks and leak prevention plans • Spill and oil containment
Rental Car Lots	• Locations • Sizes • Lighting • Storm water management
Airport or Air Strip	• Fight numbers , schedules, seasonal fluctuations • Locations • Sizes and capacity • Design

COMPONENT	PROJECT DESCRIPTION INFORMATION
Small Harbor or Marina	• Oceanographic conditions, water circulation and tidal flushing in the harbor/marina, port reception facilities for wastes (oil, trash, hazmat, etc.), recycling facilities for waste, location of sensitive marine or coastal habitats, avoidance of damage to groundwater resources, oil spill plans

3.8 Hotel, Resort and Restaurant Facilities

According to the IUCN (2009), most of the impact that tourism businesses have on biodiversity occur during the company's operations phase. The EIA should present a complete description of the operation of the hotel/resort and management of inland and coastal activities and developments designed to protect not only biodiversity but also the coastal and inland environment.

3.8.1 Hotel and Resort Operations

The following gives a brief description of information that should be included during the operation phase of the project:

- Description of how the project would operate (seasonally, monthly, daily, hourly, as appropriate)
- Operation information
  - Roster of equipment and machinery to be used during operation, specifying type and quantity by size, weight, motor size, and fuel requirements for each activity
  - Operation plans and conservation methods to be used for water, solid waste management including recycling, and energy
  - Labor during operation
    - Number and type of employees (by local hire and non-local hire) by field of expertise
    - Days per week
    - Hours per day
    - Shifts per day
  - Raw materials to be used for operation
    - List of the raw materials to be used, indicating the amounts per day, month, and the storage means
    - Inventory of chemical, toxic or hazardous substances, active elements, sites and storage means, safety aspects regarding transportation and handling and any other relevant information

Additional project description information typically required for hotels and associated land-based facilities are presented in Table C-3.

Table C-3: Project description information for hotel and resort projects

COMPONENT	PROJECT DESCRIPTION INFORMATION	INFORMATION REQUIREMENTS
General	• Estimate and locations of disturbed acreage • Detailed site map • Expected life of operations • Anticipated usage – seasonal, monthly • Location and design information for principal project facilities ○ Primary material of construction (wood, brick, stone, etc.) ○ Layout and dimensions ○ Design drawings should be provided for each facility, including: Plan (overhead view), Elevations (front view), Profiles (side view) and Sections	• Flood plain maps • Maps showing locations of sensitive habitats, cultural/historical/ archaeological resources • Erosion and sediment control plans • Drainages • Depth to groundwater • Seasonal variation in climate • Water sources and wastewater discharge facilities
Hotels and Lodges	• Number of rooms by: ○ Locations ○ Sizes ○ Drinking water usage ○ Types of bath/toilet facilities (common or private, components) ○ Wastewater treatment and water reuse for landscaping • Reception area • Hallways, causeways, stairs, elevators, etc	• Stormwater management • Maps showing runoff control and sediment control • Use of vegetation (lawns and gardens) • Maps showing pathways and roads
Swimming Pools	• Size (dimensions, water capacity) • Water treatment • Bath/toilet facilities	• Water sources and waste water management
Golf Courses	• Number of holes • Length, width and layout of each fairway (included maintained ruff) • Size and location of each tee, green and hazard • Vegetation (tees, fairways, roughs, greens, landscaping, undisturbed [natural]) • Cart paths • Vegetative management (irrigation, fertilization, pest control, etc.) • On-site support facilities (clubhouse, cart storage, cart repair, equipment storage, toilets) • Water reuse for irrigation and landscaping	• Stormwater management • Sensitive area protection • Drainage • Erosion and sediment control
Athletic Complexes (Tennis, Basketball, Soccer, etc.)	• Types, numbers and sizes • Surface material • Fences	• Stormwater management
Restaurants	• Seating capacity • Hours of service • Kitchen facilities • Quantities of raw materials and waste • Wastewater treatment, grease removal, and discharge • Methods of transportation to be used for delivery of raw materials and collection of waste	• Wastewater management • Water supply
Boutiques and Shopping Areas	• Number and size of stores or booths • Locations and sizes of toilet facilities • Hallways, causeways, stairs, elevators, etc.	• Stormwater management • Water supply • Wastewater management

COMPONENT	PROJECT DESCRIPTION INFORMATION	INFORMATION REQUIREMENTS
Outdoor Venues – Theatre, Concert, Wedding, etc.	• Seating Capacity • Parking • Toilet facilities • Support concessions • Waste/Litter Management • Daily/Peak Usage estimates • Parking Requirements	• Stormwater management • Water supply • Wastewater management
Laundry and Housekeeping	• Quantity of water, water conservation, energy, and supplies required • On- or off-site service • Upgrade requirements • Sewerage (location, design, piping size) ○ Type ○ Discharge quantity and location ○ Pretreatment and grease removal	• Stormwater management • Water supply • Wastewater management
Employee Housing	• Number of rooms by: ○ Structure (if more than one structure will house rooms) ○ Number and types of beds (single or double occupancy beds) ○ In-room or shared bath/toilet facilities ○ Other in-room facilities (kitchens, kitchenettes, pools, jacuzzis, etc.) • Locations, sizes and types of common bath/toilet facilities cafeteria	• Stormwater management • Maps showing runoff control and sediment control • Use of vegetation (lawns and gardens) • Maps showing pathways and roads
Support (maintenance, shop and chemical management)	• Shop design and placement • Location, size, and number of machines • Chemical storage	• Spill control • Stormwater management • Wastewater management

3.8.2 Golf Course Operations

Golf course descriptions need to include:

- Site clearing
- Plantings and species that will be used
- Water demands or wastewater reuse for watering
- Source of water for water holes, means of supply, and habitat maintenance
- Maintenance, including watering, proper use of fertilizers, chemical pesticides and herbicides
- Support facilities such as club houses
- Golf cart storage and maintenance
- Energy requirements, supply of electricity for charging batteries of golf carts
- Alteration to topography
- Drainage and erosion controls

Should a golf course be constructed, details will be particularly important on water usage requirements for irrigation and other requirements. Golf courses can consume more water than the rest of the facilities combined.

3.8.3 Support for Activities/Concessions

Concessions: For the operation of a concession much of the same information presented above for hotels and restaurants is required. Additional information should also be presented.

- Hours and seasons of use, limitations on access, expected capacity and demand

- Maintenance procedures and schedules for trails, golf courses, campgrounds, and sanitation facilities
- Educational brochures, programs, and handout to be given to hikers, golfers, as well as workers to protect biodiversity and the environment
- Remediation measures to take place if a natural disaster occurs such as a flood, fire, hurricane, volcano, or earthquake/tsunami
- Penalties to be enforced should operational rules of a golf course, hiking area, off-road vehicle use, campground or other facility be broken
- Litter and solid waste control measures –any plans to reduce, reuse, recycle

Information requirements for concessions are summarized in Table C-4.

Table C-4: Project details for concessions

COMPONENT	PROJECT DESCRIPTION INFORMATION
General Considerations for all Concessions and Smaller Facilities	• Location and design ○ Primary material of construction (wood, brick, stone, etc.) ○ Layout and dimensions ○ Design drawings should be provided for each facility, including: Plan (overhead view), Elevations (front view), Profiles (side view) and Sections Storage areas and warehouses • Parking lots • Repair shops • Fuel stations • Electrical energy • Water supply • Waste handling and disposal ○ Sewers ○ Wastewater treatment and disposal ○ Solid waste collection, treatment and disposal ○ Stormwater and nonpoint source runoff treatment and disposal • Roads
Trails	• Target group • Widths and layout • Surface material (natural, groomed, and surfacing) • Erosion control • Daily/peak usage estimates • Parking Requirements • Protection of sensitive terrestrial and aquatic habitat • Protection of sensitive cultural, historical, or archaeological resources
Ziplines	• Start point, end point and route (for canopy walks) • End point • Toilet facilities • Daily/peak usage estimates • Parking requirements
Campgrounds, Cabins and Trail Huts	• Number, type (tent or recreational vehicle) and sizes of sites • Site amenities (tables, benches, barbeque, fire pits, electrical hookups, etc.) • Common facilities, including wastewater and greywater facilities • Number, locations, capacity per location and layout • Site amenities (tables, benches, barbeque, fire pits, etc.) • Bath/toilet facilities • Water taps • Solid waste management • Daily/peak usage estimates • Parking requirements

COMPONENT	PROJECT DESCRIPTION INFORMATION
Remote Concession Activity Areas	• Description of activity • Site facility needs (storage, vendor office, toilets, water supply, parking, waste management, etc.) • Size and amount of materials offered and waste generated • Delivery of supplies, means, access, frequency
Guided Tours Points of Origin	• Description of activity • Site facility needs (storage, vendor office, toilets, water supply, parking, waste management, etc.)
Kayak/Canoe/Raft Garages and Put in Points	• Put in and take out locations and related equipment/facilities • Camping or picnicking sites • Toilet facilities • Daily/peak usage estimates • Parking Requirements
Horseback Riding	• Trails (Widths and layout, Surface material, Erosion control) • Stables (Location, Dimensions, Animal waste management, Toilet facilities) • Pastures (Location, Dimensions, Feed sources) • Daily/Peak Usage estimates • Parking Requirements
Off Road Vehicles	• Types, number, sizes and fuels of vehicles • Trails (Widths and layout, Surface material, Erosion control) • Vehicle storage • Vehicle fueling and repair facilities • Toilet facilities • Daily/Peak Usage estimates • Parking Requirements
Lake Based Recreation	• Types of uses • Dock • Developed beach • On-site facilities (equipment storage, toilets, etc.)
Sport Fishing	• Types of services and equipment provided • Facilities
Water Sports	• Diving operations controls to protect sensitive coastal and marine habitats: ○ Depths ○ Instructor or certified guides ○ Locations of dives ○ Transportation to dive sites to prevent damage to sensitive coral reef habitat from improper diver activities • Controls to protect sensitive coastal and marine habitats such as beaches, seagrass beds, coral reefs, lagoons and fish/shellfish nursery areas • Controls to protect shoreline and underwater cultural, historical and archaeological resources

3.9 Marine and Coastal

Again much of the same information as presented above is required to be presented for the operation of marine and coastal development. In addition, the following information is to be presented.

- Marina and port management procedures, operational rules, and requirements
- Penalties to be assessed should operational rules such as "no wake" zones be broken
- Maintenance and management procedures for docks, marinas, navigation channels, and associated facilities
- Remediation measures which will be taken should a natural disaster occurs
- No discharge zones for sewage or ship-generated trash
- Port reception facilities for wastes of all kinds
- Reduce, Reuse, Recycle

Information requirements for marine and coastal tourism developments are summarized in Table C-5.

Table C-5: Project details for marine/coastal developments

COMPONENT	PROJECT DESCRIPTION INFORMATION
General	• If needed, breakwaters and shoreline erosion protection needs • Substrate, adjacent protected areas • Dredging schedules and disposal area requirements • Protection of sensitive terrestrial, aquatic or marine habitats and resources • Protection of sensitive cultural, historical, or archaeological resources
Water Sports	• Nature and kind of water sports • Water supply and toilet facilities • Daily/peak usage estimates • Parking Requirements • Put in and take out locations and related equipment/facilities • Camping or picnicking sites • Types of services (life guard stations, etc.)
Cruise Ship Ports	• Ship sizes drafts, etc. • Daily usage/schedules • Passenger disembarkments • Support facilities • Solid waste management facilities • Water supply facilities • Wastewater disposal facilities
Marinas	• Ship sizes drafts, etc. • Slip numbers and sizes • Daily usage/schedules • Passenger disembarkments • Support facility needs (fueling needs, repair shops, chandlery, grocery, etc.) • Solid waste management facilities • Water supply facilities • Wastewater disposal facilities
Developed Beaches	• Beach uses • On-beach structures • Beach access for local residents • Legal source of local sand • Protected habitat areas • Solid waste management facilities • Water supply facilities • Wastewater disposal facilities

COMPONENT	PROJECT DESCRIPTION INFORMATION
Over water Villas and Cottages	• Number of rooms • Locations, sizes and types of common bath/toilet facilities • Pilings and other special construction • Solid waste management facilities • Water supply facilities • Wastewater disposal facilities
Beach–based Clubhouse Bars and Restaurants	• Seating capacity • Hours of service • Kitchen facilities • Solid waste management facilities • Water supply facilities • Wastewater disposal facilities
Arenas and Entertainment Venues (Indoor and Outdoor)	• Size and seating capacity • Locations and sizes of toilet facilities
General	• If needed, breakwaters and shoreline erosion protection needs • Substrate, adjacent protected areas • Dredging schedules and disposal area requirements • Protection of sensitive terrestrial, aquatic or marine habitats and resources
Cruise Ship Ports	• Ship sizes drafts, etc. • Daily usage/schedules • Passenger disembarkments • Support facility needs
Marinas	• Ship sizes drafts, etc. • Slip numbers and sizes • Daily usage/schedules • Passenger disembarkments • Support facility needs (fueling needs, repair shops, chandlery, grocery, etc.) • Water circulation assessment to prevent anoxic conditions from developing in the marina.
Docks	• Types of Dock uses • On-site facilities (equipment storage, toilets concessions)
Water Sports	• Numbers and types of support facilities including toilets and wastewater facilities • Solid waste management facilities • Types of boats to be uses (motorized or non-motorized) • Fueling facilities with spill prevention and control • Delineated diving areas • Location of sensitive coastal and marine habitats such as beaches, seagrass beds, coral reefs, lagoons and fish/shellfish nursery areas • Location of shoreline and underwater cultural, historical and archaeological resources
Developed Beaches	• Beach uses • On-beach structures • Beach access for local residents • Legal source of local sand • Protected habitat areas, including avoidance of smothering of sensitive nearshore marine habitat if beach nourishment is required.
Over water Villas and Cottages	• Number of rooms by: • Locations, sizes and types of common bath/toilet facilities • Pilings and other special construction
Beach–based Clubhouse Bars and Restaurants	• Seating capacity • Hours of service • Kitchen facilities • Wastewater management

4 EXPECTED RELEASES TO THE ENVIRONMENT AND DEMANDS ON RESOURCES

Project details should lead to credible and well supported estimates of the releases to water, air, and land, to generation of demand for water and other raw materials, transportation, energy, communications and public health infrastructure and to impacts stemming from site design and location and to local socio-economic-cultural impacts related, for example, to changes in employment, land use, and access.

4.1 Water and Sanitation Facilities

The Environmental Setting section should include descriptions of:

- Existing capacity for drinking water (use, treatment, delivery, desalination)
- Water conservation and reuse
- Wastewater collection, treatment, and discharge
- Water needs and plans for: landscaping, fountains, swimming pools, watersport/vehicle washing, laundry, and fire fighting
- Management of nonpoint source runoff generated by the project during construction and the life of the project.

The Project Description needs to address the demands for these services or resources, how it was calculated and plans for providing them for the tourism project.

The quantity of water consumed by the proposed project depends on the type of infrastructure installed, as well as the practices implemented during the operations phase. Water consumption in hotels around the world ranges between 200-1000 liters per guest per night. Table C-6 shows the international benchmark for hotels (shown as the "GOOD" category). This reference is based on actual data gathered in hotels.

Table C-6: Water consumption per guest per night (in liters)

HOTEL SIZE	GOOD	ACCEPTABLE	REGULAR	POOR
< 50 rooms	< 439	439 – 507	507 – 583	> 583
50 – 150 rooms	< 583	583 – 678	678 – 806	> 806
> 150 rooms	< 666	666 – 856	856 – 980	> 980

Source: IUCN Tourism Guideline International Hotels Environmental Initiative, Water Efficiency Benchmarks

For wastewater management purposes, in the United States it is assumed that estimated that at least 90 percent of the water consumed in guest rooms, restaurants and bars is returned as wastewater. Table C-7 shows average hotel daily water consumption and wastewater generation in hotels in the United States.

In contrast, in Europe, consumption varies between 500 liters per guest per night in Denmark and 200 in the Netherlands. European youth hostels average between 93 and 200 liters, while bed and breakfast accommodations consume between 100 and 200 liters (FEMATOUR). The quantity of water requirements will vary according to the type of hotel and its policies.

As above, the detail needed about proposed water and sanitation facilities is commensurate with the magnitude of the development. For smaller-scale tourism developments that are connecting directly to existing water or sewer systems, a drawing and short description of pipelines; areas of temporary and permanent disturbance; and measures for restoring disturbed areas to pre-construction features may be adequate (if a permit requirement exists, the status of the application should be included).

Table C-7: Water consumption and wastewater generation in Hotels in the United States

Source	Water Consumption (liters/ guest /day)	Wastewater Generation (liters/ guest /day)
Room (double occupancy) • In-room use only	40	36
• Including laundry	230	207
Golf course	400	Minimal (only from on-course restrooms if any)
Pool	40	Not Available
Restaurant: • Restrooms and kitchen	40	36
• Bar	6	5

Source: IUCN Tourism Guideline Architectural Graphic Standards, by Charles George Ramsey, John Ray, Jr. Hoke, ISBN 9780471348160

For larger-scale developments that are connecting to existing lines, a discussion of any required permits should accompany information on construction methods; temporary and permanent areas of disturbance; measures for returning disturbed areas to pre-construction features; contingency plans and emergency response measures in case the existing system malfunctions. If there is no formal permit application procedure, information should be provided on the capacity of existing water and sewage treatment systems to ensure it is adequate for the additional input.

If water or sanitation facilities will be provided on a temporary basis for construction staff, these should also be described. The process for decommissioning should be included.

For tourism developments that will construct their own water or sanitation systems, the following information should be provided in the “Proposed Design” chapter:

- Drawing of water and sewer lines, connections, and treatment facilities
- Planned use, treatment and reuse of gray water
- Location, size, and capacity of each structure, including type of treatment
- Construction method including temporary placement of fill
- Areas that will be temporarily disturbed during construction and measures to reclaim these areas
- Water use budget and plan
- Use of groundwater vs. use of supplied water
- Water conservation plan
- Ground water resources and potential contamination concerns
- Emergency response and containment measures for leaks
- Monitoring and maintenance plans

If an on-site well will be constructed to provide water for the tourism development, information on any permit requirements should be provided. The information needed for the “Proposed Design” section will depend on the existence and the extent of any other permit required. In general, information on depth to groundwater, projected drawdowns, monitoring and maintenance should be provided for the EIA.

Information requirements for water management are presented in Table C-8.

Table C-8: Project details for water and sanitation

COMPONENT	PROJECT DESCRIPTION INFORMATION
Uses	Requirements (m3/day), including conservation measures, and storage needs for: • Rooms • Restaurants/bars • Toilet facilities • Firefighting • Vehicle washing • Landscaping • Pools • Fountains • Other non-potable uses
On-site Water Supply	• Water Rights • Sources (surface/groundwater) • Treatment (including desalination plant if proposed) • Distribution Wells
Public/Community Water Supply	• Source • Treatment plant capacity, expansion or upgrade requirement • Conveyance system upgrade and expansion requirements • Pipe line location, constructions management and size
Wastewater Treatment	• Requirements (m3/day), including conservation measures • Sources • Pretreatment, including grease removal from kitchen and food resources • Conveyance system upgrade and expansion requirements • Treatment system • Treatment plant capacity, expansion or upgrade requirement • Discharge point • Reuse of wastewater for irrigation, golf courses, landscaping toilet flushing, etc. • Constructions management

4.2 Solid and Hazardous Waste

4.2.1 General

Tourism projects and use of resources generate solid waste that needs to be collected and disposed of. Some, such as vehicle maintenance, storage areas, power generation, and fueling facilities, may generate hazardous wastes including solvents, lubricants, hydraulic fluids, anti-freeze, spent tires, and wash water. Others, such as warehouses, storage buildings and fueling stations may store hazardous products (fuels and chemicals). As presented in Table C-9, in the EIA detailed solid and hazardous waste management plans including spill prevention and containment plans are required. This includes a detailed description of kind and quantities of wastes. These wastes are not only generated from hotels and restaurants but also include spoils dredged material from keeping harbors free of sediment, the maintenance of golf courses, and visiting cruise liners.

Table C-9: Project details for waste management

COMPONENT	PROJECT DESCRIPTION INFORMATION
Solid Waste	• Quantity (kg/day and m^3/day), including waste reduction measures • Collection • Separation (if any) • Disposal • Recycling • Dredge material disposal and disposal site management • Prevention of marine debris from land-based and ocean-based sources and nonpoint sources of pollution
Hazardous Waste	• Facilities Support (Maintenance, shop and chemical management) • Disposal method • Spill control, response, and prevention • Golf course waste management

A review of like facilities built and operated elsewhere is often the best tool to forecast waste production and impacts for solid, liquid and hazardous wastes. Once in operation, environmental audits to track actual waste general are useful tools in the Environmental Management scheme.

Solid waste generated during construction and operation will depend on what is built and where, and subsequently what wastes are generated as a result of operation. The hospitality industry directed towards western foreigners as patrons is notorious for the volumes of solid waste generated per capita compared to local residents. Large resort complexes, transportation hubs (airports, cruise ship docks, marinas, etc.) and theme parks can overwhelm the capabilities of local solid waste facilities. Accurate estimations of the solid waste volumes and categories are essential necessary to assess impacts. Waste generation calculators can assist in forecasting needs and thus impacts of solid wastes. Benchmarking can be used to measure waste management against desired "best in the industry" norms. The World Wildlife Federation-UK and the International Business Leaders' Forum have developed international environmental best practice benchmarks for the hospitality industry (WWF-UK and IBLF, 2005).)

The "Proposed Project Design" should describe how wastes will be managed, recycled, and disposed. It will include containment designs and emergency response provisions for all facilities in which hazardous substances will be stored and handled as well as those that may generate hazardous wastes.

4.2.2 Dredging Waste

Dredging operations and sediment placement is the excavation of material from the bed of a sea, river or lake bed and the placement of the excavated material elsewhere. For tourism projects it is associated with improving the navigable depths in ports, harbors and shipping channels. The management of dredging site plans, dredging site operations, dredge material dredged material disposal and dredged material disposal sites are extremely important to protect terrestrial, aquatic, and marine habitats. Careful evaluation must be made of the dredging project and appropriate project management and environmental protection made clear to the project managers. The evaluation of dredged material disposal sites and alternatives must also be considered as part of the overall EIA process in order to select sites with minimal adverse environmental impact. These investigations should include alternatives for the beneficial reuse of the sediment such as for beach nourishment or habitat creation. Disposal site selection in the open sea beyond the baseline of the territorial sea needs to be considered in light of the London Protocol or the United Nations Convention on the Law of the Sea (UNLOS), international treaties to which many nations are signatory.

The final dredging project plan should include:

- Quantities and quality of dredge materials to be excavated
- Location of dredging project
- Proximity of the dredging project to sensitive areas
- Location of disposal sites
- Proximity of the disposal areas to flood plains, sensitive areas (biologic and cultural/historic/archeological
- Proximity of disposal areas to population centers
- Sediment to prevent problems from occurring during the project and after the project has been constructed, including risk assessments biological, physical, geological, chemical, and disposal operations.
- Site clearing, including protection of sensitive terrestrial and aquatic biological resources

4.2.3 Cruise Ship Waste

If the project is a cruise ship terminal or cruise ship access is part of a proposed tourism project or as a source of patrons of concessions might include the following information as relevant:

- Number and size of cruise ship capacity
- Capacity of ships anticipated for terminal in terms of number of rooms and tourists
- Number of employees

The project description should include plans for collecting, storing, and disposing of solid and hazardous wastes. Table C-10 includes a list of the types of waste materials generated by large passenger cruise ships. Management of these wastes both on-shore and near-shore is important to reduce the environmental impact to sensitive ecosystems. Organic wastes such as food stuffs may be disposed at sea depending on regulatory authorities while other wastes can be disposed on shore in a regulated landfill or by incineration.

Table C-10: Large passenger cruise ship waste generation and disposal

Medical waste	Oil sludge and slops
Oily waste	Used oil
Oil filters	Incinerator residue and air emissions from ship stacks
Dry cleaning solvents	Paint and solvents
Used sand or bead blasting residue	Food wastes
Plastics	Scrap metals
Photographic processing chemicals	Fluorescent light bulbs
Batteries	Glassware, bottles, and crockery
Swimming pool chemicals	Cleaning agents
Miscellaneous spray cans	Expired medicines/drugs
Cardboard and paper products	Miscellaneous garbage
Printer cartridges and e-Waste	Insecticides

Source: A California Task Force (2003) on evaluating solid waste and hazardous wastes from vessels

4.2.4 Restaurants

Descriptions of restaurants included in the proposed project:

- Assumptions about meals that would be eaten on-site or in existing local establishments
- Seating capacity

- Assumptions and plans for access for deliveries of food and supplies and means of transportation
- Plans for collection and disposal of solid and hazardous wastes as well as organic food wastes
- Water and energy sources and demand

4.2.5 Other Support Facilities

Support facilities and activities may include power generation and transmission facilities. These may be located on or off-site. Information needs are described in Table C-11. If it becomes clear that closure will be required, or when the project nears the end of its service life, the project operator shall contact the proper regulatory agency(ies) to obtain the environmental guidelines to carry out the closure or decommissioning. The project description shall include at least a general.

Table C-11: Project details for energy facilities

COMPONENT	PROJECT DESCRIPTION INFORMATION
Power Supply Electricity Demand, Supply Conservation	• Locations • Sizes • Lighting • Spill prevention and control • Emergency power needs for critical site operations
Other Energy Demand, Supply, Conservation	• Locations • Sizes • Lighting • Storm water management • Office Location and size • Rest rooms • Consumption, including energy conservation measures • Source – offsite ○ Transmission lines (if necessary) ○ Substation (if necessary) • On-site power generation power ○ Type ○ Emissions and noise controls (if applicable) • On-site distribution (routes, overhead or buried) • Fueling stations with spill prevention and control

5 PROJECT ALTERNATIVES

The Project and Alternatives Description section of the EIA should provide Information on the proposed project and alternatives sufficient not only to describe how they meet the purpose and need but as a basis for identifying and assessing their impact(s). This project description should include the nature, size and type of project and all related facilities and activities, its overall design, construction, operation, site design and land area, subsequent anticipated expansion and closure as well as the profile of direct releases into the environment, employment, resource and waste streams, related transportation, energy, communications, public health and safety infrastructure and the like, which are elaborated below. Additional detail on tourism projects is provided in Appendix A.

5.1 Identification and Assessment

Analyzing alternatives is important to exploring opportunities to avoid environmental, social and economic concerns rather than just mitigate them for a specific proposal. Alternatives are particularly important given the significant potential impacts of tourism projects. Alternatives should include:

- No action alternative: what happens in absence of the proposed actions
- Alternative Project
  - Alternative project at another location
- Modified project
  - Alternative size
  - Alternative Timing and sequencing of the project
  - Alternative location/sites
  - Alternative site design/facility design or use
  - Alternative water, wastewater

Consideration of alternatives is the "heart" of the EIA process and is a requirement of many country EIA laws and procedures to foster sustainable development and improved decision making to reconcile economic, environmental and social concerns. This requirement to consider alternatives only pertains to economically and technically feasible alternatives and usually only a subset of alternatives considered would be taken to full analysis of impacts as needed to address identified issues. No Action On-going activities in the analysis area would continue to affect the environment. Project alternatives offer opportunities to avoid or reduce adverse environmental, social and economic impacts of the project. Given the public participation requirements of the EIA process, it is also important for the project proponent to solicit public comment on the proposed alternatives analysis.

There are several issues to consider in determining the scope of alternatives that will need to be addressed. All EIAs for tourism projects must include:

- No Action Alternative: the analysis of the no-action alternative which represents the reasonable impacts, projected into the future, of not taking the proposed action. What would happen in the future if the proposed project or action is not approved or withdrawn?
- Reasonable technically and economically feasible project options that would reduce potential adverse environmental and socioeconomic impacts such as alternative designs, technology , site design and facility design options for the project location including proposals by stakeholders, for modifications or new project options posing lower impact.

Project descriptions for alternatives should be of sufficient detail to assess relative impact on the environment and support any conclusions about why the alternative may have been selected or rejected and the project proponent and government reviewer has had the opportunity to consider whether feasible alternatives can achieve the purpose and need in a manner which better achieves sustainable development goals.

5.2 Types of Alternatives for Tourism Development

5.2.1 No Action Alternative

This alternative provides the baseline against which impacts of the other analyzed alternatives are compared. It can mean either doing nothing or maintaining the status quo. For a proposed new facility or project it means that the proposed activity would not take place. It can also mean phasing out certain activities. There may be more than one version of a no action alternative. A no action alternative may or may not be a reasonable result of the EIA process. This could also pertain to specific aspects of a proposed project.

5.2.2 Alternate Project Site

Alternative site locations should be considered while continuing to realize the objectives of the tourist activity, particularly sites which avoid or minimize adverse impacts on physical, biological and social-economic-cultural resources. This will require an understanding of land ownership, proximity to attractions, and other economic considerations. In doing so, concern must be given to environmentally sensitive areas. An alternative site might also prove to be beneficial to better utilize existing infrastructure or to avoid increasing risks of marine or river bank flooding related to climate change.

5.2.3 Alternative Site Configuration Design

Resorts and associated developments are usually classified as high impact (IUCN,2009). They usually involved large areas of land that may or may not have environmentally sensitive areas. Alternatives may include changes to the site configuration or layout of a site to protect wildlife habitat, mangroves, waterways, and other sensitive areas so that buffer zones can be developed or areas can be protected to reduce or eliminate potential adverse impacts, for example, from erosion, mudslides, flooding threats. Different site configurations may address concerns of the local population over issues like visual, light and noise impacts. Proposed development of manmade beaches, such as “pocket” beaches, may have alternative locations and configurations which can minimize impact on beach sand deposition or erosion. In the EIA, such alternatives should be evaluated. As described in Section F, various configurations can be evaluated using computer simulations.

In addition, various alternatives for harbor and port design are to be evaluated for the EIA. These include but not limited to:

- Use Alternatives to use of jetties and breakwaters.
- Channel Alternatives to any proposed channel design and dredging requirements
- Use Alternatives to the use of fishing piers
- Alternative locations of concessions
- Mooring alternatives and alternative mooring docking areas
- Alternatives for proposed canals
- Debarkation Alternatives for embarkation areas – accessibility for physically disabled
- Location of parking lots, office, and toilets
- Alternative use dry stacking to store boats
- Considerations for protection from storms
- Alternative locations for pathways, trails, and off-road

GREEN BUILDING

Green building (also known as **green construction** or **sustainable building**) refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation.

A similar concept is natural building which is usually on a smaller scale and tends to focus on the use of natural materials that are available locally. Other related topics include sustainable design and green architecture. Sustainability may be defined as meeting the needs of present generations without compromising the ability of future generations to meet their needs.

Source: US EPA (2009) and Hopkins (2002) extracted from http://en.wikipedia.org/wiki/Green_building

vehicle use
- Alternative design, locations, and construction of concession stands

5.2.4 Construction Materials and Methods

In the EIA, the selection of building materials is to be discussed in detailed. As potential alternatives discussed include:

- Green building concepts
- Not using chemically treated wood
- Use of porous materials for surfacing parking lots
- Minimization of land disturbance for quarrying aggregate
- Use of wood that is in abundant supply and from rapidly growing trees (bamboo)

5.2.5 Smaller Scaled Project

An alternate to the preferred alternative may be to build a similar facility only smaller – less active beach front, fewer rooms, fewer amenities such as the number of pools and golf courses, smaller parking lots, use of satellite parking, etc. Smaller developments with smaller hotels, smaller parking lots, and other facilities might be also considered as an alternative.

5.2.6 Construction Sequencing

Initial construction sequencing should be presented, including the scheduling of construction for the various components of the project including roads, repair shops, warehouses and other support facilities, power sources and transmission lines, water sources and conveyances etc. Best practice alternatives should be presented to minimize impact to near-by residents, wildlife (in terms of noise, light, and obstruction). It should also be done in regard of seasonal fluctuations (rainy and dry season) with most work being completed if possible during drier months.

5.2.7 Non-Structural Alternatives

Many Structural alternatives are often proposed for addressing flood risks and beach erosion, however, there are often non-structural alternatives which are not only less costly but also potentially more effective. For sensitive ecosystems such as wetlands, floodplains, mangroves, and beaches in coastal areas, structural changes can have cascading impacts which can even exacerbate or undermine the purpose for which structural changes were introduced. For example, many resorts are built in relationship to ocean front areas and beaches play a critical role in offering recreational activities. In the EIA, alternatives are to be discussed as to ways that beach developed in a safe and environmentally sound manner including access to the beaches protection of sand dunes, and sensitive areas with stabilizing vegetation, and protection of near shore, aquatic or marine habitats (i.e., seagrass beds, lagoons, river/estuaries, patch reefs or fringing reefs in shallow water, mangrove forests, etc.), such as sea grasses.

On occasion, beaches are constructed with sand hauled in from other locations or removal of existing landscape to provide improved access to the beach. These are sometimes referred to as “pocket beaches.” For any such beach side tourism development, various alternatives for the following should be discussed in detail as appropriate:

- Alternatives to proposals for new beach construction (use of “pocket beaches”) and potential impact on existing aquatic or marine habitats that are sensitive to smothering by beach erosion
- Alternatives to any proposed dredging for sand to develop beaches

- Alternatives to proposals for shoreline protection (use of piers, jetties, etc.) should be considered and planned carefully after a geological evaluation of the proposed project because the construction may disturb the "river of sand" and affect up coast or down coast beach areas or sensitive near shore habitats through erosion, accretion, or smothering by sand
- Alternatives to methods of dredging
- Alternatives to shoreline protection (use of piers, jetties, etc.)
- Alternative methods for sand dune protection (fencing, vegetation, etc.)
- Alternatives to golf design and location, such as golf course development near ocean front beaches
- Alternatives to any proposals for dredging, solid waste, debris, and trash control and removal

5.3 Alternative Environmental Management and Control

5.3.1 Wastewater Management

As stated in IUCN (2009), a tourist business' wastewater consists of the effluent from toilets, showers, and washstands, as well as kitchen and laundry facilities. Toilet effluents are called sewage, while the others are called gray or soapy water. Sewage contains bacteria that are harmful for health, while gray waters contain soap, detergent, chlorine, fat, and food residues. Both need treatment; however, many companies do not treat gray waters properly. Moreover, pool water contains chlorine, and water from green areas may contain pesticides and fertilizers.

One alternative is for a tourist development is for it to "hook-up" to available wastewater treatment systems such as a city's. This is not without an impact for sewerage pipelines must be developed to meet main trunk lines producing potential impacts due to construction activities. More often than not a resort must develop its own system. The design of a system could be simple or complex but must be designed to prevent harmful bacteria (pathogens), nutrients, and unwanted chemicals from entering groundwater or waterways. In the EIA, alternative wastewater treatment must be considered. These alternatives include:

- Removing fats, oils, grease, and other food residues from the gray water using a trap.
- Having the waters flow into a tank where the solids sink to the bottom (septic tank).
- Using sealed processes (anaerobic treatment) or aerated processes (aerobic treatment) in the water, make biogas generator bio-digesters for the organic matter.
- Filtering.
- Primary settling in an oxidation pond.
- A series of lagoon treatment ponds, and filtering through a constructed wetland before discharge to the ocean.
- More sophisticated methods using secondary treatment with chlorine/dechlorination, ozone, or some other process killing any remaining bacteria or viruses.

According to IUCN (2009), the main decision to be made during the design stage is about the type of water treatment needed. Whenever there is an absence of municipal water treatment, the company would generally need to build its own treatment plant, both for sewage and gray waters depending upon the size and location of the project. For large projects, two options are available: aerobic or anaerobic plants. Aerobic plants require an oxidation pond with either air or oxygen injection, and with constant energy consumption of about 1 KW or more. Large anaerobic plants may use a process known in Central America as UASB (Upflow Anaerobic Sludge Blanket Reactor), which does not require electricity; in addition, this process produces methane gas that may be used as fuel itself or utilized in order to generate electricity. The operation costs of anaerobic plants are lower in tropical climates than aerobic plants, and they produce only a fourth of the sludge. The quality of a UASB plant effluent tends to be better than that of aerobic plants. The design and construction of a treatment plant requires the services of experts. For more information, visit www.uasb.org/index.htm#TOC or www.monografias.com/trabajos10/tratami/tratami.shtml.

5.3.2 Solid waste management

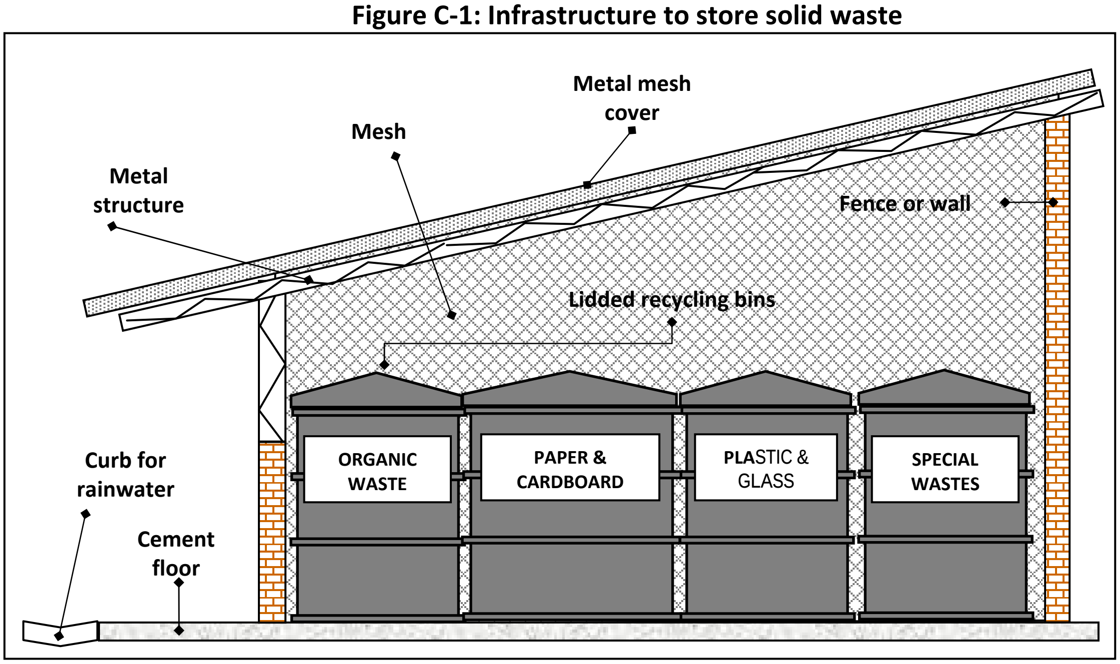
Waste reduction is an important aspect of solid waste management. In addition, recycling items such as news papers, aluminum cans, bottles, plastic, and other materials can go a long way in reducing costs. If possible, it is also good to reuse items such as soft drink bottles by returning them. Finally, organic waste can be composted and turned into fertilizer with biogas as a by-product with could be used for energy production.

In the development of an EIA, several alternatives need to be evaluated. These include:

- Waste reduction (recycling, reuse, etc.)
- Construction of on-site landfill (with evaluation of several site locations and strict management to prevent stormwater and nonpoint source runoff of solid waste or fluids.)
- Transport to an off-site municipal landfill site
- Site litter management (locations of receptacles, etc.) and cleanup of marine debris
- Pet waste control

An example of a structure which can be used to manage solid waste is presented in Figure C-1.

Figure C-1: Infrastructure to store solid waste



Source: Astorga, Allan (2006), "*Guía ambiental centroamericana para el sector de desarrollo de infraestructura urbana*", UICN/ORMA, San José, Costa Rica.

5.3.3 Hazardous Waste Management

According to IUCN (2009), resorts, marinas, ports, and other tourism activities although minimal produce toxic and hazardous substances such as paint, insecticides, pesticides, wood preservatives, swimming pool disinfectants, and fuel (as well as their containers), in addition to computer monitors and circuits, fluorescent bulbs, and nickel-cadmium batteries (NiCd or NiCad), and automobile batteries are all toxic wastes requiring special storing and pickup systems. Unfortunately, this type of service is not available in many parts of the region. Alternatives must be developed for the management, storage and placement of material with spill prevention and control plans in place. These alternatives should have emergency measures in place with proper personnel protection for employees.

5.3.4 Noise and Light Management

Excessive light and noise can disturb neighbors, patrons, and wildlife (IUNC). Alternatives must be developed in the EIA to limit the impact of such disturbances. These alternatives can include:

- The placement of restaurants, discos, party areas, etc. away from protective areas and guests
- Use of sound proof buildings
- Shield lighting systems
- Use of light reduction curtains in rooms
- Limiting hours of operation , perhaps with the use of timers

5.3.5 Water Drainage and Stormwater Management

Managing stormwater properly can reduce erosion and inflow of sediment and chemicals into waterways. Since stormwater management is a cross-cutting issue for construction and operation of a resort and other tourist facility information on the project design should provide alternatives for design, construction and maintenance of appropriate water-control measures including protection of natural streams, rivers, aquifers, and other waterbodies; collection ditches, sedimentation ponds, diversions, and culverts; and activities that would minimize erosion and sedimentation. The design should address run-on, runoff and seepage. The type of information that should be provided for each type of facility is detailed in each subsection.

5.3.6 Sediment and Water-Control Facilities

- Location of all facilities – alternatives to protect sensitive areas and be environmentally friendly
- An analysis showing that the smallest amount of land as possible will be disturbed at one time and potential alternatives
- Alternative methods to reduce runoff, run-on, sedimentation and erosion – use of natural and constructed methods to reduce runoff
- Alternative methods of retaining sediment
- Alternative methods for diverting runoff from the disturbed areas
- Alternative methods for diverting surface water, including stormwater, around the disturbed area
- Alternative methods for preventing seepage
- Alternative methods for treating and maintaining roads for reducing runoff, erosion, and dust
- All supporting engineering designs, methodology and justification for selecting the appropriate methodology over alternatives
- Alternative methods for closure and restoration
- Monitoring and maintenance plans

5.3.7 Temporary Ponds and Permanent Impoundments

- Number of each type of impoundment showing alternative locations
- Location, size and capacity of each structure evaluating potential alternatives

- Alternative materials to be used, and its source
- Alternative designs with design criteria and justification
- Alternatives for water discharge treatment facilities
- Alternative methods for closure and restoration
- Monitoring and maintenance programs

5.3.8 Culverts, Dikes and Diversions

- Number of each type of structure with alternatives
- Location and size of each structure
- Alternative methods for design
- Alternative construction methods: cuts, fills, materials and their sources, compaction
- Timing of construction
- Alternative methods for closure and restoration
- Monitoring and maintenance programs

5.3.9 Groundwater Management

- Alternative well locations (away from the sea and sensitive areas)
- Alternative methods to reduce pumping rates (water conservation, well field management)
- Alternative well placement or depth to improve water chemistry and reduce water treatment requirements
- Use of well field management tools to optimize well placement – groundwater model and projected draw-downs
- Monitoring and maintenance programs

6 Manpower and Local Purchases

The project description should present information on the number and type of employees that will be hired by the project, during all phases of its life, and the level at which the project will be relying upon local businesses to provide goods and services. This information is necessary for assessing the social impacts of the proposed project. For both construction and operation, this information should include:

- Number and type of employees (by local hire and non-local hire) by field of expertise, skilled and unskilled
- Days per week
- Hours per day
- Shifts per day

Inventory of needed construction materials and their available, local, licensed quarries, gravel pits and other material suppliers must be itemized. If employee housing will be provided, this should be described as part of the discussion on ancillary/support features. This information is necessary for assessing the social impacts of the proposed development.

7 Closure

The project description should include at least a general closure and decommissioning plan describing the plan for closing, restoration, abandonment or reuse of the projector facilities, the machinery and structures, and restoring the land surface. The plan should contain a commitment to contact the proper regulatory agency(ies) before the time of closure to obtain the environmental applicable guidelines to carry out the closure or decommissioning, recognizing that terms of closure may be very different when this phase approaches.

Restoration, Reuse and Closure Plan, recognizing that terms of closure may be very different when this phase approaches. The description of restoration measures should include the size of the area to be restored as well as concurrent, temporary and final restoration measures to be used and their schedules. For each measure include:

- Area to be addressed
- Timing and schedule for executing measures
- Equipment and structure removal or conversion
- Remedial measures, including success indicators and contingency measures if initial efforts are unsuccessful
- Plans for reuse of all or parts of the proposed project. The description of plans for reuse should include the size of the area to be reused (the whole or partially) as well as concurrent, temporary and final restoration (if applies) measures to be used and their schedules and a restoration and closure plan in case the reuse alternative no longer applies. For each probable reuse include:
    - Area to be addressed
    - Possible entities interested in the property
    - Narrative of each possible use
    - Timing of which the area might remain inactive while waiting for the definitive reuse plans
    - Commitment to perform restoration and closure plan if the initial efforts for reuse are unsuccessful

D. ENVIRONMENTAL SETTING

1 INTRODUCTION

A detailed description of the Environmental Setting for a tourism project is an important aspect of an Environmental Impact Assessment (EIA). It provides an environmental, socioeconomic and cultural baseline for assessment of impacts by describing the existing conditions and those that are predicted for the future in the absence of the proposed project. The information presented in the Environmental Setting should not be encyclopedic, but rather should include the specific, detailed information that is necessary to predict impacts and ultimately against which to monitor impacts. This section should include an environmental baseline of what would exist in the absence of the proposed project for the physical, biological and social-economic-cultural environments that could be affected by the alternatives under consideration, taking into account both the current situation and important trends. What is included in each of these three environments is summarized in Table D-1. The scope of the specific information required to describe each type of environment will vary with type and setting of the project as well as the typical types of impacts with which it is associated with each type of project.

ENVIRONMENTAL SETTING

In order to predict potential impacts of a tourism project it is important to have detailed information on the Environmental Setting to provide baseline conditions for the:

- Physical environment,
- Biological environment, and
- Socioeconomic and cultural environment.

The details on how each of these is addressed in the EIA are dependent on the complexity of the area, the nature of the operation (small or large, in an urban environment or rural, land or water, concessionaire or fixed-base, etc.), social issues and regulatory requirements. The period of baseline data collection for water resources, air, climate, and ecosystems (flora, fauna, wildlife, etc.) must be significant enough so that determination of long-term impacts can be made and may require data to be collected over a period of one to five years.

Special emphasis for baseline studies depends on the nature of the proposed project. For example a proposed resort with a golf course would evaluate archeological resources more thoroughly than a proposed pier for a small diving concession due to the nature and extent of the ground-disturbing activities.

This baseline aids in focusing attention on the critical environmental and socioeconomic factors, how the project might affect them, and how best to avoid or mitigate potential problems. In addition, the description of both the current environment and predicted conditions in the absence of the proposed project aids in the determination of potential cumulative environmental impacts that might occur should there be other impact causing activities to those same resources.

Any new collection of data for a baseline environmental setting requires theinvolvement of appropriate experts following scientifically accepted methods and specifically designed sampling and monitoring plans. This process should be documented in the EIA. In some instances plans for countries may require that monitoring may requireand specific sampling plans undergo review and approval by EIA review officials prior to execution. It is a cautionary note to project proponents and consultants preparing an EIA that the need for any such monitoring be established and agreed to by the EIA reviewing authority well in advance so as not to create delays in developing the EIA.

Table D-1: Elements of the physical biological and social-economic cultural environments

Physical Environment	Geology and Soils • Topopgraphy and slopes • Soil quality, stability (includes erosion hazards susceptibility to landslideslandslides) • Seismology/volcanology and susceptibility to earthquakes, development of faults, cracks, or ground movement from seismic events and volcanic eruptions • Mineral and contruction material types and sources • Paleontological resources • Unique geological formations Freshwater Resources • Surface Water (and flood potential) • Watersheds • Groundwater (water levels, aquifer characteristics, recharge zones, flow direction, etc.) • Water Quality • Water Quantity Marine Water Resources • Physical oceanography • Geological oceanography • Marine water quality in relation to: contact recreation, noncontact recreation, and baseline water chemistry (total N, total P, biological oxygen demand, suspended solids and sediment, pH, E. coli, Enterococcus sp., and faecal coliform bacteria concentrations) Air and Climate • Meteorology (includes regional and local and susceptability to storms and tidal surges) • Ambient Air Quality (includes levels, visibility and deposition patterns) • Existing Emissions (includes: onshore vehicles; recreational vessels, commercial vessels, and cruise ships; onshore diesel generators at the facility; cooking facilities; wastewater treatment facilities; nearby recreational, commercial or industrial facilities; acid rain; and crop burning) Noise and Vibration Aesthetic Resources Risk assessment related to natural disasters (including floods, landslides, erosion, hurricaines, drought, earthquakes, tsunamis, volcanoes, and other trends and dangers related to climatic change)

Biological Environment	Terrestrial and marine flora (especially mangrove forests and seagrass beds) Terrestrial and marine fauna (especially all types of coral reefs (e.g., fringing, patch, bank, barrier, etc,), shellfish beds, nursery areas for fisheries, local fishing areas) Ecosystems (terrestrial, wetlands, aquatic, and marine) • Key trends in structure and functions not captured under Flora and Fauna • Sensitive Ecosystems • Ecosystem Services Endangered or Threatened Species, Species of Concern, and Habitats Protected Areas
Social-Economic-Cultural Environment	Socioeconomic Condition and Resources • Population • Economy • Social Characteristics • Health • Safety and emergency response (e.g., range of natural disasters, oil or hazardous material spills, beach cleanup and debris removal, dangerous ocean currents, dangerous river currents, underwater obstructions that may affect boating, known contaminated areas on land or in aquatic or marine areas) • Education • Vulnerable Populations (indigenous peoples, minority and low income populations) Infrastructure • Transportation • Public Health (potable water supply, water and wastewater treatment, solid and hazardous waste management) • Communications • Energy Cultural, Archeological, Ceremonial and Historic Resources • World Heritage and cultural sites • Historic and archeological sites (Land and underwater sites) Land Use (Actual and potential land use) • Agriculture, forested lands, watersheds, wetlands) • Recreation and tourism (recreational boating areas; swimming, diving and snorkeling areas; beach areas; hiking and trail areas; shipwrecks and underwater archaeological or historical sites; etc.) • Housing o Commercial and industrial developmentPopulation centersScientific research and educational use areas

2 PHYSICAL ENVIRONMENT

2.1 Geology and Soils

Documentation of geology, soils and topography at the tourism site should be presented in the Environmental Setting in narrative and tabular form, cross-sections, and on maps on which potential impacts can be overlaid. Information on geology, soils and topography is typically available from the responsible ministries and academia. A site-specific soil survey and test may be required if such data is not reliable, adequate or readily available. Some of the specific areas that should be included are:

- Regional geology should be addressed in terms of and paleontological resources.
- Identification and characterization of geological, geophysical and stratigraphic profiles, faults, and structures. A preliminary level to characterize the seismic conditions.
- Characterize surface features and morphogenic processes operating in the study area.
- Topographical characterization
- Summary table of soil properties estimating quantities, depth, area and type of soil removal and/or recommended replacement material. Include mechanical properties of soils. Identify the available sources of materials used.
- Characterize and map represent land units representing the study area. Analyze current and potential uses of soil in the study. Carry out preliminary agrological quality soil for areas of study.
- Methodology of sampling and tests and their respective depths. Conclusions and recommendations specific to the project in engineering terms, load capacity of the land.

2.1.1 Topography and Slopes

It is important to a a thorough understanding of the topography and slope stability of a tourism site. This is important in terms of predicting runoff characteristics of rainfall events, in the identification of geologic hazards, and the stability of buildings should an event such as an earthquake occur.

2.1.2 Soil Quality and Erosion Potential

Soil quality is important in both as a potential factor in agricultural productivity and potential function in its stability characteristics for supporting the construction of new facilities. Many tourism projects have the potential to modify runoff and sedimentation, so it is important that enough soil data are provided so that runoff and sediment transport models can provide meaningful results.

During baseline data collection, it is important to collect information on the erosion potential of the soils, the chemical composition of each soil type, and the availability and suitability of soils for use during restoration and revegetation. If a soil survey is necessary, it should include:

- Soil type
- Grain size distribution,
- Engineering properties including stability
- Depth of various horizons
- Permeability
- Erosion and sedimentation potential
- Current land uses
- Soil map units representing the study area
- Current and potential uses of soil in the study areas

- Preliminary agricultural soil quality: fertility, vegetative growth potential, etc.

Particular care should be given to studying tropical soil structure and chemistry since such soils are very sensitive to degradation.

2.1.3 Geologic Hazards

Tourism activities can often take place in regions prone to natural hazards. Seismic activity, including frequency and intensity of earthquakes and tremors, should be included in this subsection, particularly for projects that include large structures. If the tourism site or right-of-way is located within a radius of 30 km from an active volcanic emission center, information should also be presented on the general volcanic features of the area near the site, historical eruptions, and period of recurrence, type of eruptions, and areas most likely to be affected by eruptions.

In addition, tsunamis caused by earthquakes even several thousand kilometers away can generate waves that can cause severe damage to beaches, infrastructure, dwellings, and buildings. In the planning process consideration should be given in defining those area which are prone to be affected by large waves and potentially affected areas should be delineated.

2.1.4 Beaches and Coastal Areas

Beaches are a major attraction for tourist activities and can vary greatly in quality of the sand, roughness of the surf, seasonal erosion of the sand and trends, whether they are rocky and difficult to access or easy to access. The seasonal wave direction and trends in beach erosion are tied to meteorological disturbances and seasonal changes in ocean currents as well as the natural contours of the ocean floor (including coral reefs or sandy areas) below the surface. This information should be clearly presented, and in appropriate detail for projects which will utilize this resource and in particular for those projects that include proposals for the development of any dredging operations, jetties, piles, docks, marinas etc which can alter coastal ocean current patterns. If any structural activities are proposed for shore stabilization it is important that the EIA also explore non-structural shore stabilization measures because of the experience of such structures creating their own beach erosion and destabilization in adjacent and nearby locations.

For the marine-coastal environment project, the bathymetry and substrate conditions are critical to construction and operations and for assessing impacts. Additionally, seasonal currents and wave patterns must be accounted for in design and affect the in-water, over-water and near shore land-based construction.

2.1.5 Unique Geological Formations

Unique geological geological formations should be identified in terms of their biological, historic or future destination by tourists and particular sensitivities for sustaining their integrity and values. Among these are underwater and above ground caves, geothermal sources which have provided the source of hot water saunas and bathes, as well as energy, and the types of coral reefs (fringing, patch, bank or barrier) and their associated ecosystem components.

2.2 Water Resources

2.2.1 Surface Water

The Environmental Setting section must include an evaluation of surface water resources in the area of influence of the project. Area of influence is defined further in Chapter F, Assessing Impacts. This should include the analysis of the watershed characteristics including water quality, flow characteristics, soils, vegetation, and impervious cover (see box below). This information should be shown on topographic maps which should include all surface water resources and floodplains in the area of influence overlaid with the proposed project facilities including all monitoring stations and discharge points. In addition this analysis should take into account likely climate change impacts, e.g., sea level rise, which should be considered in evaluating water resources. See e.g., http://coastalmanagement.noaa.gov/climate/adaptation.html.

All rivers, streams, wetlands, lakes, bays, coastal reaches, and other water bodies should be identified as well as the current uses of the water within the area of influence (See Chapter F for definition). All existing historic surface water flow data in the area of influence should be collected, compiled and analyzed to present information on:

- Average daily, monthly and annual flows in cubic meters per second (m^3/s)
- Maximum monthly flows in m^3/s
- Minimum monthly flow in m^3/s
- The river network and geomorphological characteristics of the streams
- Inter-relationships with tidal fluctuations in ocean areas
- Wetlands and their relatiionship with streams
- 2-, 10-, 25-, 50- and 100-year flood and storm runoff events and associated floodplains for streams and rivers
- Seasonal fluctuations in area and volume of wetlands, lakes and reservoirs

WATERSHED APPROACH

It is important to evaluate impacts of a tourism project in relation to the entire watershed. Watershed management involves both the quantity of water (surface and ground water) available and the quality of these waters. Understanding the impact of the project on both the quantity and quality of water must take into account the cumulative impacts of other activities in the same watershed.

A watershed-based impact assessment approach involves the following 10 steps:

1. Identify and map the boundaries of the watershed in which the project is located and place the project boundaries on the map
2. Identify the drainage pattern and runoff characteristics in the watershed
3. Identify the downstream rivers, streams, wetlands, lakes, bays, seas, and other water bodies
4. Determine the current and projected consumptive and non-consumptive uses of the water in these resources
   - Drinking water
   - Irrigation
   - Aquaculture
   - Industry
   - Recreation
   - Support of aquatic life
   - Navigation
5. Estimate the impact of the project on the consumptive and non-consumptive use of water
6. Determine the existing quality of the water in these resources
7. Determine the nature and extent of pollutants discharged throughout the watershed
8. Determine the anticipated additional pollutants discharge from the proposed activity
9. Identify other anticipated additional developments planned or projected for the watershed
10. Identify stakeholders involved in watershed and encourage their participation in project design

An important aspect of an EIA is the development and presentation of baseline surface water quality monitoring data, which should be collected prior to disturbance. Monitoring of baseline conditions should take place for at least a year so that seasonal fluctuations in flow and water quality can be determined. All existing historic water quality data for the area of influence should be compiled to help define the baseline, and the need for additional monitoring defined in terms of its duration, location, frequency and methods to be used. The need for additional monitoring should be established with sufficient lead time to include necessary information within the EIA. Any new monitoring that is performed to obtain additional information should be carried out by appropriate professionals following and documenting scientifically accepted and replicable procedures.

Prior to implementing any baseline monitoring program, a "Sampling and Analysis Plan" should be developed. This plan would define sample locations, sampling techniques, chemical parameters, and analytical methods. Sample locations should be located upstream and immediately downstream of potential pollutant sources. The selection of chemical parameters to be monitored is dependent on the nature of the pollutants to be discharged to surface water. Monitored parameters may include: field parameters (pH, specific conductance, temperature, dissolved oxygen, etc.) and laboratory analyzed parameters (total dissolved solids, total suspended solids, selected trace metals, major cations/anions, Biological Oxygen Demand, nitrate, Phosphate, oil and grease, total and fecal coliform, turbidity), and perhaps other parameters depending on the nature of the operation. The plan should be coordinated with the EIA reviewing authority or the governmental agency responsible for managing water resources to ensure that the information will be acceptable to the government when the EIA is evaluated.

Tourism projects vary widely and the potential sources of water pollution are equally diverse. A golf course operation can strain the water supply and have the potential of nutrient loading to both surface and ground waters from irrigation,fertilization practices and the application of pesticides, herbicides and fungicides; transportation hubs have the potential for chemical contamination from fuels, oils and air emission depositions; and onsite wastewater septic systems can pollute surface or ground waters with bacteria and nutrients. For tourism projects that have these identifiable associated risks, data should be augmented by the results of a site specific surface water (or as relevant groundwater) quality monitoring program conducted at specific locations within the project area.

2.2.2 Marine Waters

The quality (total suspended solids, BOD_5, pH, oil and grease, bacteria, floatables, etc.) and physical characteristics (temperature, salinity, transmissivity, sediments, currents, wave characteristics, etc.) of the marine waters are important to define as they may impact potential uses at the tourism facility. In regard to the water environment, instances of oil and other organic, inorganic, and bacteriological contaminants should be noted along with seasonal trends. Changes in temperature, salinity, water clarity, and ocean currents during levels of high and low tide will affect the flora and fauna described in the biological environment. The location and status of coral reefs should be noted as well. Section 3 includes examples of methods for characterizing the health of coral reefs.

2.2.3 Groundwater

The extent of the characterization of the baseline groundwater resources necessary for tourism projects varies greatly with the type of project. Many Concession projects have little potential for impacts to groundwater, so may not require baseline information on groundwater. Those with on-site septic systems may have percolation tests, depth to groundwater and other limited added investigations. Other projects may have impacts on groundwater quality or quantity or both, and therefore require more information on groundwater conditions. The primary potential impacts to groundwater resources commonly associated with tourism activities and facilities include: hardscaping such as buildings and parking lots on large development projects can diminish recharge of aquifers; wastewater systems and septic fields could contaminate springs and wells; and handling of chemicals, fuels and hazardous wastes have the potential for contaminating groundwater sources.

For those projects that can impact groundwater quantity, the Environmental Setting section should include descriptions of aquifers (bedrock and alluvial) including their geology, aquifer characteristics (hydraulic characteristics), and the flow regime/direction for each aquifer. The influences of geologic structures (faults, contacts, bedrock fracturing, etc) and surface water bodies on the aquifers should also be mapped or determined.

All wells and springs in the area should be mapped and information should be provided on their flows, water levels and uses. These maps should be overlaid with the topography and should cover the area of influence. For wells, depth and construction information should be presented. The EIA should also indicate which ones have been monitored and which ones will be monitored during and after operations. This information can then be used, along with the locations of potential recharge and contaminant sources, to determine potential impacts.

For those projects that can impact groundwater quantity quantityor quality, the information on vadose zone and aquifer characteristics should include sufficient data on the parameters to allow aquifer and vadose zone modeling, as necessary. The necessary parameters will depend on the type modeling that will be required, which should be selected based on the nature of the potential impacts. Any model used requires valid validdata to make realistic predictions. The baseline information should make it possible to determine whether there is any danger of salt water intrusion on fresh water sources because of draw down.

As with surface water, an important aspect of the EIA is the development and presentation of baseline water monitoring data, collected prior to project-induced disturbance. All existing data on quantity and quality of water from springs and wells in the vicinity of the project area should be collected and reported in the EIA to help define the baseline. For projects that can potentially have impacts on groundwater quality, if data for existing wells and springs are not available, a “Sampling and Analysis Plan” should be prepared and a sampling program implemented. The sampling should include water levels and flow rates as well as other parameters such as pH, temperature, and specific conductance. The selection of chemical parameters to be monitored is dependent on the nature of the activity and its potential to contaminate the aquifer.

2.2.4 Special Water Resources

In the context of tourism the EIA should highlight water resources that have particular significance for tourism as an attraction or historical use. Trends in these special sources in terms of quality and use should be described.

2.3 Air and Climate

2.3.1 Climate and Meteorology

Understanding climate and meteorology in the project area is important for the design of a long-term air monitoring program (as necessary for large tourism complexes where significant transportation-related emission increases are likely), developing a water balance for the site, and designing water/erosion control structures and public safety. During the baseline data collection period, climatic data from local weather stations should be gathered and analyzed. This data should include at least historic data such as:

- Rainfall (monthy, total, intensity, and duration)
- Wind direction and speed (by month)
- Solar radiation (monthly)
- Evaporation rates (monthly)
- Barometric pressure (monthly)
- Temperature (maximum, minimum, average by month)
- Tropical weather systems such as hurricane frequency and magnitude.

For large projects, if no data are available near the site, a weather station should be established and baseline data should be collected for at least one year to reflect the seasonal changes at the site. All sampling site and weather station locations should be depicted on a map in the EIA. In addition, potential risks and risk management programs should be identified for hurricanes, tropical storms and tsunamis. Changing climatic patterns due to climate change should be factored into this analysis.

2.3.2 Ambient Air Quality and Existing Emissions

If the tourism project includes a large increase in transportation services, collection of baseline air emission data is advised. Transportation emissions affect not only air quality, but also greenhouse gases contributing to global climate change; and emission deposition can effect surface water quality.

Many areas attractive to tourists lack air quality data because their environmental issues have primarily related to other concerns or their have not been funds to monitor air quality; however, baseline emissions and ambient air quality information can be important, particularly where tourist activities may cause increases in emissions as a result of burning dirty fuels and vehicular traffic or project site clearance activities may increase levels of particulates via suspension of dust and open burning of debris.

2.4 Noise and Vibration

Baseline noise measurements should be taken at representative points of reception prior to start of construction, for comparison to expected noise levels during construction and operation, and comparison to applicable noise standards. Noise levels in and around sensitive habitats and areas of human habitation should also be taken if possible impact is suspected.

A point of reception or receptor may be defined as any point on or near the premises occupied by persons or animals where extraneous noise and/or vibration are received. Examples of receptor locations include: permanent or seasonal residences; hotels/motels; schools and daycare facilities; hospitals and nursing homes; places of worship; parks and campgrounds; sensitive habitats such as breeding, birthing or nesting areas. Beyond “point of reception”, the physical setting must also be described. Noise travels and dissipates over terrain differently; water, open lands, vegetated strips, urban settings and elevation changes can affect the resultant noise impact at the “point of reception”. At waterside outdoor tourism locales (beaches, restaurants, bars, music venues, etc,.), the receptors across the waterwaymust also be given consideration.

Noise monitoring programs should be designed and conducted by trained specialists. The monitoring periods should be sufficient for statistical analysis and may last 48 hours or cover differing time periods within several days, including weekday and weekend workdays. Noise monitoring should be carried out using Type 1 or 2 sound level meters meeting all appropriate IEC standards and capable of logging the type of data required by the design (continuously over the monitoring period, or hourly, or more frequently, as appropriate). Monitors should be located approximately 1.5 meters above the ground.

2.5 Aesthetic Resources

Baseline information on views and vistas that could be impacted by the proposed project should be identified in the Environmental Setting. Vistas and views include, but are not limited to mountains, waterfalls, skylines (including sunrises and sunsets), beaches,), and cultural, archeological, and historical structures. Narrative descriptions of existing visual assets are also useful as the specific importance of a view may not be obvious to a non-local viewer. In addition, this subsection should present information on existing visibility in the project area. This subsection should present panoramic photos of the proposed facility site from potential viewpoints such as communities, roads, and designated scenic viewing areas. These photos can be used to establish the views without the facility and provide a baseline on which the facility can be overlaid.

Information should also be presented in the subsection on light pollution from existing sources in the project area, including communities, factories, street lights, etc. Where objective measurement is desired, light levels can be quantified by field measurement or mathematical modeling, with results typically displayed as an isophote map or light contour map.

2.6 Risk Assessment from Natural Hazards

Many sources of risk to the biological and socio-economic-cultural environments are contained within the descirption of the physical enviornment. To provide an adequate basis for impact assessment for the proposed project and alternatives as well as form the basis for mitigation, monitoring and contingency plans for addressing residual risk, it is important that the various risks be adequately portrayed and assessed both statistically and in geo-spatial terms so that they can be related to the proposed project. Chapter F describes scenarios for bounding risks that may have a great deal of uncertainty related to them. For purposes of the EIA, risks should be reasonably foreseeable, but should attempt to take into account known risks which have low probability but high risk. These risks as portrayed in the EIA should be readily related to descriptions of the biological and socio-economic-cultural impact sections as well as to the proposed project and alternatives. Any plans for climate adaptation should be identified and taken into account.

3 BIOLOGICAL ENVIRONMENT

The Environmental Setting information for biological resources should include information on:

- Terrestrial and Marine Flora
- Terrestrial and Marine Fauna
- Ecosystems: terrestrial, wetland/mangroves , aquatic and marine ecosystems
- Threatened or endangered Species and habitats
- Protected Areas, artificial reefs, and sensitive ecosystems

In evaluating baseline conditions of terrestrial, wetland/mangrove, aquatic and marine ecosystems, the following steps should be taken:

- Obtain readily available information on biodiversity through review of maps, reports and publications available from government agencies, universities, NGOs or online.

- Produce maps of all habitats and key species locations, protected areas, migration corridors, seasonal use areas (mating, nesting, , etc.)
- Describe timing of important seasonal activities (nesting, breeding, migration, etc.) for species that could be affected by the tourism project activities.
- Determine the following ecological characteristics of the project area:
    - Size of each habitat and buffer areas needed to protect sensitive habitats
    - Existing condition of each habitat and its value
    - Speciesvalue of species/habitat richness
    - Fragility of the ecosystem
    - Population size for important species or species of concern
    - Rarity of any species or habitat
- Identify whether the site or surrounding area falls within a protected area – e.g., a natural area designated by the government as having special protection (National Park, National Forest, Wildlife Reserve, Marine Protected Area, etc.).
- Identify whether the site or surrounding area is not currently protected but has been identified by governments or other stakeholders as having a high biodiversity conservation priority.
- Identify whether the site or surrounding area has particular species that may be under threat.
- Review and summarize relevant legal provisions relating to biodiversity, species protection and protected area management (including requirements of any management plans that exist for designated protected areas).
- Elicit the views of stakeholders and recognized experts within the country (inside and outside of government) on whether the site or surrounding area has rare, threatened, or culturally important species.

The evaluation of any ecosystem whether terrestrial, wetland/mangrove, aquatic or marine, is dependent upon professional judgment and requires the involvement of experts in the technical area appropriate for the type of resource and their use by the local population. In areas where there is little or no information available, considerable field work may be required to collect the information listed above and should be collected and assessed by appropriate experts and generally accepted methods and under a replicable sampling plan. Different techniques and sampling plans to establish biodiversity may be appropriate for flora and fauna in the area of influence.

3.1 Flora

An inventory of terrestrial, aquatic, and marine flora within the project boundaries and project area of influence should be conducted during the collection of baseline information for the Environmental Setting. The best sources of data on local flora are local peoples, relevant ministries (forestry, agriculture and environment), and academia. The results of the inventory should be presented as vegetation maps of the area which usually will also serve to provide a map of the relevant ecosystems. Narrative descriptions of vegetation types should also be included, identifying species endemism, keystone species (species that play a critical role in maintaining the structure of an ecological community and whose impact on the community is greater than would be expected based on its relative abundance or total biomass) and species rarity including identification of those that may be threatened or endangered. Areas of special interest may include canopies, mangroves, types of corals, and seagrasses.

3.2 Fauna

An inventory of terrestrial, aquatic, and marine fauna within the project boundaries and project area of influence should also be conducted during the collection of baseline information for the Environmental Setting. The best sources of data on local fauna are local peoples, relevant ministries (forestry, agriculture and environment), and academia.

The results of the inventory should present information on the status (i.e. endemic, migratory, exotic, endangered, threatened, keystone, etc.) and life history characteristics (mating and brooding seasons, migratory patterns, etc.) of the species identified as residing in the area. For terrestrial species, maps should be included identifying:

- Breeding areas
- Nesting and calving areas
- Migratory corridors (if applicable)

Information on fish, mussel, macroinvertibrate and other aquatic species should incude:

- Spatial and temporal distribution
- Species life stage composition
- Standing crop
- Age and growth data
- Spawning timing run
- Maps of coral reef areas, including fringing reefs, patch reefs, bank reefs, or barrier reefs

There are often native species or groups of fauna that are extremely popular and a draw for tourism (e.g.: birds, primates, butterflies, turtles, coral reefs, marine mammals, marine reptiles, etc.) These may or may not be protected. Particular attention should be given to these fauna resources if their habitats are expected to be independent tourist destinations from either resorts, cruise ship day-trippers, or from guided tours. If any of these are present, special studies inventorying the numbers and the health of the population and habitat may be required.

3.3 Ecosystems

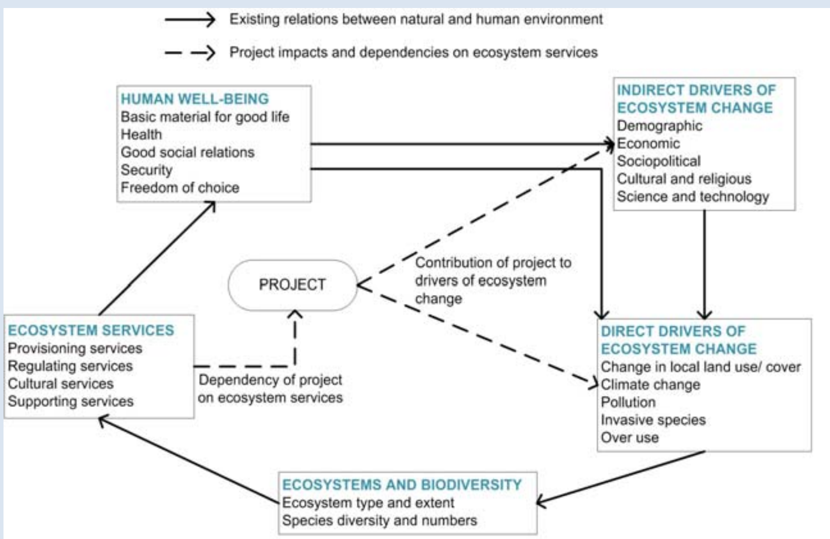
Beyond looking at flora and fauna separately , an EIA needs to be integrated, fromfrom an ecosystems perspective and organized in a manner which facilitates examination of the interinterrelationships between biophysical, social and economic aspects in assessing project impacts (IAIA 1999). Addressing these relationships relies on an integrated description of the Environmental Setting as well as integrated impact assessment (see box on the ecosystem services approach). Methodologies for describing ecosystem interactions are evolving and describing complex interactions between flora and fauna, physical and human threats, and key trends in the structure and functions of the ecosystems is difficult because of the complex nature of their relationships.

ECOSYSTEM SERVICES APPROACH: PULLING IT ALL TOGETHER

An ecosystem services approach recognizes the intrinsic and complex relationships between biophysical and socio-economic environments. It integrates these aspects by explicitly linking ecosystem services (the benefits people derive from ecosystems), their contribution to human well-being, and the ways in which people impact ecosystems' capacity to provide those services. The approach relies on a suite of tools, such as: a conceptual framework linking drivers of change, ecosystems and biodiversity, ecosystem services, and human well-being (MA 2005); guidelines for private sector companies to assess risks and opportunities related to ecosystem services (Hanson et al. 2008); and a manual for conducting ecosystem services assessments (UNEP to be published).

In the context of environmental impact assessments, the ecosystem services approach provides a more systematic and integrated assessment of project impacts and dependencies on ecosystem services and the consequence for the people who benefit from these services. It helps EIA practitioners to go beyond biodiversity and ecosystems to identify and understand the ways natural and human environment interrelates. This holistic understanding, from description of the Environmental Setting to the impact assessment, will lead the EIA practitioner through a new set of questions organized around the conceptual framework shown below:

- What are the ecosystem services important for local communities? Which services will the project potentially impact in a significant way? How does the impact on one ecosystem service affect the supply and use of other ecosystem services?
- What is the underlying level of biodiversity and the current capacity of the ecosystems to continue to provide ecosystem services?
- What are the consequences of these ecosystem service impacts on human well-being, for example what are the effects on livelihoods, income, and security?
- What are the direct and indirect drivers of ecosystem change affecting the supply and use of ecosystem services? How will the project contribute to these direct and indirect drivers of change?



Source: Conceptual framework to assess ecosystem services (Adapted from the Millennium Ecosystem Assessment, MA 2005)

Examining all the boxes in this framework systematically as part of an environmental assessment of project impacts carries the following promises:

- Since ecosystem services by definition are linked to different beneficiaries, any ecosystem service changes can then be explicitly translated into a gain or loss of human well-being.
- It will highlight the impact on all important ecosystem services provided by the area such as erosion control, pollination, water regulation, and pollutant removal.
- It will ensure that the EIA accounts for the effects of the project on existing direct and indirect drivers of ecosystem change that in turn could impact the ecosystem services provided by the area.
- It will improve the project's management of risks and opportunities arising from ecosystem services.

Ecosystems are generally divided into terrestrial, wetlands/mangroves, aquatic and marine but there are various ways to delineate important community systems of plants and animals. Terrestrial ecosystems are defined by species which may occur only on land or within a specific watershed, including mammals, birds, reptiles, amphibians, invertebrates, trees, shrubs, forbs, grasses, fungi, mosses and microbes. Native vegetation can be divided into upland and lowland communities. Upland communities consist of forests, shrublands and grasslands. Lowland vegetation occurring within drainages forms riparian (streamside) communities.

Aquatic –freshwater ecosystems are dependent on watershed characteristics and may include mammals, reptiles, fish and benthic macro invertebrates that live in an aquatic environment. Phytoplankton and other life forms can also be considered, depending on the aquatic habitat along with vegetation/plants which grow underwater.

Wetlands including mangrove forests are defined by plants and animals that inhabit a partially inundated and partially above ground existence. The delineation of wetlands is of particular importance with respect to hydrology as these are sensitive habitats and quite important with respect to cleaning of water passing through the wetlands and mangroves as well as serving as buffers against flooding elsewhere in the hydrological basin. Already identified in surface water subsection, in this subsection the ecological characteristics should be presented.

LOS MANGLARES
"THE MANGROVE"

El manglar es fruto del enamoramiento entre el río y el mar
cuando el río viene besar el mar nace el manglar

"The mangrove is the fruit of the love between the river and the sea.
When the river comes to kiss the sea the mangrove is born"

Dra. Clarice María Neves Panitz

Marine/coastal ecosystems are typified by organisms that live in a brackish or salt water aquatic environments. Where applicable, the delineation of coastal ecosystems should identify the transitional boundaries from saltwater to brackish water to freshwater. These should be mapped and described, and the tidal influences documented. When assessing marine and coastal ecosystems, primary considertation should be given to habitats, such as coral reefs and seagrass beds, and the need for buffer areas that may be affected by the development of tourism facilities and coastal infrastructure.

3.4 Endangered or Threatened Species and Habitats

These guidelines suggest that the endangered and threatened species and habitats be covered separately under flora and fauna, and then summarized in an integrated section to highlight particularly sensitive areas of concern in evaluating impacts. This separate section is not intended to duplicate the information under Flora and Fauna, but rather to pull it together in an integrated manner.

Threatened and endangered flora and fauna are a subset of the complete inventory of flora and faunafaun for a project and its area of impact. This involves:

- Review of local, national, regional and global literature on the range and domain of endangered or threatened species.
- Consultation with local and national government agencies, NGOs and academic institutions to determine what species may be in the project area.
- Cross-referencing this list with national lists of threatened and endangered species as well as the International Union for Conservation of Nature (IUCN) Red List (http://www.iucnredlist.org).

- Conducting a thorough physical survey of the project area and inquiring of local residents and authorities to determine if those species are present.

3.5 Protected Areas and Sensitive Ecosystems

Protected areas, including officially designated parks, preserves, marine areas, shipwrecks, cultural areas, archeological areas, historical areas, and the like should be highlighted in the EIA as areas which have already been identified as significant and needing special protection. One of the challenges in preparing the EIA that boundaries of protected areas may be imprecise on available maps. Given the area of influence of the project's potential impact, it may be important to carry out specific steps to better define these boundaries to ensure that the proposed project will not encroach on or be inconsistent with the intended level of protection of habitat and species.

The EIA must address vulnerable flora and fauna and their habitats regardless of legal designation. So, it will be important to identify areas that have been officially designated for protections and what those protections are, as well as those areas that have been identified for potential future protection. Often in the absence of clear protective designations. This involves looking at a range of criteria to determine whether the site or biological resource is of local, regional, national or international importance.

Some particularly vulnerable natural areas include (Source: IUCN, 2009):

- Coral reefs
- The Mesoamerican Reef, in the Caribbean from Mexico's Yucatan to the north of Nicaragua, especially the cays in Belize and the islands in the Bay of Honduras.
- The islands in the Pacific and the Caribbean of Panama, and the southern zone of Costa Rica
- Bodies of fresh water in Peten, Guatemala, and Belize, because of the porous limestone soils around them.
- To a lesser degree, the bodies of water in the rest of the Central American isthmus
- Tropical rainforests in all countries, except El Salvador
- Dry forests along the isthmus' coasts on the Pacific Cloud forests in the highlands
- High, treeless plains or paramos on top of hills and volcanoes
- Mangroves
- Turtle nesting beaches Natural protected areas
- Limited scope ecosystems out of protected areas (e.g., the coastline mountain range in southern Costa Rica)
- Islands, because of their water scarcity and sparse natural habitats
- Endemic areas (where species unique to the area are found)
- Live molluscs that inhabit shells (bivales or gastropods)
- Shipwrecks and artificial reefs
- Submerged historical sites, similar to Port Royal, Jamaica
- Sites with submerged historical, cultural, or archeological artifacts around coastal towns, cities, settlements, historical piers and anchorages (e.g., old bottles; cannon balls; military, nautical, or other valuable items; etc.)

For these protected areas and sensitive ecosystems within the area of influence of the proposed project, the EIA should indicate whether there is a current management plan, or any other planning tool or study that the country uses, and whether the management plan accommodates the current and future use of protected area, whether the protected area quality and use has deteriorated or been maintained, and trends in capacity and use in the absence of the proposed project over the anticipated life of the project.

Various methodologies have been developed to characterize the health of coral reefs and trends over time. One such methodology is the Simplified Integrated Reef Health Index developed for Meso-America, which takes into account coral cover, algal cover and fish abundance described in the accompanying text box.

SIMPLIFIED INTEGRATED REEF HEALTH INDEX

Coral cover is a measure of the proportion of reef surface covered by live stony corals, which form the reef 's three-dimensional framework. It is the most widely measured indicator.

- Fleshy macro algae cover is a measure of the proportion of reef surface covered by fleshy algae or
- "seaweed". It is widely collected data along the same transects as coral cover
- Herbivorous fish abundance measures the biomass (total weight of fish per unit area) of surgeonfish and
- parrotfish, the most important fish grazers on plants that could overgrow the reef.
- Commercial fish abundance measures the biomass (total weight of fish per unit area).

Source: Healthy Reefs, 2010

3.6 Base Line and Monitoring Reef for the countries of the CAFTA-DR

Several methodologies of qualitative order exist to establish a base line and subsequent monitoring. Some of the most utilized in the Caribbean are:

1. Atlantic and Gulf Rapid reef Assessment (AGRRA)
2. Synoptic monitoring of the Meso-America Reef System Reef (SAM)
3. Caribbean Coastal and Marine Productivity Program (CARICOMP)

Of these three, the most utilized in the Caribbean are AGRRA and CARICOMP.

These two methodologies have advantages and disadvantages. AGRRA is a fast evaluation of reefs, which utilizes lineal transects to determine the condition of the reef through points of intersection. On the other hand, CARICOMP utilizes permanent transects that allow it to gather trends over several years, also utilizing lineal transects. CARICOMP is more precise that AGRRA, but the efforts of time and cost are a lot greater.

AGRRA is being utilized for long-term monitoring with good results. The primary difference is ease of use; the user of AGRRA may obtain technical support through its website to analyze the data collected in the field. Data is sent to the website and is analyzed and returned to the collector. Thus, the analysis is standardized and the results the can be compared between 800 places throughout the Caribbean.

To access the AGGRA monitoring tool and to request training assistance, see www.agrra.org. To access the CARICOMP monitoring tool, see www.unesco.org/csi/act/caricomp/ecosystem.htm.

For more information on the different protocols of monitoring reef: www.icran.org/pdf/Methods_Ecological_Monitoring.pdf

The protocol utilized to establish a base line can vary, but the indicators to be measured should at least include the following: (Adapted from www.healthyreef.org)

- **"Cover of Choir"** is a measure of the proportion of the surface of the reef cover by alive stone choirs, that are the ones that form the three-dimensional framework of the reef. This is the indicator that is most frequently measured.

- **A fleshy macro algae cover** is a measure of the percentage of surface of the reef that is covered by fleshy algae or for which is known simply as "algae". This data is obtained in the same transects utilized to determine the cover of choir
- **Abundance of herbivorous fish** measures the biomass (total weight of fish by unit of area) of fish surgeon and fish parrot, the fish that are known for foraging in the plants that cover the reef.
- **Abundance of commercial fish** measures the biomass (total weight of fish by unit of area) of significant commercial fish defined in the method of AGRRA. (www.healthyreefs.org)

Once the values of the previous indicators have been obtained, they can be compared with the following "Thresholds of Health" table presented by the Initiative Healthy Reefs (www.healthyreefs.org).

INDEX/ INDICATOR	VERY GOOD (5)	GOOD (4)	FAIR(3)	POOR (2)	CRITICAL (1)
Coral Index					
Coral cover (%)	≥40	20.0–39.9	10.0–19.9	5.0–9.9	<5
Coral disease prevalence(%)	<1	1.1–1.9	2.0–3.9	4.0–6.0	>6
Coral recruitment (m^{-2})	≥10	5.0–9.9	3.0–4.9	2–2.9	<2
Reef Biota Index					
Fleshy Macroalgal Index	<10	10–19	20–39	40–59	≥60
Herbivorous fish abundance ($g{\cdot}100m^{-2}$)	≥4800	3600–4799	2400–3599	1200–2399	<1200
Commercial fish abundance ($g{\cdot}100m^{-2}$)	≥2800	2100–2799	1400–2099	700–1399	<700
Diadema abundance (m^{-2})	>2.5 (and <~7)	1.1–2.5	0.5–1.0	0.25–0.49	<0.25

Healthy Reefs for Healthy People

4 SOCIAL –ECONOMIC-CULTURAL ENVIRONMENT

4.1 Socio-Economic Conditions and Resources

Economic and social data address relationships between the project and the communities it may affect. The objective of this information is to establish the relationship between alternatives with the socio-economic conditions defined by the size and precise demographic indicators of the vulnerabilities for the range of alternations. This baseline information should include demographics, employment, income, and fiscal information that includes various types of payments to governments.

This subsection should include descriptive and quantitative information for the area surrounding the project site on:

- Population, including age, gender, ethnic composition, religions, languages spoken and educational level
- CrimeCrime ratesLiteracy rates
- Community organizations
- Employment and unemployment, with mix of types and levels of jobs and key trends
- Public Health and Safety
    - Public health and ddiseases in the project area (including the sources of data and the methodology used to collect and analyze the data)
    - Existing practice for assessment of occupational and public health
    - Public safety conditions and resources

SOCIO-ECONOMIC SURVEY

Rapid urban appraisal using techniques such as windshield observations of the project area and communities; structured and semi-structured interviews with stakeholders; and desk research to investigate the socio economic aspects of the project area:

- Population and settlement characteristics
- Land uses and livelihoods
- Social infrastructure
- Community perceptions

Economic activities include industrial and commercial activities, employers, employment, incomes and distribution of income, tax base and skills, services and goods availability in the communities. This may need more emphasis for tourism projects that may include an influx of large numbers of affluent foreigners.

Indigenous, minority and low income populations should be indentified for the geographic region relative to the environmental setting or impact type. It should be considered whether the populations rely on specific natural resources for living or rely on areas for cultural, religious or economic reasons and whethere proposed tourist development might create displacement of the population or threats to their way of life.

4.2 Infrastructure Systems and Equipment

This section should include the current and future planned infrastructure and equipment, its current capacity and trends throughout the life of the proposed project in terms of quality, and demand in the absence of the proposed project in the following areas:

- Transportation
- Public Health
- Communications
- Energy/Utilities
- Emergency Response

It should not repeat the information provided in the project and alternatives description unless necessary for clarity. Baseline information may be cross referenced, as needed.

The adequacy of this infrastructure into the future under the no-action alternative without the proposed project should consider climate change that may create new or changing infrastructure demands. See e.g., http://www.rff.org/rff/documents/RFF-IB-09-15.pdf

4.2.1 Transportation Infrastructure

The information on the transportation infrastructure should address baseline conditions of transportation and traffic patterns on existing roads. This should include:

- Maps showing the location of all existing roads and evacuation routes, if applicable
- Whether tourists are expected to arrive at the destination via private automobile, rental, tour bus, public bus
- Conditio
- Surface materials
- Erosion and sediment problems and controls
- Maintenance programs (what, when and whom)
- Description of anticipated third-party improvements (government or entity other than the proponent)
- Traffic patterns and densities on roads which may experience significant increased use during construction or operation of the project. Traffic Studies/models may be warranted for larger tourism projects
- Safety levels and current circulation issues, and capacity
- Available Fueling Stations - gas, marine, jet

Other forms of transportation for tourists and materials required by the project that are expected to utilize the proposed project should be identified commensurate with the locations and countries from which tourists are likely to be drawn, including, but not limited to:

- Water transport—recreational boats, diving operations, cruise ships, other recreational water craft
- Railroads,
- Air strips,
- Airports and heliports
- Pipelines for fuel, water etc.

In addition, cruise ships and other kinds of boats, such as cruisers and sailboats, are also expected to carry tourists to destinations. It is therefore important to have similar information of ports and marinas. This information should also include:

- Design features
- Fueling facilities
- Moorings for port and marinas
- Mooring floats (e.g., NOAA's Anchors Away Program, or the PADI Dive Site Mooring Program) placed at dive sites to reduce anchor damage on sensitive marine habitats.
- Safety protocols for tourism activities (e.g., scuba diving and snorkeling, hiking, boating, flying, motor vehicle operation, sightseeing, etc.)
- Medical response capabilities (e.g., recompression chamber, medical assessment of diving accidents, medical emergency or trauma center, medivac system, etc.)
- Capacity
- Imbarkation and debarkation areas
- Maintenance programs
- Parking facilities
- Dry docks and waste handling facilities

- Port or marina reception facilities to handle garbage or other wastes generated aboard boats and ships

4.2.2 Public Health Infrastructure

The information presented on the public health infrastructure includes information on the existing drinking water, wastewater and solid waste management systems. The Environmental Setting should provide maps and quantitative information on the existing infrastructure for these systems, their capacities and any plans for expansion or change in technology or management of the systems. Information should be presented on maps as well as in narrative and tabular forms. This information should also include existing problems, constraints, capacities of facilities, and compliance with international norms.

4.2.2.1. Water System

- Sources of water
- Quality (before and after treatment)
- Access
- Trends in availability of potable water
- Maps, distances and distribution system information (pump stations specifications and transmission pipe sizes)
- Elevation changes form project site to tie-in point
- Issues, problems, constraints with these facilities – Is the Water Safe to Drink?

4.2.2.2. Wastewater System

- Quantity (inflow and discharges)
- Treatment type/level
- Sludge disposal, if applicable
- Discharge points designed to avoid health effects in contact recreation areas and contamination or negative impacts on sensitive biological areas
- Trends
- Maps, distances and distribution system information (pump stations specifications and transmission pipe sizes)
- Elevation changes form project site to tie-in point
- Issues, problems, constraints with these facilities

WHAT ARE WASTES AND WHAT TYPES OF WASTES SHOULD BE CONSIDERED?

A waste is any solid, liquid, or contained gaseous material that is being discarded by disposal, recycling, burning, or incineration. It can be byproduct of a manufacturing process or an obsolete commercial product that can no longer be used for intended purpose and requires disposal.

Solid (non-hazardous) wastes generally include any garbage, refuse. Examples of such waste include domestic trash and garbage; inert construction / demolition materials; refuse, such as metal scrap and empty containers (except those previously used to contain hazardous materials which should, in principle, be managed as a hazardous waste); and residual waste from industrial operations, such as boiler slag, clinker, and fly ash.

Hazardous waste shares the properties of a hazardous material (e.g. ignitability, corrosively, reactivity, or toxicity), or other physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if improperly managed. Wastes may also be defined as "hazardous" by local regulations or international conventions, based on the origin of the waste and its inclusion on hazardous waste lists, or based on its characteristics.

Sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations should be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste.

4.2.2.3. Waste Management System

- Quantity (daily quantities generated, collected and disposed of)
- Collection systems
- Recycling programs
- Disposal facilities (locations, sizes and management)
- Availability of chemical and hazardous waste management and disposal services
- Issues, problems, constraints with these facilities
- Port or marina reception facilities to handle garbage or other wastes generated aboard boats and ships

4.2.3 Communications Infrastructure

- Telephones: landlines, cell phone coverage
- WiFi
- Access
- Issues, problems, constraints with these facilities
- Television and radio stations
- Emergency communication network

4.2.4 Energy Infrastructure

- Sources of energy generation
- Energy transmission and distribution
- Substations
- Capacity
- Trends
- Issues, problems, constraints with these facilities
- Emergency power generation during a natural disaster

4.2.5 Additional Infrastructure

- Water for landscaping and grounds management
- Water for irrigation of golf courses
- Desalination plant for drinking water
- Water for firefighting activities

4.3 Cultural, Archeological, Ceremonial and Historic Resources

This section should include information on all cultural, archeological, ceremonial and historical resources in the project area. This information should include the existence in the area of pre-Hispanic settlements and preliminary archaeological surveys of the area, if they exist. For large projects, an archaeological survey may be necessary if it does not exist.

Some cultural, archeological, ceremonial or historic sites may need to be kept confidential due to the sensitivity of the resource and possible disturbance from disclosure. Project planners should consult with governmental managers for these resources to ensure that the sites are not disturbed or affected negatively by disclosure of their locations. These resources may be found in terrestrial, aquatic and marine locations.

In addition, this section will identify customs and cultural aspects of the population and identify any indigenous communities or sites used by indigenous people.

4.3.1 Within the Impact Zone

All cultural, archeological, ceremonial and historic resources within the project boundaries and within the area of direct impact should be inventoried and mapped. Excellent sources of information on location of such assets usually include federal ministries responsible for such assets, local religious institutions and scholars, and the UNESCO World Heritage Site (http://whc.unesco.org/en/list). During the preparation of the EIA, views should be solicited from stakeholders on whether there are any sites or surrounding areas have important traditional or cultural value. This subsection should also include information on any indigenous people or other traditional cultures in the project area.

4.3.2 At Tourist Destinations

Within the broad spectrum of tourism activities, impacts expand past the project boundaries and area of direct impact to areas that are visited by those staying at the resort or campground or cruise ship, including underwater sites. These may be concession-run areas or unregulated areas that have the potential to be access and damaged. As above, the cultural, architectural, ceremonial, historic and natural resource areas that are currently utilized or propose to be utilized as tourist destinations should be mapped and inventoried. The carrying capacity of each should be assessed and the percent of current utilization and projected utilization should be estimated.

4.4 Land Use

Qualitative and quantative information is provided in this section concerning land ownership, existing land uses and general features. Land use patterns should be evaluated by watershed. In addition marine use patterns should be evaluated, including vessel traffic lanes, navigation channels, anchoring areas, and particularly sensitive sea areas where anchoring and vessel traffic are restricted. Included in the land use description would be a map that would show the various uses, such as residential, commerical, mining, agricultural areas, airstrips, boundaries, rivers and lakes. Also, land uses or marine uses proposed by the project such as roads, facilities, trails, navigation channels, artificial reefs, mooring floats, and docks should be provided.

LOCAL LAND USE REGULATIONS

Before the project starts, it is imperative that the applicable land use regulations be determined. In some places, construction is forbidden (e.g., the first 50 meters from the high tide mark in Costa Rica). In others, constructing certain building types or making modifications to existing buildings is highly restricted (e.g., Antigua in Guatemala). Usually, local land use planning status provide for the allowable soil coverage, the minimum lot size, the maximum height, etc. Technical aspects regarding earthworks are described in detail in the *Guide for Infrastructure: An Environmental Management Instrument.* In order to build in some coastal areas, islands, and protected areas, it is necessary to obtain a concession.

Source: UICN: *Guide for Tourism: An Environmental and Social Management Instrument*

4.4.1 Proposed Project Site

The baseline of environmental information should include information on actual and potential land use on the proposed project site. This will include the current state of the project property and any associated marine area. Describe the property as urban or rural, vacant land or existing structures to be demolished, etc. For marine construction sites, existing or planned aquatic structures must have detailed examination. Such features as docks, breakwaters, bridge abutments, etc. not only pose impediments in the project footprint, but also affect local currents,sand movements, and potential smothering of nearshore areas which have to be factored into the designs and operations. Likewise, there are setbacks and restrictions to construction and operations around those features. Proximity to navigable channels pose another concern to construction and operations at an aquatic tourism project. Navigation channels generallyhave to be dredged initially and periodically over the life of the project to maintain the stated draft depths. There again are off-sets and restrictions that apply to construction and operations adjacent to navigable channels, as well as proper designation and monitoring of dredged material disposal sites.

4.4.2 Surrounding Lands

The baseline of Environmental Setting information should include information on actual and potential land use and marine areas around the proposed project. It should indicate trends in land/marine use and patterns of land/marine use. The information should be presented as a land/marine use map showing location, size and proximity of:

- Agricultural lands
- Forested lands
- Flood plains and water bodies
- Coastal zones
- Urban zones
- Protected areas
- Marine ecosystems
- Environmentally sensitive areas (not in protected areas)
- Culturally sensitive areas
- Population centers including the number and density of dwelling units
- Commercial and industrial areas
- Other land uses as appropriate

This subsection also should include descriptive and quantitative information as well as maps one the social, tourism and recreation. The information on the social infrastructure includes the numbers, sizes and locations and proximity to the project area with some indication of quiet zones which may include:

- Schools
- Cemeteries
- Churches
- Other public buildings
- Existing recreation and tourism opportunities
- Housing
- Educational Institutions
- Employment (mix of sources)

The information on the tourism and recreation infrastructure includes the numbers, sizes and locations of recreation facilities and eco-cultural-tourist locations. The subsection on socioeconomic conditions and resources also should include information on the current and projected future employment opportunities associated with tourism based on natural or cultural resources.

E. ANTICIPATED ENVIRONMENTAL IMPACTS

1 INTRODUCTION

The impacts section of the EIA examines the potential impacts on the physical, biological and socio-economic-cultural environments that may result from the construction, operation and closure of the proposed project or its alternatives.

Section E of this Guideline introduces the types of impacts generally associated with tourism projects. Section F identifies ways to assess and, wherever possible to quantify, the impacts, their magnitude, duration, extent and their significance for a proposal and location.

The impact assessment should account for all of the primary and support structures and related elements and activities involved in the project as described in the Project and Alternatives Description for the full range of direct, indirect and cumulative impacts:

- Direct impacts are due to a specific project-related activity in the same place and time as the project.
- Indirect impacts are due to actions resulting from the specific project, and are later in time or farther removed in distance, but still are reasonably foreseeable. Indirect impacts may include growth inducing impacts and other impacts related to induced changes in the pattern of land use, population density, or growth rate, and related impacts on air and water and other natural systems, including ecosystems.

POTENTIAL IMPACTS FROM TOURISM

By its very nature tourism is the attraction of people who do not live in an area to take advantage of its physical, biological and/or socio-cultural attributes for the enjoyment of the visitor. Because of the potential economic benefits to tourist destinations, it is often an active policy of governments and individuals to compete for the potential positive economic benefits to local employment and development.
Nevertheless, tourism can result in four basic types of adverse impacts:

- Seasonal and intensive increases in population density that increase the burden on and stress existing local infrastructure, resources, food production, and cultural practices.
- Destruction or restructuring of the natural environment, land and water resources and sensitive cultural, historic or architectural values due to tourism-related development, which may compromise habitat and species survival and damage socially important sites.
- Contamination of land and water resources because of the generation of waste and pollution from tourism activities.
- Direct environmental harm caused by tourists' activities, often within fragile ecosystems. Examples include damage caused by walking on coral reefs or using off-road vehicles in deserts.

When natural systems such as the natural barriers provided by wetlands and mangroves fail or deliver reduced services, serious threats to public health safety, and the environment can occur through flooding, and erosion, and possible saltwater intrusion to the drinking water supply.

Tourism that is poorly managed can damage the resources that attract tourists, so the tourism industry must be sensitive to changes in environmental quality. The biological concept of carrying capacity, particularly in sensitive ecosystems, suggests that beyond a certain level, areas cannot absorb additional tourism activity without significant deterioration of the environment. Strategic planning, and cautious development and implementation of environmental controls, are required to achieve environmentally sustainable tourism and economic growth.

Source: (INECE), 1995

- Cumulative impacts are the incremental impacts of the proposed project when added to past, present, and reasonably foreseeable future activities, regardless of what entity undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Impacts are site-specific and are determined by the geology, soils, hydrology, hydrogeology, climate, ecosystems and human populations in the vicinity of the project. The impacts may be positive or negative. Positive impacts can result, for instance, if a tourism activity or facility restores or protects an environmental or heritage resource, thus resulting in net improvement in conditions. However, generally the environmental impacts of tourism will have some negative environmental impacts.

Impacts associated with tourism can result from many different types of activities, ranging from large hotels or resorts or cruise ship terminal construction, to relatively small concessions focused on a particular activity, such as scuba diving or zip line adventure tours. In all cases the EIA will serve to identify and assess individually and as a whole the impacts of all of these actions as they may be involved at the proposed project through site preparation, construction, operations and closure stages.

The guideline is structured around impacts to each type of environment: the physical environment, the biological environment, and the socio-economic-cultural environment. These subsections are followed by a subsection that presents methods for identifying cumulative impacts.

2 PHYSICAL ENVIRONMENT

2.1 Geology, Soils and Ocean Topography

Tourism projects generally will include construction and management activities that may impact geology, soils and the marine substrate, including:

- Land clearing for site preparation and access routes
- Earth moving and terrain shaping including excavation and filling, involving earth moving equipment and occasionally blasting
- Disposal of cleared material (vegetation, soil, stones, dredged material) removed during these activities and construction debris
- Use and possible storage of lubricants, fuels and other chemical products
- Closure, involving further terrain shaping, debris disposal and use of lubricants, fuels and other chemical products

Land clearing, earth moving, and terrain shaping at the project site as well as at the sites where material for project construction will be collected (quarries, borrow pits, etc.) will remove vegetative cover and change the topography of the affected area, which can cause increased soil compaction, erosion and associated sedimentation. Changing the topography of the site can also create the potential for landslides or slope failure, depending on the soil types and magnitude of the change.

Changing the topography will change the drainage patterns and in combination with removal of vegetative cover can lead to erosion, the magnitude and extent of which will in part be determined by the resulting gradients, soil types, rainfall, and local hydrology. Exposing bare soil during these activities can also increase wind erosion. These impacts can be short-term, if proper soil erosion and slope stability controls are used or installed, although they may often exist through the completion of construction of onsite facilities, structures and buildings, access roads and transmission line connections, as these activities also disturb soil. Construction planning should take into account the seasonal rains that are common in the Central American and Caribbean region to manage erosion of exposed soil.

In the coastal and marine environment or for inland waterways, construction in and near the water may require dredging and/or filling activity which can significantly affect water flow, wave action/dissipation, which in turn can have impacts on, erosion and sedimentation. In the marine and coastal environment, dredging and disposal activities for the construction of docks, moorings, jetties, marinas, structures on piles, terminals for cruise ships, new hotel land, and beach nourishment can radically change the topography of the ocean bottoms and alter wave action to increase erosion and sediment at the site or farther along the shore.

Tourism development in coastal areas (including hotel, resort, airport and road construction) is of increasing concern worldwide. This can lead to sand mining, beach erosion and land degradation. Coastal construction can remove stabilizing beach vegetation and change the coastal structure and along-shore wave movement, causing undesirable erosion and deposition patterns. This can trigger requirements for additional construction components to correct/alleviate those problems (breakwaters, revetments, shoreline armoring, etc.) These constructed fixes often increase the natural environmental disturbances and can require additional mitigation efforts.

Some fixed-base tourism activities have fueling depots and other chemical storage areas that contain hazardous substances, including fuels, fertilizers, pesticides, cleaning products, etc. If these substances leak, they can contaminate soil.

Table E-1 presents various impacts which could be caused to geology and soil resources as well oceanography and beaches due to tourism development.

Table E- 1: Potential impacts on geology and soil resources from tourism development

ACTIVITY	POTENTIAL IMPACT
Land clearing, earthmoving, terrain shaping (leveling, drainage, etc.) and associated activities (e.g., borrow pits, quarries and other off-site sources of materials)	• Landslide hazards (creation of unstable slopes) • Erosion and sediment production • Soil compaction • Soil contamination from spills and fuel leaks • Disposal of cleared debris
Construction and landscaping of onsite facilities, structures and buildings Construction and/or upgrade of access roads and power lines	• Soil compaction • Soil contamination from spills and fuel leaks • Disposal of construction wastes, including potentially hazardous wastes • Off-site earth material sources (sand, marl, rock soil, aggregate, wood, etc.) Need to see they come from legitimate sources
Wastewater	• Soil contamination
Hazardous wastes and fuels	• Soil contamination
Solid waste disposal	• Erosion and sediment production from construction of land fills • Contamination of soils
Dredging and filling	• Changes in stream or ocean bottom topography • Beach erosion • Sedimentation and aggregation • Creation of new land areas causing erosion in other places
Dredging material disposal	• Changes in stream or ocean bottom topography • Erosion and sediment production • Soil contamination • Impacts of sediment mounding (changes to wave climate, vessel depth limitations)
Beach development	• Increase beach erosion • Disturbance for bottom areas including ocean topography
Development of docks, moorings, marinas, jetties, breakwaters, etc	• Alter beach erosion and aggregation areas • Modify ocean topography
Hiking and camping	• Erosion and sediment production • Soil compaction
Off-road biking and touring	• Erosion and sediment production • Soil compaction • Beach erosion
Closure/Decommissioning	• Erosion • Soil compaction • Spills and fuel leaks • Disposal of construction wastes, including potentially hazardous wastes

2.2 Water Resources

As discussed in the previous subsection on Geology and Soil, nearly all tourism projects involve land clearing for site preparation and access routes and earth moving and terrain shaping, which may change the drainage patterns and increase runoff and associated soil erosion and sedimentation.

Runoff can carry sediments and other contaminants, either attached to the sediment or in solution, including soil nutrients and lubricants, fuels and chemicals that may be spilled at the sites. Any source of soil contamination identified in the previous subsection, can be carried in runoff. If agricultural chemicals are used on farms or forests associated with biomass production, or if herbicides are used during land clearing or to manage vegetation in right-of-ways, they can also become components of runoff. Depending on the local conditions and the distance to surface water, these contaminants can impact water quality in the surface waters that receive drainage from the affected areas.

> Freshwater availability for competing agricultural, industrial, household and other uses is rapidly becoming one of the most critical natural resource issues in many countries and regions. Rapid expansion of the tourism industry, which tends to be extremely water-intensive, can exacerbate this problem by placing considerable pressure on scarce water supply in many destinations. Water scarcity can pose a serious limitation to future tourism development in many low-lying coastal areas and small islands that have limited possibility for surface water use and storage, and whose groundwater may be contaminated by saltwater intrusion.
>
> Source: Neto (2002)

Construction or upgrading of access roads to the facility site or to the right-of-way, in the case of transmission projects, may also require construction across wetlands or streams, which can disrupt watercourses and wetland flow regimes, directly impacting water quality and cause bank erosion.

Another potential water quality impact can occur when construction takes place on marine floors causing increased disturbances of sediments, increased turbidity and subsequent damage to habitats.

Table E-2 identifies potential impacts to water resources from various activities.

Table E- 2: Potential impacts on water resources from tourism development

ACTIVITY	POTENTIAL IMPACT
Land clearing, earthmoving, terrain shaping (leveling, drainage, etc.) and associated activities (e.g., borrow pits, quarries and other off-site sources of materials)	• Modification of drainage patterns • Erosion and sediment contaminating surface water • Water contamination from spills and fuel leaks • Disposal of cleared debris • Modification of streams and rivers
Construction of onsite facilities, structures and buildings Construction and/or upgrade of access roads and power lines	• Modification of drainage patterns • Erosion and sediment contaminating surface water • Water contamination from spills and fuel leaks • Disposal of construction wastes, including potentially hazardous wastes can contaminate surface and ground water • Increased runoff due to soil compaction and changes in vegetation cover • Water needs for construction, such as cement mixing and dust control
Landscaping	• Potentially high water consumption butting strain on water resources • Runoff of pesticides, fertilizers contaminating surface and ground water • Erosion and sedimentation • Increased runoff
<u>Generation, collection, treatment, disposal of:</u> Wastewater	• Surface and ground water contamination
Water supply development	• Depletion of nearby water resources
Hazardous wastes and fuels	• Surface and groundwater contamination
Solid waste disposal	• Increase sediment from construction • Surface and ground water contamination
Development of docks, moorings, marinas, jetties, breakwaters, etc.	• Modification of drainage patterns • Increased runoff due to soil compaction and changes in vegetative cover • Modification of streams and rivers due to crossings • Run-off carrying sediments and associated contaminants • Spills and fuel leaks
Dredging and filling	• Mobilization of contaminants that may occur in existing sediments • Surface and ground water contamination if dredge material are deposited on shore. • Spills and leaks contaminating ground and surface water • Increase turbidity • Disposal of potential hazardous substances contaminating surface and groundwater • Changes in tidal exchange (between the ocean and bay or river) and associated changes in salinity regime
Dredging material disposal	• Erosion and sediment production contaminating surface water
Hiking and camping	• Erosion and sediment production contaminating surface water
Off-road biking and touring	• Erosion and sediment production contaminating surface water
Scuba diving and snorkeling	• Erosion and sedimentation at points of entry
Closure/Decommissioning	• Erosion and sediment contaminating surface water • Spills and fuel leaks contaminating surface and ground water • Disposal of construction wastes, including potentially hazardous wastes contaminating surface and ground water

2.3 Air Resources

Air contamination at tourism projects arise primarily from dust and equipment emissions during construction and increased transportation-related emissions during both construction and operations. Dust is generated at all tourism projects during land clearing, earth moving, terrain shaping, construction and decommissioning activities. Despite the best attempts to control dust, there will be areas and times when elevated dust concentrations will occur during these activities. A large portion of dust is made up of large particles, with diameters greater than 10 microns. This coarse dust usually settles gravitationally within a few hundred meters of the source. The smaller particle size fractions (PM10), however, can be carried by wind in dust clouds for great distances and may be deposited on or near populated areas. Dust from land clearing and construction, however, is a short-term impact.

During site preparation and construction, the project will also generate particulate and gaseous air pollutant emissions from burning of cleared debris andvehicle and construction equipment exhaust. Particulate emissions (including PM10 emissions), carbon monoxide, unburned hydrocarbons (volatile organic compounds), nitrogen oxides and sulfur dioxide result from fuel combustion in vehicles, heavy equipment, and generators associated with land clearing and construction. If asphalt batch plants will be used during these activities, then there will also be emissions of volatile organic compounds (VOCs).

During operation of the tourism project air emissions may be associated with power generation and from cruise ship emissions. Cruise ships burn high sulfur fuels that can contribute to raised levels of asthma. Recent efforts to control these sources highlight the contributions that they are making.

Table E- 3: Potential impacts on air resources from tourism development

ACTIVITY	POTENTIAL IMPACT (i.e. public health, visibility, acid rain resource impacts from air pollution)
Land clearing, earthmoving, terrain shaping, and construction of onsite facilities, structures and buildings and construction and/or upgrade of access roads and power lines	• Emissions from vehicles • Fugitive dust • Smoke from debris burning • Fumes and volatile organics from asphalt batch plants
Generation, collection, treatment and disposal of: Wastewater Hazardous wastes and fuels Solid waste	• Odors • Fumes • Emission from vehicles and heavy equipment
Dredging and filling	• Emissions for dredgers
Energy production	• Emissions from generators
Motor boats	• Emission from motors
Cruise	• Stack emission from burning high sulfur fuel near-shore • Acid rain from high sulfur emissions
Airplanes and airports	• Emissions from airplanes and vehicles

2.4 Noise and Vibration

Noise and vibration at tourism projects are generated during construction and decommissioning activities from blasting, construction equipment, and the transport of equipment and materials and from increased tourism – related traffic during operations. Marine construction always involves pile driving or specialized foundations which result in both noise and vibrations.

Any tourism activity will increase human traffic and thus noise. Fixed –base construction noise and operations and concessionaire tours/activities in natural areas will introduce noises and vibrations not native to the fauna. Marine activities such as motorized boats and jet skis will increase noise and vibration to sea creatures. . Table E-4 presents a brief summary of activities and potential impacts.

Table E- 4: Potential impacts noise and vibration from tourism development

ACTIVITY	POTENTIAL IMPACT
Land clearing, earthmoving, terrain shaping, and construction of onsite facilities, structures and buildings and construction and/or upgrade of access roads and power lines	• Noise and vibration from heavy equipment, on-site machinery (crushers, batch plants, etc.) and transport of materials and machinery to site • Noise from the use onsite of tools • Noise and vibration from blasting affecting wildlife and property
Solid waste disposal	• Noise from garbage trucks • Noise and vibration from landfill development and operation
Dredging and filling	• Engine noise
Energy Production	• Generator noise
Motor boats, jet skiis	• Engine noise from motors
Cruise/Rail/Plane	• Engine noise • Track noise • Whistle noise

2.5 Aesthetic Resources

Impacts of tourism projects on landscape and aesthetic resources include:

- Impacts on visual resources
- Impacts on panoramic landscapes (including cultural resources)
- Impacts on visibility (air contamination projects only)
- Increases in light contamination

Visual impacts of tourism projects are highly variable, depending on the project type, location, lines of sight, and scenic vistas that may exist in the project area. Visual impacts are generally new facilities and road construction. New construction can introduce building heights uncommon to the surroundings. Road constructions can mar a formerly pristine view shed. New construction can add might time lights in areas where there formerly were none, again disturbing the formerly pristine view shed.

Light pollution that is excessive or obtrusive artificial light and can be a problem at large fixed –base facilities. Light pollution is a broad term that refers to multiple problems, all of which are caused by inefficient, unappealing, or (arguably) unnecessary use of artificial light. Light pollution sources from Tourism projects include:

- Lights used during construction to enable work at night or during low light conditions
- Building and structure exterior and interior lighting
- Nighttime security lighting
- On-site streetlights
- Vehicular lighting associated with traffic to and from the site

3 BIOLOGICAL ENVIRONMENT

The primary pathways of impacts on the biological environment are contamination of soil, water and air and alteration of flow in surface water or ocean currents. However, biological resources can also be affected by land use conversions, increased human activity in the vicinity of the project, and increased pressure on natural resources in the area of influence due to human population increases associated with the project activities. Ecosystems are complex webs and relationships among plant and animal species and their physical environment. Some order this information by Flora and Fauna, and in the process of describing them describe their associated ecosystem. Ecosystems can be described flora and fauna within freshwater, terrestrial, and coastal/marine ecosystems. Table E-5 presents a brief summary of how various activities can impact the biological environment.

Table E- 5: Potential impacts on biological environment from tourism development

ACTIVITY	RESOURCE	POTENTIAL IMPACT
Land Clearing, Earthmoving, Terrain Shaping, and Construction Activities	Terrestrial Flora and associated Ecosystems	• Spread of invasive species and/or loss of indigenous species • Ecosystem loss due to swamp draining, wetland infill, etc. Loss of habitat forever. • Wildfire
	Terrestrial Fauna	• Disruption and dislocation (via noise, vibration, lights and human presence, flooding or coastal erosion) of local and/or migratory wildlife, including disturbance of migratory corridors and breeding, nesting and calving areas • Wildfire
	Aquatic Species and associated Ecosystems	• Run-off carrying sediments and associated contaminants • Wave and current control structures (jetties, breakwaters, groynes, etc.) directly destroy habitat • Water quality impacts such as increased sediment disturbance can indirectly affect habitat health
Construction Camp	Terrestrial and Aquatic Fauna, and associated Ecosystems	• Animals attracted to garbage and food waste • Disruption and dislocation (via noise, vibration, lights and human presence) of local and/or migratory wildlife, including disturbance of migratory corridors and breeding, spawning, nesting and calving areas • Degradation of ecosystems from fuel wood gathering • Increased collecting, hunting and fishing (food for workers)
Dredging and Filling	Terrestrial Flora and Fauna	• Loss of habitat if dredged material is disposed of on land
	Aquatic Species and associated Ecosystems	• Direct degradation or destruction of benthic communities, coral reefs and other aquatic habitats • Degradation or destruction of habitat from disposal of dredged material in water bodies • Breaching of protective reefs, leading to degradation or destruction of habitat • Disturbance of species during sensitive life history stages • Mobilization of contaminants from sediment causing water contamination and potential species poisoning
Beach Nourishment Operations	Aquatic Species and associated Ecosystems	• Disturbance for bottom vegetation areas including ocean topography • Degradation or destruction of habitat
Development of docks, moorings, marinas, jetties, breakwaters, etc.	Aquatic Species and associated Ecosystems	• Direct loss of habitat • Degradation of habitat caused by shading of plants (seagrass, mangroves, marsh species, coralline algae)
Solid and Hazardous Waste Discharge of polluted or treated wastewater	Terrestrial and Aquatic Fauna and associated Ecosystems	• Attraction of pests and vectors • Contaminated runoff and water discharges can cause fish kills and poison wildlife • Solid waste collection, storage and disposal sites affect wildlife migration patterns • Litter in stream, lakes, and the ocean adversely impacts aquatic life • Runoff from golf courses that is contaminated with pesticides and herbicides can poison aquatic life and wildlife
	Terrestrial Flora and associated Ecosystems	• Hazardous substances in runoff can kill vegetation
Fuel Storage	Terrestrial and Aquatic Fauna and associated Ecosystems	• Uncontrolled spills and leakage of fuelscan poison aquatic life and wildlife
	Terrestrial Flora and associated Ecosystems	• Uncontrolled spills and leakage of fuels can kill vegetation

ACTIVITY	RESOURCE	POTENTIAL IMPACT
Tourist Activities	Terrestrial Flora and associated Ecosystems	• Camping and Hiking • Increase trampling and compaction • Introduce foreign weeds, invasive species, • Increase wildfire risk
	Terrestrial Fauna	• Misuse of natural resources • Destruction, modification or fragmentation of habitat • Disruption of behavior including: feeding, migration, breeding, nesting, and calving • Poisoning from chemicals and wastes • Increased human access increases e harvesting by collection and hunting
	Aquatic Species and Ecosystems	• Same as terrestrial flora and fauna • Boat anchoring and wakes can cause direct damage • Overharvesting by sport fishing

3.1 Terrestrial Species and Associated Ecosystems

Impacts on terrestrial species and the ecosystems associated with them include:

- Destruction, modification or fragmentation of habitat
- Disruption of behavior, including feeding, migration, breeding, nesting, and calving
- Direct impacts
- Poisoning from direct contact with hazardous substances or contamination of watering holes
- Increased collection and hunting

Destruction or fragmentation of terrestrial ecosystems is largely associated with physical disruption during construction (land clearing, earthmoving and terrain shaping at the facility site) and along access roads and right-of-ways, or operational activities (hiking, zip lines, ATV /Jeep tours) which bring intense human activity that may intersect normal migratory paths or habitats. Excessive collection of fuel wood by workers during construction or operation can also lead to deforestation. Destruction of ecosystems can also be caused indirectly if emissions kill or reduce productivity of vegetation downwind from the tourism activity.

Wildfires are another source of ecosystem destruction. Facility construction and operation increases the number of humans in its vicinity, which increases the possibility of human caused wildfires. This is also true along access routes and right-of-ways. If vegetative management of right-of-ways allow for the build-up of fire fuels, such as slash, this can increase the intensity of fires in the right-of-ways.

Riverbed scouring caused by construction in or adjacent riparian zones can cause stream bed erosion, which can lower water availability in riparian zones in the area of the scouring, causing die-off of vegetation.

The construction of access roads and right-of-ways can fragment existing ecosystems and interrupt migratory corridors. Access roads and right-of-ways can also open to human activities areas that had previously been relatively wild, disturbing the species in those areas and creating opportunities for increased collection or harvest of plant life and collection or hunting of animals.

Some ecosystem areas are more critical to species survival than other areas. These include migratory routes or corridors, watering holes, salt licks, and breeding, nesting and calving areas. These areas should have been identified in the preparation of the Environmental Setting. Any impacts in these areas should receive special attention.

Modification of habitat can be associated with right-of-way management as well as with releases of noxious or invasive species. Excessive vegetation maintenance in right-of-ways may remove unnecessary amounts of vegetation resulting in disrupting succession and increasing the likelihood of the establishment of non-native invasive species.

Alteration of terrestrial habitat for construction of transmission and distribution projects may also yield benefits for wildlife such as the creation of protective nesting, rearing, and foraging habitat for certain species; the establishment of travel and foraging corridors for ungulates and other large mammals; and nesting and perching opportunities for large bird species atop transmission towers and associated infrastructures.

Tourism projects can disrupt animal behavior in several ways. If the project involves a construction camp or onsite housing during operation, animals can be attracted to garbage and food waste thus changing their feeding habits and their interactions with humans. Regular maintenance of right-of-ways to control vegetation may involve the use of mechanical methods, such as mowing or pruning machinery, in addition to manual hand clearing and herbicide use, all of which can disrupt wildlife and their habitats. Noise, vibration, illumination, and vehicular movement can disrupt animal activities. These are particularly of concern if animals are disrupted in sensitive habitats, such as migratory routes or corridors, watering holes, salt licks, and breeding, nesting and calving areas.

Light pollution poses a serious threat to wildlife, having negative impacts on plant and animal physiology. Light pollution can confuse animal navigation, alter competitive interactions, change predator-prey relations, and cause physiological harm. The rhythm of life is orchestrated by the natural diurnal patterns of light and dark, so disruption to these patterns impacts the ecological dynamics.

Inland Natural Area Tourism like camping, hiking, and auto/Jeep/ ATV tours have direct impact to wildlife. Off trail excursion can trample, compact, denude areas which can increase erosion, disrupt migrations pathways, decrease the food supply and directly impact the health of an ecosystem? Direct impacts to wildlife can be caused by increase hunting, improper solid or liquid waste disposal and direct contact by animals with project components. Increased collection and hunting can be stimulated by increased human activity in the area by workers and the population that grows to meet those workers needs. Improper waste disposal can bring animals into direct contact with hazardous substances or poison watering holes.

3.2 Aquatic Ecosystems

Changes in water quality affect aquatic resources by increasing the loading of sediment, nutrients, or toxic/hazardous materials (metals) to streams and water bodies, decreasing the oxygen in the water, and/or changing ambient environmental conditions. Physical modifications in the resources can also impact aquatic habitats, such as modifying shade, pool and riffle sequences, flow of ephemeral, intermittent, or perennial streams due to contaminated runoff from parking lots, paths, roads, and other surfaces disrupting flows into or the size of wetlands or other water bodies. Impacts may result in changes to relative abundance of species or biological diversity.

Tourism activities can also impact aquatic ecosystems if increased resource demands (such as overfishing) or the introduction of other secondary impacts (such as clothing washing, recreational use, or lighting from coastal facilities) displace species or disrupt habitats.

3.2.1 Wetlands and Mangrove Forests

Wetlands and riparian areas are usually the most productive and diverse vegetation types within an ecosystem. Impacts to wetlands due to tourism operations may occur directly or indirectly.

Direct impacts can include wetland destruction through removal for development of resorts, over pumping groundwater or changes in stream flow or aquifer conditions, or filling as a result of construction activities. Some of these activities can result in saltwater intrusion which is destructive to fresh water wetlands. Sedimentation can also impact wetland resources as a result of uncontrolled runoff and erosion from the construction sites or scouring and head cutting from poorly designed stream diversions or discharge outfalls.

MANGROVES

A general name for several species of halophyte belonging to different families of plants (including trees, shrubs, a palm tree and a ground fern) occurring in intertidal zones of tropical and subtropical sheltered coastlines and exceeding one half meter in height. The term is applied to both the individual and the ecosystem, the latter of which is termed mangal. Mangroves provide protected nursery areas for juvenile reef fishes, crustaceans, and mollusks. They also provide a feeding ground for a multitude of marine species. Many organisms find shelter either in the roots or branches of mangroves. Mangrove branches are nesting areas for several species of coastal birds. The root systems harbor organisms that trap and cycle nutrients, organic materials and other important chemicals. Mangroves also contribute to higher water quality by stabilizing bottom sediments, filtering water and protecting shorelines from erosion. They protect reefs from land runoff sedimentation. Conversely, coral reefs protect mangroves and seagrasses from erosion during heavy storms and strong wave action. Sediment, contaminated stormwater runoff and other pollutant can damage ecosystems associated with mangrove ecosystems.

Source: NOAA

Indirect impacts on riparian and wetland resources can occur from increased human activities in those habitats, including recreation and gathering of plant materials for food, construction, fuel or medicinal uses.

3.3 Marine/Coastal Species and Associated Ecosystems

Marine/Coastal species are those species that may live in the water or near the shorelines of seas, oceans, or great lakes. They include species that live in marine water as well as freshwater. Impacts that can affect aquatic species and the ecosystems associated with them include:

- Water contamination
- Changes in water flows or water levels in surface water
- Direct aquatic habitat alteration
- Injury or mortality from direct contact with in-water technologies, increased collection or fishing, habitat avoidance due to noise or visual disturbances.

Rapid expansion of coastal and ocean tourism activities, such as snorkeling, scuba diving and sport fishing, can threaten coral reefs and other marine resources. Disturbance to marine aquatic life can also be caused by the intensive use of thrill craft, such as jet skis, frequent boat tours and boat anchors. Anchor damage is now regarded as one of the most serious threats to coral reefs in the Caribbean Sea, in view of the growing number of both small boats and large cruise ships sailing in the region. Severe damage to coral reefs and other marine resources may, in turn, not only discourage further tourism and threaten the future of local tourist industries, but also damage local fisheries.

Source: Neto, 2002

Coastal and Marine Tourism includes construction, operations and concessions associated with ports, marinas, docks and seaside resorts.

Hotels and resorts can cause decreased water quality resulting from raw and improperly treated wastewater discharges and fertilizer runoff. An increase in solid and hazardous wastes, as well as noise and vibrations can disturb ecosystems. Marinas, docks and boating activities increase the potential for spillage or disposal of oil and fuels, lubricants, and anti-fouling chemicals, which can directly harm wildlife or indirectly impair it through diminished water quality. In adequate port reception facilities for wastes and garbage may cause such materials to be discharged in the ocean from commercial vessels or recreational vessels. Additionally anchors and wakes can directly cause physical damage. Boats allow tourists the ability to access previously inaccessible marine and coastal areas. There they can directly impact habitats through: trampling, collecting souvenirs/coral/shells/etc., over fishing, disturbing nesting birds and turtles, littering, and starting wildfires.

Impacts on aquatic ecosystems caused by water contamination and water flows are derived directly from the water quantity and quality impacts identified in subsection 2.2, Water Resources. If the project will impact water quality or quantity in surface water, then it has the potential to impact the aquatic species in those waters. For example, discharges with elevated temperature and chemical contaminants can affect phytoplankton, zooplankton, fish, crustaceans, shellfish, and many other forms of aquatic life. Similar ecosystem and species composition impacts can occur if the amount of flow is reduced or if the project introduces large variances in flow rates. These types of ecosystem changes can often lead to invasion by non-native species. These impacts and others caused by changes in water quality and quantity should be investigated and characterized.

Direct aquatic habitat alteration can occur during construction or upgrading of access roads and right-of-ways. If such activities require construction across wetlands or streams; on the borders of ponds or lakes estuaries; or on coastlines, they can disrupt watercourses and wetland flow regimes, impact water quality and cause bank erosion all of which impact aquatic habitats. Any dredging or construction on marine floors can disrupt marine habitat including intertidal vegetation (e.g. eelgrass), coral reefs, and marine life.

TOURISM IMPACTS TO CORAL REEFS AND MARINE HABITATS

Development of marinas and breakwaters can cause changes in currents and coastlines. Furthermore, extraction of building materials such as sand affects coral reefs, mangroves, and hinterland forests, leading to erosion and destruction of habitats. Mining of coral for resort building materials has damaged fragile coral reefs and depleted the fisheries that sustain local people and attract tourists.
Overbuilding and extensive paving of shorelines can result in destruction of habitats and disruption of land-sea connections (such as sea-turtle nesting spots). Coral reefs are especially fragile marine ecosystems and are suffering worldwide from reef-based tourism developments. Evidence suggests a variety of impacts to coral result from shoreline development, increased sediments in the water, trampling by tourists and divers, ship groundings, pollution from sewage, overfishing, and fishing with poisons and explosives that destroy coral habitat.

Development of marinas and breakwaters can cause changes in currents and coastlines. Furthermore, extraction of building materials such as sand affects coral reefs, mangroves, and hinterland forests, leading to erosion and destruction of habitats. Mining of coral for resort building materials has damaged fragile coral reefs and depleted the fisheries that sustain local people and attract tourists.
Overbuilding and extensive paving of shorelines can result in destruction of habitats and disruption of land-sea connections (such as sea-turtle nesting spots). Coral reefs are especially fragile marine ecosystems and are suffering worldwide from reef-based tourism developments. Evidence suggests a variety of impacts to coral result from shoreline development, increased sediments in the water, trampling by tourists and divers, ship groundings, pollution from sewage, overfishing, and fishing with poisons and explosives that destroy coral habitat.

Source: UNEP (2001)

3.4 Endangered or Threatened Species and Habitats and Protected Areas

It is imperative that no endangered or threatened species or designated protected areas be adversely impacted by tourism projects. These species should receive particular attention during the assessment of impacts on flora and fauna, striving for no net loss. All activities proposed for the project should be overlaid on maps of the habitats for endangered and threatened species as well a protected areas, to identify any potential impacts.

4 SOCIAL-ECONOMIC-CULTURAL ENVIRONMENT

Socioeconomic impacts of tourism projects are highly variable and dependent on the project type, project size, project footprint, energy source(s), existing land use and ground cover patterns, proximity of population, local livelihoods, presence of cultural and religious assets, and the area of primary and secondary impact. Further, different types of impacts will occur during project preparation, construction, operation and decommissioning. Nonetheless, there are sets of impacts on the social-economic-cultural environment that are common to nearly all tourism projects. These are summarized in Table E-6.

Table E- 6: Social-economic impacts that may occur from tourism projects

RESOURCE	POTENTIAL IMPACT
Economic	Increase or decrease in individual incomes
	Direct employment at the project
	Indirect employment generated by project activities
	Increased purchases from local businesses
	Other economic activities stimulated in the community as a result of the project
	Employment opportunities for local residents (short- and long-term)
	Increased tax base
	Commitment to community development support from the project company
	Displacement and relocation of current settlements, residents or community resources
	Displacement or disruption of people's livelihoods (e.g., fishing, hunting, grazing, farming, forestry and tourism) related to disrupted access or resource loss
	Public finance requirements – will more infrastructure or services be needed to meet the demands of increase population in the areas (e.g., public education, policing, fire protection, water, sanitation, roads)
Social	Reduction in quality of life for residents from visual and noise impacts
	Increased crime (drugs, alcohol, prostitution, etc.)
	Change in population
	Change in character of community
	Change in religious, ethnic or cultural makeup of community
	Change in housing market (during construction and operation and after closure)
Public Health	Increase exposure to disease due to an influx of tourists and workers from other locations
	Increase burden on public health system
	Increase burden on public officials to provide services during emergencies such as floods, volcanic eruptions, etc.
Public Safety and Physical Risk	Risk of loss of life from increased flooding potential
Worker Health and Safety	Increase in sexually transmitted diseases among workers
	Increase in on the job injury
	Increase in occupational diseases due to exposure to dust and other project related activities such as handling of explosives, solvents, petroleum products, etc.

Social and economic impacts of tourism projects will be both positive and negative. Socio-economic impacts will vary by location and size of the project, length of the project from construction to closure, manpower requirements, the opportunities the company has for the local community employment and involvement, and the existing character and structure of the nearby communities. Some of these communities have opted to participate in tourism in a controlled fashion, thus deriving substantial economic benefits. Others have been subjected to forms of tourism which are denigrating, yield few benefits, and operate without the community's consent.

The tourism business actively supports initiatives for positive social and infrastructural development. One of the primary socio-economic concerns is displacement of people through: involuntary or forced taking of land, relocation or loss of shelter, loss of assets (farmlands, forests, fisheries, etc.), and/or loss of income sources or means of livelihood. This is an especially crucial consideration for indigenous people and projects, like hydroelectric dams, that can impact vast areas. Development bank experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social and environmental risks arising from a chain of actions following displacement. Production systems are dismantled and people face impoverishment. People are relocated to environments where their productive skills may be less applicable and the competition for resources greater. Community institutions and social networks are weakened. Kin groups are dispersed. Cultural identity, traditional authority and the potential for mutual help are diminished or lost.

The impacts on public health will vary with the type of project. Any projects that create water bodies can create habitats for mosquitoes. If dengue fever or malaria is prevalent in the area, these impoundments could increase the population of mosquitoes that carry these diseases. Emissions from thermal/combustion projects can impact health in downwind communities, depending upon the concentrations and the distance to the communities. Table E-10 presents a summary of potential socio-economic impacts as well as to public health and safety due to tourism activities.

4.1 Vulnerable Populations

Impact analysis and policy considerations that may be valid for the general population may not adequately capture important impacts on subsets of society. For these vulnerable populations, efforts to protect their environmental health and wellbeing requires further investigation into their special relationship to the environment to assess whether predicted impacts may fall disproportionately heavily. Impacts that may not be considered significant for the general population may overlook potentially significant impacts on these populations without this special focus. In the context of the United States, the populations which may be disproportionately affected are referred to as "environmental justice communities." Whether these impacts can be anticipated from proposed tourism projects depends upon the area of influence of the impacts of the proposed project and the use of the affected resources by populations which may be disproportionately affected typically indigenous peoples, minority or low-income groups.

Traditional indigenous communities are particularly vulnerable to cultural changes because of the lack of concern and carelessness of some tourist operators with regard to the communities' wishes and interests. Some of these communities have opted to participate in tourism in a controlled fashion, thus deriving substantial economic benefits. Others have been subjected to forms of tourism which are denigrating, yield few benefits, and operate without the community's consent. Tourism development can:

- Push farming onto lands that may be more prone to erosion or lack suitable water supplies

- Relocate people to homes and structures that may be more vulnerable to natural disasters including flooding, volcanic activity, and fire
- Limit access to beach areas or the seas by local fishermen affecting their livelihoods
- Change dietary habits due to the availability of foods provided to tourist or limited access to seafood, fish, and wildlife which are important aspects to local population diets
- Pressure cultural survival by being influenced by tourist
- Modify or deprive traditional use of land and natural resources.

4.2 Infrastructure: Systems, Equipment, Capacity, Performance

As presented in Table E-7, the impacts on infrastructure of tourism projects can be neutral, positive or negative, varying with the location and size of the project, manpower requirements, economic benefits to the community, impact on availability of public funds and the existing infrastructure.

Table E- 7: Impacts to existing infrastructure

TYPE	FACILITY OR FEATURE AFFECTED (e.g. cost, capacity, pollution impacts, demands for infrastructure)
Transportation	• Existing roads--Potential changes to traffic patterns, densities, and traffic safety issues or deterioration in area affected by project • Associated structures (bridges, tunnels, traffic controls, etc.) • Marinas, boats, and mooring activities • Landing strips and airports • Bus terminals
Public Health Infrastructure	• Drinking water supplies and treatment • Wastewater treatment and management • Solid and hazardous waste management and treatment
Energy Infrastructure	• Increased demand for energy creating potential black outs • Alterations to distribution system and reach • Cost of energy
Communications Infrastructure	• Increased need for communications infrastructure • Alterations to distribution system and reach

For all of these types of infrastructure, the question for the EIA is do they have the capacity to meet the demands the project will create, or will they have to be altered, improved or expanded? Additionally, the EIA should determine if the project will alter the condition of the infrastructure. If the infrastructure will not meet the demand of the project, or if the project will impact the condition of the infrastructure, then the project has an impact on infrastructure.

For transportation infrastructure, this subsection should addresses impacts of transportation and traffic patterns on existing roads. It should identify any anticipated changes in traffic patterns, densities, and traffic safety. If such changes are identified, the EIA should also estimate their impact on traffic accidents, congestion and noise.

4.3 Cultural, Archeological, Ceremonial and Historic Resources

Impacts on cultural, archeological, ceremonial and historic resources include any direct or indirect alteration of sites, structures, views, landmarks or traditional cultural lifestyles and resources associated with those lifestyles. Cultural, archeological, ceremonial and historic resources include: archeological sites (on land or underwater), historic buildings, burial grounds, sacred or ceremonial sites, areas used for the collection of materials used in ceremonies or traditional lifestyles, and sites that are important because of their roles in traditional stories. Tourism activities inherently provide more access to heritage areas, bringing more man-induced impacts. Tourism does bring the opportunity to generate funds to preserve sites and implement management strategies that can have positive impacts.

Examples of adverse effects to cultural and historical resources from tourism projects include:

- Destruction during construction
- Damage and alteration
- Removal from historic location
- Introduction of visual or audible elements that diminish integrity
- Neglect that causes deterioration
- Loss of medicinal plants
- Loss of access to traditional use areas
- Impacts to previously inaccessible areas from development/improvement of roads
- Visual changes on a sacred horizon
- Removal of submerged artifacts

Impacts to cultural and historic sites are often a two edged sword with the possibility of both negative and positive benefits. Archeological sites are vulnerable not only to plundering, but also to the construction of tourist infrastructure that harms and deteriorates these heritage sites due to uncontrolled visitation. On the other hand, the presence of tourism may finance archeological research and bring a halt to pillage in isolated sites. Similarly, tourism in historic sites may either aid to conserve their heritage through sustainable tourism, or can actually hasten their destruction through uncontrolled building (IUCN). Table E-8 presents a brief overview of potential impacts from tourism development to cultural, architectural, ceremonial and historic resources.

LAND ACQUISITION WITHIN INDIGENOUS PEOPLE'S COMMUNITIES

A recurring complaint in conversations with members of indigenous peoples where there is tourism is that some tour operators use the communal lands without the community's consent. The acquisition or construction of any type of infrastructure in communal lands have construction of any type of infrastructure in communal lands has the clear prior and informed consent of the community, which is also entitled not to grant such consent. This is a legal obligation in the countries that have ratified *Convention 169 on Indigenous and Tribal Peoples* of the International Labor Organization (Costa Rica, Guatemala, and Honduras). Furthermore, the indigenous peoples of Panama, Nicaragua, and Belize have different degrees of legal autonomy, which requires that developers to undergo a similar process.

Something similar happens in farming and fishing communities in many areas of Central America where there are no clear property titles. There are cases in which the local population was displaced to build a beach hotel because they lacked land titles. The de facto owners in places with no clear property titles should be compensated adequately and should be free to reject the displacement proposal.

Table E- 8: Impacts to cultural-architectural-ceremonial-historic resources

RESOURCE	POTENTIAL IMPACT
Cultural, Archeological, Historical and Ceremonial	Destruction or alteration of physical structures during construction
	Removal of artifacts from historic location during construction and operation
	Introduction of visual or audible elements that diminish integrity of structures or sites
	Visual changes on a sacred horizon
	Additional resources and impetus to restore and protect
	Changes to community cohesion and traditions
	Introduction of competing culture and practices effecting lifestyles of local and indigenous peoples
	Changes in diet, health and livelihood of indigenous groups

4.4 Land Use

Tourism projects will impact local land use. Clearly, land use on the project site itself will be modified for the life of the project. This impact, however, varies greatly with the size of the facility site. A small concessionaire activity may have little impact whereas a large resort complex will have a greater impact. Other long-term impacts can include those associated with roads, rails and other ancillary facilities that may stay in place and be used for many years, possibly even after the project's life.

Projects can impact land use on properties adjacent to the facilities as well as properties through which roads and right-of-ways may pass. Demand for products consumed by the project may also result in a change in land use, particularly if the products can be produced on land currently in other uses. Land use in these areas can be affected by visibility, noise, odor, air pollution, and water contamination. The development of new roads also may open up previously inaccessible areas to development.

Changes in land use should be described by the type; and location of the change as well as the area (size in hectares) of the change. Changes land use caused by changes in demand for social infrastructure (schools, cemeteries, churches, other public buildings, tourist facilities and housing) should also be assessed.

5 IDENTIFYING CUMULATIVE IMPACTS

Cumulative effects are those effects on the environment that result from the incremental effect of the action when added to other past, present, and reasonably foreseeable future actions regardless of what a project proponent undertakes. Cumulative effects can result from individually minor, but collectively significant actions, taking place over a period of time.

Tourism projects can contribute to cumulative effects when their effects overlap with those of other activities in space, or time, or both. Effects can be either direct or indirect. Direct effects are those that occur in the same place and at the same time and are a direct result of the proposed action. For example, indirect effects can occur at a distance from the proposed action, or the effects may appear some time after the proposed action occurs. For example, an upstream timber harvest area and upstream water sewage treatment plant may affect water quality, in addition to the effects on water quality from the proposed action. If water resources are diverted away from current uses such as agriculture, then impacts to those previously managed agricultural lands must be considered. These land disturbed by agricultural activities, now left unmanaged, to return to nature will be vulnerable to erosion, landslides, invasive species and perhaps undesirable replacement habitat.

EXAMPLES OF CUMULATIVE EFFECTS
- Incremental loss of wetlands
- Degradation of rangeland from multiple grazing allotments and the invasion of exotic weeds
- Population declines in nesting birds from multiple tree harvests within the same land unit
- Increased regional acidic deposition from emissions and changing climate patterns
- Cumulative commercial and residential development and highway construction associated with encroaching development outside of urban areas
- Increased soil erosion and stream sedimentation from multiple logging operations in the same watershed
- Change in neighborhood social-cultural character resulting from ongoing local development including construction
- Degraded recreational experience from overcrowding and reduced visibility

Although required of EIAs the cumulative impact assessment is often overlooked because many of the actions that need to be taken into account are not within the control of the project proponent, or because methods for cumulative impact assessment may not be apparent.

Cumulative impacts may be positive or negative. In summary, additive or cumulative impacts of the project with those of existing, planned or future activities must be accounted for. This is typically done by adding predicted impacts to existing conditions.

5.1 Identifying Resources that Have Potential for Cumulative Impacts

Resources which may require the analysis of cumulative effects described be identified through the results of any scoping meetings, site visit, public interest in a particular resource; and consultation with the agencies and governmental organizations (NGOs) familiar with or responsible for those resources. Additional guidance on defining cumulative analysis resources can be found in "Considering Cumulative Effects Under the National Environmental Policy Act" (Council on Environmental Quality, 1997). This document is available on the web at http://ceq.hss.doe.gov/nepa/ccenepa/ccenepa.htm.

> Over-consumption by many tourist facilities – notably large hotel resorts and golf courses – can limit current supplies available to farmers and local populations in water-scarce regions and thus lead to serious shortages and price rises. In addition, pollution of available freshwater sources, some of which may be associated with tourism-related activities, can exacerbate local shortages.
>
> Source Neto, 2002

An example of the affected environment, or a resource, where operations may cause a cumulative and additive impact would be groundwater usage. In the project area there already may exist wells that are tapping the same aquifer for irrigation, industrial, and municipal uses. Pumping water from that same aquifer may produce a cumulative impact. These uses, when evaluated separately, may not produce a noticeable or measurable decline in the groundwater elevation. However, if these usages are modeled together with the estimated volumes per year of each use and over the time period of planned use, the model may show a cumulative impact of widespread and significant decline in groundwater elevation. A cumulative impact for groundwater, widespread and significant decline in water elevation, then may produce an impact to surface water elevation by lowering stream levels and base flows in nearby streams if there is a hydrologic connection between the aquifer and streams. Declines in groundwater elevations, causing declines in base flows in neighboring streams may produce an impact to habitat critical to wildlife or vegetation therefore impacting certain species of wildlife and vegetation. If in the coastal zone, groundwater depletion has the potential to cause saltwater intrusion into freshwater supplies.

The effect of large scale or even small tourism development can have widespread impact on the local community and the environment. For instance if development pushes farmers away from prime farmland to areas that less suitable for farming that may be more prone to erosion, the resulting sedimentation into waterways would be considered an part of the cumulative impact of a project. Another examples would be increases in algal blooms in water bodies due increases in nutrient loading from sewerage, nutrient runoff from golf courses or landscaping, and seepage from landfills. Increased dredging in numerous locations can increase:

- Changes in tidal exchanges between the ocean and bays or rivers.
- Changes in salinity regime
- Breaching of protective reefs

- Direct loss of habitats
- Disturbance of species during sensitive life history stages

5.2 Regional, Sectoral or Strategic Assessment

Regional, sectoral, or strategic social and environmental assessment may be available to provide the additional perspective in addition to the social and environmental impact assessment. Regional assessment is conducted when a project or series of projects are expected to have a significant regional impact or influence regional development (e.g., an urban area, a watershed, or a coastal zone), and is also appropriate where the region of influence spans two or more countries or where impacts are likely to occur beyond the host country. Sectoral assessment is useful where several projects are proposed in the same or related sector (e.g., power, transport, or agriculture) in the same country, either by the client alone or by the client and others. Strategic assessment examines impacts and risks associated with a particular strategy, policy, plan, or program, often involving both the public and private sectors. Regional, sectoral, or strategic assessment may be necessary to evaluate and compare the impact of alternative development options, assess legal and institutional aspects relevant to the impacts and risks, and recommend broad measures for future social and environmental management. Particular attention is paid to potential cumulative impacts of multiple activities. These assessments are typically carried out by the public sector, though they may be called for in some complex and high risks private sector projects. These analyses will come into play when establishing setting “carrying capacities” for heritage sites and natural resource areas. The following text box presents some basic questions that should be answered in such assessments.

Figure E- 1: Identifying potential cumulative effects issues related to proposed action

1. What is the value of the affected resource or ecosystem? Is it:
    - Protected by legislation or planning goals?
    - Ecologically important?
    - Culturally important?
    - Economically important?
    - Important to the well-being of a human community?
    - Important to the well-being of the world community?

2. Is the proposed action one of several similar past, present, or future actions in the same geographic area?

3. Do other activities (whether governmental or private) in the region have environmental effects similar to those of the proposed action?

4. Will the proposed action (in combination with other planned activities) affect any natural resources; cultural resources; social or economic units; or ecosystems of regional, national, or global public concern? Examples: release of chlorofluorocarbons to the atmosphere; conversion of wetland habitat to farmland located in a migratory waterfowl flyway.

5. Have any recent or ongoing EIA analyses of similar actions or nearby actions identified important adverse or beneficial cumulative effect issues?

6. Has the impact been historically significant, such that the importance of the resource is defined by past loss, past gain, or investments to restore resources?

7. Might the proposed action involve any of the following cumulative effects issues?
    - Long range transport of air pollutants resulting in ecosystem acidification or eutrophication
    - Air emissions resulting in degradation of regional air quality
    - Release of greenhouse gases resulting in climate modification
    - Loading large water bodies with discharges of sediment, thermal, and toxic pollutants
    - Reduction or contamination of groundwater supplies
    - Changes in hydrological regimes of major rivers and estuaries
    - Long-term containment and disposal of hazardous wastes,
    - Mobilization of persistent or bio accumulated substances through the food chain
    - Decreases in the quantity and quality of soils
    - Loss of natural habitats or historic character through residential, commercial, and industrial development
    - Social, economic, or cultural effects on low-income or minority communities resulting from ongoing development
    - Habitat fragmentation from infrastructure construction or changes in land use
    - Habitat degradation from grazing, timber harvesting, and other consumptive uses
    - Disruption of migrating fish and wildlife populations
    - Loss of biological diversity

Source: Adapted from Table 2.1, Council on Environmental Quality, Considering Cumulative Effects under the NEPA Policy Act, January 1997

F. ASSESSING IMPACTS: PREDICTIVE TOOLS AND CONSIDERATIONS

1 OVERVIEW OF USING PREDICTIVE TOOLS FOR AN EIA

Environmental impact assessment (EIA) employs predictive tools to determine the locations, magnitude, duration, extent and significance of potential impacts on the natural and human environment. Tourism sector projects involve a wide range of activities project size, complexity of components and diversity of impacts. Generally accepted scientific practices should be used to estimate potential impacts. Many of these practices are presented in this section of the guidelines.

TOOLS FOR ASSESSING THE IMPACTS OF TOURISM PROJECTS

Predictive tools can be quantitative – as in the case of analytical or numerical air and water models, semi-quantitative based on the results of surveys used to evaluate socio-economic impacts, or qualitative based on professional judgment or comparisons with known impacts of similar projects and environmental settings.

1.1 Ground Rules: Basic Considerations for Predicting Impacts

The EIA should assess as appropriate the direct, indirect and cumulative impacts for the proposed project including alternatives and for every phase of the project: site selection, site preparation and construction, operation, maintenance and closure.

Ground rules for prediction impacts:

1. Generally accepted scientific practices should be used to estimate potential impacts.
2. Greater detail and analysis should be included for those impacts which are potentially significant.
3. It will be important to identify uncertainties to lay the groundwork for decisions about the project, proposed environmental measures, monitoring and contingency plans.
4. The assessment of impacts builds on and indeed depends on both a complete and accurate description of the project, alternatives, and related activities, and the information on the environmental setting. The assessment may take into account proposed environmental measures incorporated into the siting, design and processes and procedures, but to the extent that this is done in the assessment of impacts, those actions must be included in the Environmental Management section of the EIA which describes the commitments of the project developer to environmental measures activities. In other words, you cannot assume for purposes of analysis that the impact is half of what it would otherwise be because of a control device and fail to include that control device in the environmental measures that are committed to for the project. Control technologies proposed are also often part of the project alternatives addressed – balancing cost against benefits.
5. Key assumptions must be explicit in the EIA. Because prediction is only as good as the assumptions and the appropriateness of the tools, information required must be explicitly spelled out in the EIA for the reviewer and decision maker. A range of predictive tools may be available, and the user must justify and validate or qualify the tools and data used based on the site location and situation. Topography, meteorology, hydrology, land use and ground cover, energy input types and rates, and conditions that may be unique to the project site must also be considered.
6. Cumulative Impacts should not be ignored. Impacts of project construction and operation must be added to existing and other predicted impacts (other projects already planned or under

development), as the overall net impacts must be addressed. This applies not only to the project, but also impacts to water resources, noise levels, air resources, biologic resources, concessions areas, and if appropriate marine and coastal resources.

7. To employ predictive tools it usually is necessary to calculate intermediary factors such as the resulting direct emissions or releases into the environment from a given set of activities, or, the area and type of land disturbance, number of employees that may be required during construction phases, and other factors. By applying these intermediary factors to what is known about the environmental setting, predictive tools provide quantitative and qualitative information on the impacts based upon known or anticipated relationships.

1.2 Geographic Boundaries for Assessment of Impacts

The geographic boundaries for assessment of impacts are an important factor in correct assessment of impacts. It is often called the “area of influence”. Determining the geographic boundaries depends on the characteristics of the resources affected, the magnitude and scale of the project's impacts, the timing of the source of impacts, the duration of the impacts themselves and the environmental setting. In practice, a combination of natural and institutional boundaries may be required to adequately consider both potential impacts and possible environmental measures. Ultimately, the scope of the analysis will depend on an understanding of how the effects are occurring in the assessment area.

1.2.1 Project Footprint

Development of process flow diagrams and associated plot plans is essential to understanding the “footprint” of a project, and potential impacts. Sources, pollutant transport mechanisms and potential impacts within the project boundary and within the area of influence can be more easily understood and addressed if the assessment starts with such graphic overviews of the project. Outputs of numerical predictive models can also be overlaid on plot plans and maps of surrounding areas. Both the footprint of the disturbed area, adjacent areas for temporary storage of equipment, or debris and the final site plan for the project need to be considered in the footprint.

1.2.2 Area of Influence

Determining the area of influence for a project can be complex. It is rarely limited to the project boundary or a uniform radius around the project site, and may include sensitive and protected areas at greater distances than may be normally thought of as being within the area of influence. Defining the area of influence is often, if not always, variable and dependent on the affected resource, including human health and welfare; the phase of development; the duration of the impacts; and the type of impacts (direct, indirect and cumulative).

Area of influence considerations based on type of resource include:

- **Shorelines and Beaches:** Tourism development in-water and at water’s edge has impacts well beyond the project footprint. Coastal processes are complex; the forces of wind, waves, storms, sea level changes, and other natural processes move the sediments that shape and reshape the coastlines and beaches. Coastal development projects often changes currents, scour potential, sand deposition, etc. not only at the project site but on adjacent areas. Most shoreline development requires complex analyses of a wide range of conditions just to protect the tourism facilities. Hazards evaluations are always required. These same analyses can be extended to forecast potential impacts.
- **Ecosystems and watersheds:** The boundaries of coastal development projects should be based on watershed units, the resources of concern and the characteristics of the specific area to be

assessed. In many cases, the analysis should use an ecological region boundary that focuses on the natural units that constitute the resources of concern **and** watershed areas that sustain the resources of concern. Importantly, the geographical boundaries should not be extended to the point that the analysis becomes unwieldy and useless for decision-making. In practice, the areas for several target species or components of the ecosystem can often be captured by a single eco-region or watershed.

- **Biological Resources:** The area of influence for biological resources is defined by the presence of flora and fauna and key habitat areas for terrestrial, freshwater, or marine species. The area of influence can be complicated by the presence of migratory species that are not present year-round and ecosystems which are sensitive and unique. Thus, areas that are a great distance away from the project can be influenced by the project.
- **Soils and Geology:** The area of influence for impacts on soil is usually localized and restricted to the project footprint and disturbed area, and its immediate surroundings. However, evaluation of geologic hazards should consider the area of potential impact of geologic risks.
- **Water Resources:** The area of influence related to releases of pollutants to a water body will depend on the nature of the watershed, type of water body (e.g., stream, river, lake, or coastal ocean area), the volume and flow of that water body, the nature of the pollutant, and the chemical characteristics of the water body. For water releases, the area of influence can be limited to a single river or stream, but could extend many miles downstream to groundwater and even feeding other areas of the watershed. The area of influence related to use of water will depend upon the water source (e.g., surface water body, groundwater, captured wastewater), the volume of water required, and competing uses for the water.
- **Estuaries**: Estuaries form a transition zone between river environments and ocean environments and are subject to both marine and riverine influences. Estuaries are very productive natural habitats. Development activities from dredging and construction may alter water circulation and wave patterns causing changes in salinity, water quality, turbidity, and sedimentation, both at the project site and elsewhere in the estuary. Estuaries often have complex substrates and construction and dredging activities can adversely affect bottom dwelling and benthic communities. Wetlands, vegetated shallows and mud flats are very productive habitats that can be particularly vulnerable to development activities.
- **Coastal Waters and Open Ocean**: Waters that extend from the high water line out to sea may also be influenced by coastal developments. Similar to estuaries, development activities from dredging and construction may alter water circulation and wave patterns causing changes in salinity, water quality, turbidity, and sedimentation both at the project site and at more distant locations in the regional system. Construction in the littoral zone may interrupt the flow of sediments resulting in unwanted accretion or excessive erosion. Bottom dwelling and benthic communities in these waters may also be impacted. Vegetated shallows and coral reefs in these areas are also vulnerable to development activities.
- **Air Quality:** The area of influence for air emissions will be influenced by prevailing winds, weather patterns, terrain, and the nature of the pollutant being considered. Sophisticated air dispersion models can predict spatial patterns of air dispersion and deposition for various chemicals and allow for close delineation of the area of influence. Local, regional and global air quality impacts should be considered.
- **Land Use and Socioeconomics:** The area of influence will depend on regional socioeconomic conditions and the extent to which the proposed project and associated activities will alter the essential character of the area and its population, existing or planned land use. The geographic boundary appropriate for analysis can be quite different in rural as opposed to urban

environments. The area of influence can be localized and restricted to the project footprint and immediate surroundings, but because of induced indirect impacts it can be far reaching.

- **Noise:** The area of influence may take several forms for noise. Visitors to undeveloped areas can disturb animal mating, breeding and communications. The operational noise of everyday facility operations (air conditioners, water-based and road-based transportation noise, etc.) and the intermittent noise from outdoor entertainment venues (music or sports crowds, patron noise, car park noise, etc.) and transportation of supplies and visitors. These can have differing areas of influence, analysis and mitigation.
- **Political boundaries**: In the realm of standards, policies, plans and programs and socio-economic-cultural impacts there are not only natural boundaries, but also political boundaries including international borders, regional and local governments with varying requirements, values, and practices.

1.2.3 Area of Influence Considerations Based on Project Phase and Duration of Impacts

- **Site Characterization:** The area of influence is usually limited to the immediate area of activities. In the case of Coastal Development, the area of influence tends to be larger than land based because of the complex coastal systems of currents, winds, and waves.
- **Construction:** The area of influence includes the project footprint and immediate surroundings, and the socioeconomic regions supplying workers. Again, special attention should be directed to coastal construction, both in-water and land –based.
- **Operations:** The area of influence includes the project footprint and surroundings areas affected activities, and the socioeconomic regions supplying workers. Coastal development will have additional operational components such as maintenance dredging of navigational channels, dock areas and marinas, beach re nourishment activities, upkeep of coastal engineering structures designed to protect the tourism complex, etc.
- **Closure:** The area of influence includes the project footprint and immediate surroundings, and the socioeconomic regions supplying workers.
- **Duration of impacts:** Determining the temporal scope requires estimating the length of time the impacts of the proposed action will last. More specifically, this length of time extends as long as the impacts may singly, or in combination with other anticipated impacts, be significant on the resources of concern.

1.2.4 Area of Influence Considerations Based on Type of Impact

A project's direct, indirect and cumulative impacts may affect the area of influence. Generally, the scope of analysis for assessing cumulative impacts will be broader than the scope of analysis used in assessing direct or indirect effects. Spatial and temporal boundaries should not be overly restricted in cumulative impact analysis. However, to avoid extending data and analytical requirements beyond those relevant to decision making, the cumulative impact assessment can stop at the point where the contribution of effects of the action, or combination of all actions, to the cumulative impact is not significant. The important factor in determining cumulative impact is the condition of the resource (i.e., to what extent it is degraded). An appropriate spatial scope of the cumulative impact analysis can be made by considering how the resources are being affected. This determination involves two basic steps:

1. Identifying a geographic area that includes resources potentially affected by the proposed project.
2. Extending that area, when necessary, to include the same and other resources affected, positively or negatively, by the combined impacts of the project and other actions.

1.3 Baseline

Impacts are always assessed against a baseline. The baseline used in an EIA is the "no action alternative". This is a description of the environment in the absence of the proposed project but including consideration of other changes predicted to take place over time in the absence of the proposed project. The baseline for assessing impacts is different from existing conditions as it does consider other changes that may occur in future but independent of the project, e.g., other project start-ups, closures or major modifications. The geographic and political boundaries for assessing project impacts will depend upon the affected resource and the nature of the potential impacts and may also be influenced by the distances specified by the organization responsible for EIA review, likely specified in the Terms of Reference and/or EIA application form.

Section D, Environmental Setting, goes into considerable detail on baseline data requirements. Acquisition or development of accurate baseline data is very important in assessing the environmental impacts of a Tourism project.

1.4 Evaluation of the Significance of Impacts

In assessing the environmental impacts of a Tourism project one must determine the magnitude, location and significance of the impact.

1.4.1 Quantitative Thresholds

- If regulatory criteria standards exist (e.g., air quality standards, water quality standards, radiation exposure standards), these can serve as benchmarks against which impacts can be measured. Exceeding the standards would be considered significant. Impacts would not be considered significant if no exceedance occurred. Some of the CAFTA-DR countries may lack certain standards that might be used for criteria for determining the significance of an impact. In Appendix C this guideline provides a range of standards used internationally and for a range of countries that may be used for this purpose in lieu of in the absence of country standards in the absence of regulatory performance standards.
- If adequate data and analytical procedures are available, specific thresholds that indicate degradation of the resources of concern should be included in the EIA analysis. The thresholds should be practical, scientifically defensible, and fit the scale of the analysis. Thresholds may be set as specific numerical standards (e.g., dissolved oxygen content to assess water quality, particulate matter levels to assess air quality, etc.), qualitative standards that consider biological components of an ecosystem (e.g., riparian condition and presence of particular biophysical attributes), and/or desired management goals (e.g., open space or unaltered habitat). Thresholds should be represented by a measurement that will report the change in resource condition in meaningful units. This change is then evaluated in terms of both the total threshold beyond which the resource degrades to unacceptable levels and the incremental contribution of the proposed action to reaching that threshold. The measurement should be scientifically based.

1.4.2 Professional Judgment

Establishing criteria for insignificant and significant impacts may also rely on professional judgment, but these should be well-defined in the assessment. Criteria often need to be established separately for each resource. The idea of direct and indirect, or secondary impacts must also be considered, whereas loss of jobs by persons and industries that depend on the forest or other systems depend on the forest would be a secondary or indirect impact.

- **Area of Influence:** Discussed in subsection 1.2.
- **Percentage of Resource Affected:** This can include habitat, land use, and water resources.
- **Persistence of Impacts:** Permanent or long-term changes are usually more significant than temporary ones. The ability of the resource to recover after the activities are complete is related to this effect.
- **Sensitivity of Resources:** Impacts to sensitive resources are usually more significant than impacts to those that are relatively resilient to impacts.
- **Status of Resources:** Impacts to rare or limited resources are usually considered more significant than impacts to common or abundant resources.
- **Regulatory Status:** Impacts to resources that are protected (e.g., endangered species, wetlands, air quality, cultural resources, water quality) typically are considered more significant than impacts to those without regulatory status. Note that many resources with regulatory status are rare or limited.
- **Societal Value:** Some resources have societal value, such as sacred sites, traditional subsistence resources, and recreational area

1.4.3 For some purposes qualitative assessment criteria may be used such as:

- **None:** No discernible or measurable impacts.
- **Small:** Environmental effects are at the lower limits of detection or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
- **Moderate:** Environmental effects are sufficient to noticeably alter important attributes of the resource but not to destabilize them.
- **Large:** Environmental effects are clearly noticeable and are sufficient to destabilize the resource. Parameter assumptions and the experience of the modeler.

The results of the predictions of impacts are often reported in summary tables and matrices to facilitate comparisons across different alternatives.

1.4.4 Checklists and Matrices

Checklists and matrices do not constitute methods for actually assessing the significance of impacts but rather, are used to facilitate the characterization of the significance of impacts. Checklists and matrices can be used to assist in the identification of possible impacts, categorization of a project or valuation of the significance of impacts across a wide spectrum of potential sources and impacts. The use of checklists for identifying and, to a limited extent, characterizing, environmental impacts is very common throughout existing EIA processes. A checklist forces the assessment to consider a standardized set of activities or effects for each proposed action, thus bringing uniformity to the assessment process. Checklists can be used to determine environmental impact thresholds, thus indicating whether a full-scale EIA is needed for a particular project or whether a finding of no significant impact might be issued.

The evolution from checklist to matrix is intuitively and easily accomplished. A checklist can be viewed as a single-column summary of a proposed action, with only a coarse characterization of the nature and magnitude of potential environmental impacts provided. An EIA matrix provides a finer degree of impact characterization by associating a set of columns (actions) with each row (environmental attribute) of the matrix and assigning some value to the effect.

Matrices are very likely the most popular and widely used EIA methodology. One common application is in the comparison of alternative actions. Alternative actions (measures, projects, sites, designs) are listed as column headings, while the rows are the criteria that should determine the choice of alternative. In each cell of the matrix, a conclusion can be listed indicating whether the alternative action is likely to have a positive or negative effect relative to the indicated criterion. Very often, the conclusion is stated as a numerical value or symbol indicating the level of intensity of the effect. There is an opportunity, moreover, to apply relative weighting to the various criteria when evaluating the completed matrix.

The Asian Development Bank (ADB) Rapid Environmental Assessment (REA) checklists, Leopold Matrix approach, and the valuation matrix used by Costa Rica to assess environmental feasibility are discussed in the following sections.

1.4.3.1. Rapid Environmental Assessment Checklists

Rapid Environmental Assessment (REA) checklists allow a rapid, initial assessment of environmental impacts developed and used by the World Bank and regional development banks. The Asian Development Bank (ADB) REA checklist approach is an excellent means by which the possible environmental and social impacts of any given project can be initially assessed. The approach assists in assuring that from the start there are no serious errors or omissions with respect to possible impacts. The approach is also useful in comparing possible environmental and socio-economic impacts of alternative projects and/or of the same project on different sites. Figure F-1 presents the contents of the ADB REA checklist for projects in general. Appendix F in Volume 2 of these guidelines presents the ADB REA checklists for energy projects (Hydropower, Power Transmission, Solar Energy, Thermal Power Plants, and Wind Energy).

1.4.3.2. Leopold Matrix

The Leopold Matrix is a qualitative EIA method pioneered in 1971 by the United States Geological Survey (Leopold et. al., 1971). It is used to identify the potential impact of a project on the environment. The system consists of a matrix with columns representing the various activities of the project, and rows representing the various environmental attributes or factors to be considered.

The original Leopold Matrix consisted of 100 columns representing examples of causative actions, and 88 rows representing environmental components and characteristics (a portion of the matrix is presented in Figure F-2). As a first step, the columns that correspond with the nature of the proposed action are checked off. Then, for each column that is marked, the cells corresponding to environmental effects are examined. Two scores (on a scale from 1 to 10) are listed in each cell, separated by a slash (/); the first score represents the *magnitude* of the possible impact, while the second score represents the *importance* of the possible impact. Beneficial impacts are indicated by a plus (+) sign and negative impacts with a minus (-) sign. The interpretation of the matrix is based on the professional judgment of those individuals performing the EIA.

Measurements of magnitude and importance tend to be related, but do not necessarily directly correlate. Magnitude can be measured fairly explicitly, in terms of how much area is affected by the development and how adversely, but importance is a more subjective measurement. While a proposed development may have a large impact in terms of magnitude, the effects it causes may not actually significantly affect the environment as a whole.

Figure F-1: Asian Development Bank rapid environmental assessment checklist – general

SCREENING QUESTIONS	YES	NO	REMARKS
A. Project Siting Is the project area adjacent to or within any of the following environmentally sensitive areas?			
▪ Cultural heritage site			
▪ Legally protected area (core zone or buffer zone)			
▪ Wetland			
▪ Mangrove			
▪ Estuarine			
▪ Special area for protecting biodiversity			
B. Potential Environmental Impacts Will the project cause			
▪ Impairment of historical/cultural areas; disfiguration of landscape or potential loss/damage to physical cultural resources?			
▪ Disturbance to precious ecology (e.g. Sensitive or protected areas)?			
▪ Alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site?			
▪ Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?			
▪ Increased air pollution due to project construction and operation?			
▪ Noise and vibration due to project construction or operation?			
▪ Involuntary resettlement of people? (physical displacement and/or economic displacement)			
▪ Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?			
▪ Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STI's and HIV/AIDS) from workers to local populations?			
▪ Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents?			
▪ Social conflicts if workers from other regions or countries are hired?			
▪ Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?			
▪ Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?			
▪ Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?			
▪ Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?			
▪ Generation of solid waste and/or hazardous waste?			
▪ Use of chemicals?			
▪ Generation of wastewater during construction or operation?			

Source: Asian Development Bank,
http://www.adb.org/documents/Guidelines/Environmental_Assessment/eaguidelines002.asp

Figure F- 2: Sample page from the Leopold Matrix

Evaluation Method (Rate + or – and Score 1-10) Magnitude / Importance				Action											
				Raw Material Production	Building Operations	Water Supply	Energy Supply	Raw Material Preparation	Industrial Processes	Gaseous Emissions	Liquid Effluents	Cooling Water Discharges	Solid Wastes Treatment	Transportation	Total
Environmental / Social Conditions	Physical	Soil	Soil Quality												
			Erosion												
			Geomorphology												
		Water	Rivers												
			Coastal Zone												
			Subsurface Water												
			Sea Quality												
		Air	Air Quality												
			Odors												
			Noise												
	Biological	Flora	Forests												
			Crops												
			Wetlands												
			Sea-Grasses												
			River Flora												
		Fauna	Mammals												
			Birds												
			Fish												
			Other vertebrates												
			Invertebrates												
		Eco-systems	Ecosystems Quality												
			Ecosystems Destruction												
	Social	Land Uses	Rural												
			Fisheries												
			Urban												
			Industrial												
			Recreational Uses												
		Patrimony	Landscape												
			Historical / Cultural												
			Heritage												
			Wilderness Quality												
		Social	Population Density												
			Employment												
			Hazards												
			Total												

1.4.3.3. Valuation Matrix in Use in Costa Rica

Several variants of the Leopold Matrix have been prepared. One such variant is the matrix required for use in the preparation of EIAs in Costa Rica, the Matriz de Importancia de Impacto Ambiental (MIIA).[1] The MIIA is used to calculate a numeric value for the environmental significance of impacts. As with the Leopold Matrix, the MIIA uses activities as the headings for the columns in the matrix and environmental factors as headings for the rows. For each box in the matrix a score for each of 10 variables is assigned by the team and a value for the overall significance is calculated using the following formula:

$$I = \pm [3IN + 2\ EX + MO + PE + RV + SI + AC + EF + PR + MC]$$

Where: I = Significance

IN = Intensity (Level of destruction scored as 1 [low] – 12 [very high])

EX = Extension (Size of area of influence scored as 1 [local] – 8 [extremely extensive])

MO = Moment of Impact (Time of impact relative to action scored as 1 [5 or more years after action] – 4 [immediate] and can be raised to 8 [an additional 4 points] if the impact is considered critical)

PE = Persistence (Length of time the impact will be felt scored as 1 [<1 year] – 4 [>5 years])

RV = Reversibility (Ability of impacted resource to naturally return to pre-activity condition scored as 1 [<1 year] – 4 [>5 years])

SI = Synergy (Level of synergetic effects scored as 1 [no synergies] – 4 [highly synergetic])

AC = Cumulative Effects (Are the effects of the impact cumulative? scored as 1 [no] or 4 [yes])

EF = Effect (Is the impact direct or indirect? scored as 1 [indirect] or 4 [direct])

PR = Periodicity (scored as 1 [irregular], 2 [periodic], or 4 [continuous])

MC = Recoverability (Ability of human actions to restore the impacted resource to its pre-activity condition scored as 1 [immediately and easily] – 8 [not possible])

The resulting score is evaluated as follows:

Less than 25 = acceptable
From 25 through 50 = moderate
From 50 through 75 = severe
More than 75 = critical

[1] A full description of the matrix can be found in Annex 2 of Decree No. 32966 of the Ministry of the Environment and Energy (MINEA) for Costa Rica at: http://www.setena.go.cr/documentos/Normativa/32966%20Guia%20para%20elaboracion%20de%20instrumentos%20EIA%20(MIT%20IV).doc

1.5 Data Requirements and Sources

Data requirements are determined by the types and locations of impacts to be predicted, and by the model and other tools to be used. Sources include direct measurement and monitoring, existing literature, field studies, surveys. As with any numerical modeling exercise, the validity of the output is governed by the appropriateness of model selection, quality of data used, and the experience of the modeler. When data are of unconfirmed quality, of insufficient quantity, are from surrogate operations and locations, or are extrapolated from other studies then results must be duly caveat.

Countries which lack some of the data required by experts or to run models for impact assessment can use the approach of "the Best Available Data (BAD)" to substitute simplified evaluation criteria for estimating potential impacts in terms of risk rather than a modeled estimate of tons/acre,

Further, some countries have built in adaptive management and monitoring to overcome these uncertainties during project implementation, but this should be done only where there is a basic confidence that significant adverse impacts are unlikely to occur or that required levels of performance can be met.

Finally, in some circumstances unlikely scenarios from accidents and natural disasters pose risks that may be beyond existing baseline and trend data but need to be assessed to bound potential impacts and to avoid and/or prepare for adequate response. The Text Box below describes approaches to bind the risks by developing scenarios for these circumstances.

2 GENERAL APPROACHES FOR PREDICTION OF IMPACTS

2.1 Predictive Tools

Prediction of impacts on physical, biological and social-economic-cultural resources is accomplished by using a variety of predictive techniques, with results compared to accepted criteria, to evaluate the significance of an impact. There are a range of predictive techniques that can be used including

- Experts/professional judgment
- Extrapolation from past trends/statistical models
- Scenarios based upon risks and potential hazards not captured by past trends
- Measured resource responses in other similar geographic areas
- Modeling of the resource
- Geographic information systems

For any of these prediction methods, data requirements are determined by the types and locations of impacts to be predicted, and by the conceptual or quantitative model to be used. As with any numerical modeling exercise, the validity of the output is governed by the appropriateness of model selection, quality of data used, parameter assumptions. When data are of unconfirmed quality, of insufficient quantity, are from surrogate operations and locations, or are extrapolated from other studies then results should be duly caveated.

The remainder of this section of the guidelines identifies quantitative models for assessing impacts as examples of scientifically accepted practices, but criteria for applying a specific methodology in any given circumstances must be carefully assessed and justified, data sources and assumptions made clear and any resulting uncertainties identified. It is important in the development of an EIA that models are used wisely and that the results are not accepted without strenuous review. Quantitative models, calibrated to particular settings and circumstances, are particularly useful to assess impacts to air and water resources as well as potential risks to humans and biota, and may even be required as a consistent and objective approach to evaluating impacts where those models are validated for use in the particular circumstances. One other advantage of using models is that sensitivity analyses can be performed and "what-if" scenarios can be modeled to identify the nature and extent of impacts and identify which variables contribute to impacts as well as uncertainty of the results.

2.2 Geographic Information Systems and Visualization Tools

To understand the impacts of a project, it is important to be able to visualize and calculate potential changes which may occur. This can be done by developing maps which show pre-project and post-project conditions. In many countries, geographic information systems (GIS) are used extensively for this purpose. GIS captures, stores, analyzes, manages, and presents data that is linked to location. GIS applications are tools that allow users to create interactive queries (user created searches), analyze spatial information, edit data, maps, and present the results of all these operations. A GIS includes mapping software and its application with remote sensing, land surveying, aerial photography, mathematics, photogrammetry, geography, and other tools.

U.S. EPA's NEPAssist tool was developed to provide a new generation of GIS applications to assist with EIA screening which has the features of a) instantaneous web-based access to distributed sources of information, b) spatial integration with easily turned on and off data layers, and c) instantaneous analysis using pre-set yes/no questions in an environment which allows the user to change assumptions and buffers for quantitative screening for information on key features, their proximity. Information sources are annotated using metadata which enables the user to determine who collected the information, how up to date it is and the like. This tool has been shared with all of the CAFTA DR countries with their own interfaces, data sources, and analytical questions.

2.3 Selecting and Applying Quantitative Predictive Tools

Models of the existing environment, calibrated to local conditions, are used to introduce new assumptions and predict future conditions. Models provide a discipline forcing the user to identify and justify key assumptions and ranges of uncertainty in the capacity of the model to predict accurately under a range of conditions.

It is important in the development of an EIA that models are used wisely and that the results are not accepted without strenuous review. Needless to say, the advantage of using quantitative models is that sensitivity analyses can be performed and "what-if" scenarios can be modeled to identify the nature and extent of impacts and identify which variables contribute to impacts as well as uncertainty of the results. When limited baseline data are available or the exact nature of the project is not known, impact determinations using models must be based on a number of assumptions. Each of the assumptions has some uncertainty associated with it. To compensate for these uncertainties, conservative assumptions are usually made to ensure that impacts are not underestimated. Even with conservative assumptions, impacts that are poorly understood (e.g., the response of resources to the environmental changes brought about by the project is not known) can be underestimated or improperly characterized. Conservative assumptions can result in greatly overestimating impacts and unnecessary costs for a project if environmental measures are not properly directed and scaled to the impact.

Different countries may also require or accept certain models. It is imperative that such requirements or preferences be determined well in advance of performance of modeling. This will assure that adequate time is allowed to collect input data required by the model(s) and that results are accepted by organizations that must approve the EIA.

The following subsections present a brief overview of how these analytical methods can be used in assessing impacts of proposed power generation and transmission projects.

ANALYZING AND PREPARING FOR POTENTIAL RISK: USE OF BOUNDING SCENARIOS

EIAs tourism projects should include an analysis of risks. The analysis should represent the range of potential impacts of potential accidents and destructive natural events, including those from likely scenarios as well as those from low-probability, high-consequence scenarios. (The latter are sometimes referred to as “worst case scenarios” but this term can be misleading.) The analysis of risk should be considered in the design of all structures as well as in the development of spill and catastrophic failure contingency plans. Modern tourism projects utilize state-of-the-art models to predict the potential environmental impacts to water, air, and other resources as well as potential exposures to populations at risk. To avoid under-predicting impacts, models use conservative assumptions and analyze potential accidents or natural disasters with the most severe consequences reasonably foreseeable to occur. These analyses enable the identification of controls to protect human health and the environment even under these unlikely but foreseeable situations. This analytical approach ensures that the risk analyses in the EIA “bound” the potential risks. That is, the analysis represents the full range of risks and will not under-predict the most severe consequences. There are understandably policy decisions that are inherent in carrying out this type of analysis as to the threshold for defining a reasonable set of assumptions in developing these scenarios.

This approach has been used to design control technologies, for natural resource protection (wetlands and sensitive habitats), created habitats (beaches, etc.) as well as facilities. In the case of unforeseen weather events, hurricanes, earthquakes, volcanic eruptions and other events, contingency plans should be applied to:

- Emergency notification and evacuation
- Fire control
- Spill cleanup – it is recommended that spill kits are kept at strategic locations throughout fixed facility tourism sites
- Warning systems
- Medical support
- Other items dealing with the health and safety of the workers and the local community

In addition, a program should be developed to train personnel how to react to emergency situations.

In evaluating these scenarios, the regulator must be aware of the environmental and socio-economic setting to ensure that the conservative assumptions made to develop the scenarios are reasonable. For instance, water management experts reviewing an EIA risk analysis often require that impoundments be designed to handle runoff from a maximum probable rainfall event. The calculation of such an event is based on many years of data. These data may not be available for a particular drainage and information must be gathered from other similar areas if available. In addition, “climate change” may increase the frequency of large storm events possibly making historic data less reliable for predictive purposes. It takes professional judgment to ensure that the right approach is taken. It is also important for the reviewers to ensure that in case of a disaster or emergency that contingency plans are in place.

3 SOILS AND GEOLOGY IMPACT ASSESSMENT TOOLS

Evaluation of impacts due to construction of a tourism facility on soils and geology is usually based on professional judgment as well as on existing literature, field studies, surveys, trend analysis or measured resource responses in other geographic areas. Tools such as GIS overlaying activities on maps of soils and geology and graphics generated from comprehensive databases are useful toward visualization and determination of the magnitude of potential impacts.

3.1 Soil Loss and Erosion Potential

For soils, it is important to understand the potential for soil loss due to wind and water erosion. The US Natural Resources Conservation Service (NRCS-ARC undated) developed the wind erosion equation (WEQ) expressed in function form as:

$$E = f(I, K, C, L, V)$$

Where:
E = the potential average annual soil loss
I = the soil erodibility index
K = the soil ridge roughness factor
C = the climate factor
L = unsheltered distance across a field
V = the equivalent vegetative cover

Because field erodibility varies with field conditions, a procedure to solve WEQ for periods of less than one year was devised. In this procedure, a series of factor values are selected to describe successive management periods in which both management factors and vegetative covers are nearly constant. Erosive wind energy distribution is used to derive a weighted soil loss for each period. Soil losses for individual periods are summed to estimate annual erosion. Soil loss from the periods also can be summed for multi-year rotations, and the loss divided by the number of years to obtain an average, annual estimate.

The NRCS has also developed the Wind Erosion Prediction System (WEPS) that incorporates this new technology and is designed to be a replacement for the WEQ. Unlike WEQ, WEPS is a process-based, continuous, daily time-step model that simulates weather, field conditions, and erosion. It is a user friendly program that has the capability of simulating spatial and temporal variability of field conditions and soil loss/deposition within a field. WEPS can also simulate complex field shapes, barriers not on the field boundaries, and complex topographies. The saltation, creep, suspension, and PM10 components of eroding materials can also be reported separately by direction in WEPS. WEPS is designed to be used under a wide range of conditions in the U.S. and easily adapted to other parts of the world.

For soil loss due to water erosion, estimation can be done using RUSLE described in the box below.

SOIL LOSS

Predicting soil loss and sediment due to rainfall erosion is an important aspect in assessing the impacts of activities that may cause disturbance of large surface areas. The Revised Universal Soil Loss Equation (RUSLE) is an empirical equation developed by the U.S. Department of Agriculture (USDA, 1997) that predicts annual erosion (tons/acre/yr) resulting from sheet and rill erosion in croplands (http://www.ars.usda.gov/Research/docs.htm?docid=5971). The RUSLE employs a series of factors, each quantifying one or more of the important soil loss processes and their interactions, combined to yield an overall estimate of soil loss. The equation is (USDA, 1997):

$$A = R * K * (LS) * C * P$$

Where: *A* = Annual soil loss (tons/acre) resulting from sheet and rill erosion

R = Rainfall-runoff erosivity factor measuring the effect of rainfall on erosion. The R factor is computed using the rainfall energy and the maximum 30 minutes intensity (EI30);

K = Soil erodibility factor measuring the resistance of the soil to detachment and transportation by raindrop impact and surface runoff. Soil erodibility is a function of the inherent soil properties, including organic matter content, particle size, permeability, etc. In the USDA soils data sets, two K factors are given, Kw and Kf. Soil erodibility factors (Kw) and (Kf) quantify soil detachment by runoff and raindrop impact. These erodibility factors are indexes used to predict the long-term average soil loss, from sheet and rill erosion under crop systems and conservation techniques. Factor Kw applies to the whole soil, and Kf applies only the fine-earth fraction, which is the <2.0 mm fraction (USDA, 1997).

L = Slope length factor accounting for the effects of slope length on the rate of erosion;

S = Slope steepness factor accounting for the effects of slope angle on erosion rates.

C = Cover management factor accounting for the influence of soil and cover management, such as tillage practices, cropping types, crop rotation, fallow, etc., on soil erosion rates. The C-factor is derived from land-use/land-cover types.

P = Erosion control factor accounting for the influence of support practices such as contouring, strip cropping, terracing, etc.

Source: http://www.ars.usda.gov/Research/docs.htm?docid=5971

3.2 Beach Erosion

Impacts from and on beach erosion can be significant. The construction of tourism facilities on or near the beach may be impacted by beach erosion, and when not carefully planned and designed, can exacerbate erosion at the project site and even over the broader coastal region. Shores erode, accrete, or remain stable, depending on the rates at which sediment is supplied and removed from the shore. Construction along the coast can interrupt the supply of sediment that moves along the coast, resulting in increased deposition or erosion. Increased erosion may be experienced far from the project site. Excessive erosion or accretion may endanger the structural integrity or functional usefulness of a beach, nearby tourism facilities, or other coastal structures. A regional characterization of coastal and riverine sediment transport rates and magnitudes, as well as the engineering activities within the region (dredging and placement of littoral resources), is a basic component in designing and evaluating the response of projects within the watershed. The regional sediment budget is a quantification of these natural sediment transport processes and anthropogenic activities and is a valuable tool in assessing beach impacts. The Sediment Budget Analysis System (SBAS) is a PC-based application for calculating and displaying local and regional sediment budgets.

The beach constantly adjusts its profile to provide in response to winds, waves, and water levels. Sediments move in both along the shore and across the near shore and beach in response to the environmental forcing. Natural protective dunes are formed by winds that blow over the beach and vegetation often grows on the dunes. The dune system provides a levee against sea attack and provides a reservoir of sand. The resilience of a beach from excessive erosion and as a line of protection for coastal infrastructure Impacts from and on beach erosion can be significant. The resilience of a beach from disturbance depends greatly on the presence of features such as dunes and vegetation. Beach nourishment is widely adopted to maintain a wide beach and dune system for a developed coastal community if a suitable beachfill is available in the vicinity of an eroding beach.

Predictive tools are available to augment professional judgment to take into account the changes that will occur in the beach system in response to waves and water levels as well as any changes that may occur due to the construction of proposed tourism projects. These tools can also be applied to design beach nourishment projects.

Coastal process models such as GENESIS and SBEACH can be applied to predict the response of the beach to the construction of tourism facilities and other coastal structures as well assist in the design of beach nourishment projects. The GENESIS model provides estimates of long-term shoreline change and the SBEACH model calculates the response of the beach profile to storm events. The GENESIS model includes a simple representation of wave transformation across the near shore region or can employ results from a more sophisticated wave transformation model such as STWAVE. The Beach-fx model combines the results of these models in an event-driven Monte Carlo approach that can incorporate beach profile response to storms, shoreline change driven by long-term coastal processes, and beach management activities. Beach-fx is a planning level tool that can evaluate proposed project alternatives in comparison with a without project condition. The model is capable of quantifying, with uncertainty the damages prevented or induced by a project. Links to these models and brief descriptions are provided in Table F-4.

3.3 Geologic Resources and Hazards

It is important to have a thorough understanding of the geologic hazards that are or could be at the site. These include:

- Landslide hazards: Types of movements and depths, such as shallow or deep-seated, translational or rotational landslides, slumps, debris flows, earth flows, mass wasting, etc. It is important that the project does not increase the potential the hazards on and off site. Analytical and numerical approaches should be used to analyze this potential problem.
- Seismic hazards: Potential for strong ground shaking, surface rupture, fault creep, and/or liquefaction. Deterministic seismic hazard analysis methods should be used to estimate most expected seismic hazards.
- Volcanic hazards: Potential for molten rock, rock fragments being propelled great distances, dust, gases, ash fall, fumaroles, landslides and mudflows. Potential for volcanic activity in the area should be assessed by a literature search.
- Other geologic hazards (e.g., subsidence, rock fall): In some localities, hazard areas have been identified in the process of developing local critical or sensitive area ordinances. Contact the appropriate local planning departments to obtain the most current information. In some localities, hazard areas are not delineated on maps, but are defined in terms of landscape

characteristics (e.g., slope, geologic unit, field indicators). In these instances, hazard areas should be mapped by identifying where the defining characteristics apply to the project area.

3.4 Dredge and Fill Operations and Their Impacts

Dredging and the management of dredged materials can have significant environmental impacts. During dredging operations, sediments are released into the water column creating turbid conditions which may have environmental consequences. Some of the tools available to assess the release of sediment from dredging operations are presented in Table F-1.

Table F- 1: Dredge and fill models

MODEL	LINK	DESCRIPTION
DREDGE	http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=drgmat	DREDGE estimates the mass rate at which bottom sediments become suspended into the water column as the result of hydraulic and mechanical dredging operations and the resulting suspended sediment concentrations. These are combined with information about site conditions to simulate the size and extent of the resulting suspended sediment plume.
STFATE	http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=drgmat	The STFATE (Short-Term FATE of dredged material disposal in open water) model estimates the release of sediment during discrete discharges from barges and hoppers. Models also exist to estimate the fate of dredged material during and after they are placed.
LTFATE	http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=drgmat	LTFATE is a site evaluation tool that estimates the dispersion characteristics of a dredged material placement site over long periods of time, ranging from days for storm events to a year or more for ambient conditions. Simulations are based on the use of local wave and current condition input.
PTM	http://el.erdc.usace.army.mil/dots/doer/ptm.html	PTM (Particle Tracking Model) can also be applied to determine the fate of sediment. PTM is a Lagrangian particle tracker designed to determine the fate of multiple constituents (sediment, chemicals, debris, biota, etc) released from local sources (dredges, placement sites, outfalls, propeller wash, etc) in complex hydrodynamic and wave environments. Each local source is defined independently and may have several constituents. Model results include the fate of each constituent from each local source. PTM simulates particle transport using pre-calculated, periodically saved hydrodynamic (and wave) model output from state of the art models.

If dredging is to be done in the vicinity of a shoreline, the impact of removing sediment from the near shore region on adjacent shorelines must be evaluated. When a pit or channel is dredged in the vicinity of a shoreline, there is a potential for changes in wave transformation and, therefore, changes in shoreline accretion and erosion patterns. These analyses can be conducted with models such as STWAVE and GENESIS (see Table F-4).

4 WATER RESOURCES IMPACT ASSESSMENT TOOLS

4.1 Surface Water Impact Assessment Tools

When assessing surface water impacts, two initial questions must be asked:

1) Will the project alter surface water flow in the catchment?
2) Will the project affect surface water quality in the catchment and if there is conflict over water use, among others?
3) Will the project alter the flow of the water?
4) Will there be any conflicts in use of the water?

If the answer to one or both questions is yes, an effort must be made to determine the magnitude and nature of the impact. This includes but is not limited to:

An estimate of volume of water used and volume of water consumed.
Impacts of discharges of polluted water on the receiving water body.
Estimates of discharge volumes and quality characteristics.
Characterization of existing quantity, quality and performance of the receiving body.
Changes in these characterizations projected from receiving the discharges.
Long- and short-term effects of water diversions and impoundments on the river or streams including its flood plain characteristics and its structural stability as well as effects on the water table.
Effects on flood characteristics in the watershed.

For surface water, a useful way to organize this analysis is to take a watershed approach, as presented in the box below.

Impacts on surface water quality will depend largely on the assimilative capacity of the receiving water. The assimilative capacity of the receiving water body depends on numerous factors including, but not limited to:

- the total volume of water,
- flow rate,
- flushing rate of the water body, and
- the loading of pollutants from other effluent sources.

Wastewater and water quality baseline measurements of water quality must be taken to assure that receiving waters are able to assimilate the waste stream and that incremental effluents will not cause water quality violate applicable standards.

Based on the results of the analyses, indicators of water quality and quantity are used to set thresholds. For water quality, specific concentrations and levels of pH, oily wastes, additives, turbidity, dissolved oxygen, and temperature can be used. The intended uses of the water body will influence the setting of threshold levels. The WHO guidelines for recreational use are an example of health based guideline values for receiving waters based on intended use.
http://www.who.int/water_sanitation_health/dwq/guidelines/en/index.html.

WATERSHED APPROACH

It is important to evaluate impacts of an energy generation and/or transmission project in relation to the entire watershed. Watershed management involves both the quantity of water (surface and ground water) available and the quality of these waters. Understanding the impact of the project on both the quantity and quality of water must take into account the cumulative impacts of other activities in the same watershed.

A watershed-based impact assessment approach involves the following 10 steps:

1. Identify and map the boundaries of the watershed in which the project is located and place the project boundaries on the map
2. Identify the drainage pattern and runoff characteristics in the watershed
3. Identify the downstream rivers, streams, wetlands, lakes and other water bodies
4. Determine the current and projected consumptive and non-consumptive uses of the water in these resources
    - Drinking water
    - Irrigation
    - Aquaculture
    - Industry
    - Recreation
    - Support of aquatic life
    - Navigation
5. Estimate the impact of the project on the consumptive and non-consumptive use of water
6. Determine the existing quality of the water in these resources
7. Determine the nature and extent of pollutants discharged throughout the watershed
8. Determine the anticipated additional pollutants discharge from the proposed activity
9. Identify other anticipated additional developments planned or projected for the watershed
10. Identify stakeholders involved in watershed and encourage their participation in project design

Appendix C identifies some of the current parameters and requirements in place in CAFTA DR countries, the United States, other countries and international organizations as a point of reference in the absence of local criteria other recognized criteria. It also includes water quality standard setting models as examples of the procedures for setting effluent limits for particular water bodies and watersheds.

Numerical standards for dissolved oxygen and water temperature could be used to determine significance of impacts to coldwater fisheries. Prescribed standards for stream condition would be used to determine thresholds for successful fish spawning or other defined uses. This information can also be used to determine potential impacts to downstream water supplies.

Thresholds for a decline in water quality can also take the form of the presence and distribution of larval and adult macroinvertebrates and fish species or bioassays performed on indicator species in the laboratory. They may also be set as the size and amount of riparian buffer zones. Condition of riparian zones and changes in percent of buffer areas can indicate a decline in water quality due to soil erosion, sediment loading, and contaminant runoff.

The assessment of impacts to surface water can be done analytically or using numerical models. Analytical approaches include the development of water balance or using accepted formulas. More sophisticated numerical models can also be used within the constraints as outlined above for air pollution models.

4.1.1 Temperature

Many governments, including several States, do not have regulatory criteria for temperature. In the absence of numerical criteria, one might suggest the use of inferential criteria related to the resource potentially affected. A surrogate for temperature is dissolved oxygen wherein the higher the temperature the less oxygen can be dissolved in the water.

4.1.2 Water Balance

An accurate understanding of the site water balance is necessary to successfully manage storm runoff, stream flows, and point and non-point source pollutant discharges from a tourist facility site. Natural system waters are fed to the site through rainfall, seeps and springs, groundwater and surface water. Water is lost from the system through surface water runoff, infiltration, and evaporation. Each of these factors is quite variable and difficult to predict. Process and cooling water use is reasonably constant and predictable. Water is lost from the system water through evaporation; facilities such as cooling towers and sedimentation or cooling ponds may result in significant evaporative losses. Spreadsheets are a common way to evaluate water balances on the site. What-if scenarios can be easily run based on probabilities of rainfall events occurring and changeable weather patterns such as those associated with climate change.

4.1.3 Analytical Approach

The following methods are used to determine changes in runoff characteristics and sediment yield due to surface disturbances, primarily during construction. The method described by the SCS (1972) and updated in SCS, 1985 - Natural Engineering Handbook, Section 4, Hydrology, U.S. Department of Agriculture, Soil Conservation Service, Washington, D. C., March, 1985 is the most common technique for estimating the volume of excess precipitation (i.e., runoff) after losses to infiltration and surface storage. The method involves estimating soil-types within a watershed and applying an appropriate runoff curve number to calculate the volume of excess precipitation for that soil and vegetation cover type. This method was developed for agricultural uses and can be used for tourism sites if sufficient data is available to estimate curve numbers. Curve numbers are approximate values that do not adequately distinguish the hydrologic conditions that occur on different range and forest sites and across different land uses for these sites. (You may also be able to order printed copies from the National Technical Information Service or by calling 1-800-553-6847. Request document number PB86-180494)

A more appropriate technique for developing and analyzing runoff at some sites utilizes the unit hydrograph approach as defined in detail at http://www.nohrsc.noaa.gov/technology/gis/uhg_manual.html. A unit hydrograph is a hydrograph of runoff resulting from a unit of rainfall excess that is distributed uniformly over a watershed or sub-basin in a specified duration of time (Barfield et al., 1981). Unit hydrographs are used to represent the runoff characteristics for particular basins. They are identified by the duration of precipitation excess that was used to generate them; for example, a 1-hour or a 20-minute unit hydrograph. The duration of excess precipitation, calculated from actual precipitation events or from design storms, is applied to a unit hydrograph to produce a runoff hydrograph representing a storm of that duration. For example, 2 hours of precipitation excess could be applied to a 2-hour unit hydrograph to produce an actual runoff hydrograph. This runoff volume can be used as input to route flows down a channel and through an outlet or for direct input to the design of a structure.

Common methods to develop and use unit hydrographs are described by Snyder (1938), Clark (1945), and SCS (1972). Unit hydrographs or average hydrographs can also be developed from actual stream flow runoff records for basins or sub-basins. The SCS (1972) method is perhaps the most commonly applied method to develop unit hydrographs and produce runoff hydrographs. The SCS (1972) publication recommended using the SCS Type I, Type I-A or Type II curves for creating design storms and using the curve number method to determine precipitation excess. Another technique to determine runoff from basins or sub-basins is the Kinematic Wave Method. This method applies the kinematic wave interpretation of the equations for motion (Linsley et al., 1975) to provide estimates of runoff from basins. If applied correctly, the method can provide more accurate estimates of runoff than many of the unit hydrograph procedures described above, depending on the data available for the site. The method, however, requires detailed site knowledge and the use of several assumptions and good professional judgment in its application.

As previously indicated, only peak runoff rates at a given frequency of occurrence are used to design many smaller hydrologic facilities, such as conveyance features, road culverts or diversion ditches. The hydrograph methods listed above can be used to obtain peak runoff rates, but other methods are often employed to provide quick, simple estimates of these values. A common method to estimate peak runoff rates is the Rational Method. This method uses a formula to estimate peak runoff from a basin or watershed:

$$Q = C\,i\,A$$

Where: Q = the peak runoff rate as cubic feet per second
C = the run-off coefficient
i = the rainfall intensity as inches per hour
A = the drainage area of the basin expressed as acres

A comprehensive description of the method is given by the Water Pollution Control Federation (1969). The coefficient C is termed the runoff coefficient and is designed to represent factors such as interception, infiltration, surface detention, and antecedent soil moisture conditions. Use of a single coefficient to represent all of these dynamic and interrelated processes produces a result that can only be used as an approximation. Importantly, the method makes several inappropriate assumptions that do not apply to large basins or watersheds, including: (1) rainfall occurs uniformly over a drainage area, (2) the peak rate of runoff can be determined by averaging rainfall intensity over a time period equal to the time of concentration (tc), where tc is the time required for precipitation excess from the most remote point of the watershed to contribute to runoff at the measured point, and (3) the frequency of runoff is the same as the frequency of the rainfall used in the equation (i.e., no consideration is made for storage considerations or flow routing through a watershed) (Barfield et al., 1981). A detailed discussion of the potential problems and assumptions made by using this method has been outlined by McPherson (1969).

Other methods commonly used to estimate peak runoff are the SCS TR-20 (SCS, 1972) and SCS TR-55 methods (SCS, 1975). Like the Rational Method, these techniques are commonly used because of their simplicity. The SCS TR-55 method was primarily derived for use in urban situations and for the design of small detention basins. A major assumption of the method is that only runoff curve numbers are used to calculate excess precipitation. In effect, the watershed or sub-basin is represented by a uniform land use, soil type, and cover, which generally will not be true for most watersheds or sub-basins.

The Rational Method and the SCS methods generally lack the level of accuracy required to design most structures and compute a water balance. This is because they employ a number of assumptions that are not well suited to large watersheds with variable conditions. However, these methods are commonly used because they are simple to apply and both Barfield et al. (1981) and Van Zyl et al. (1988) suggest that they are suitable for the design of small road culverts or non-critical catchments. Van Zyl et al. (1988) suggested that the Rational Method can be used to design catchments of less than 5 to 10 acres. It is important that the design engineer and the hydrologist exercise good professional judgment when choosing a method for determining runoff as discussed above. Techniques should be sufficiently robust to match the particular design criteria. It is particularly important that critical structures not be designed using runoff input estimates made by extrapolating an approximation, such as that produced by the Rational Method, to areas or situations where it is not appropriate. Robust methods that employ a site specific unit hydrograph or the Kinematic Wave Method will produce more accurate hydrological designs, but requires more expertise, time and expense.

4.1.4 Numerical Models

There are several numeric and analytical computer models that are available both in the public domain and commercially that can be used to estimate impacts to surface water from tourist operations. These models have been used to assess impacts of disturbance of local soils and geology to aquatic and marine biology based on changes to chemistry, environmental effects of trace metal loading, contaminant transport, sedimentation and deposition, changes to flood plains, flooding characteristic, and others. Table F-2 presents a list of models which are commonly used. Most of these models are available for down load on the web pages indicated in the following table.

Table F- 2: Surface water models

MODEL	LINK	DESCRIPTION
CORMIX Cornell Mixing Zone Expert System	http://www.epa.gov/waterscience/models/cormix.html	Water quality modeling and decision support system designed for environmental impact assessment of mixing zones resulting from wastewater discharge from point sources. The system emphasizes the role of boundary interaction to predict plume geometry and dilution in relation to regulatory mixing zone requirements. As an expert system, CORMIX is a user-friendly application which guides the water quality analysts in simulating a site-specific discharge configuration. To facilitate its use, ample instructions are provided, suggestions for improving dilution characteristics are included, and warning messages are displayed when undesirable or uncommon flow conditions occur
EXAMS	www.epa.gov/ceampubl/swater/exams	Aquatic biology, assessment, biology, chemistry, compliance, environmental effects, metals, NPS related, permits, pesticides, point source(s), rivers, streams, surface water, test/analysis
HSCTM2D	www.epa.gov/ceampubl/swater/hsctm2d	Hydrology, sediment, contaminant, transport, finite element model, river, estuary
HSPF	www.epa.gov/ceampubl/swater/hspf	Assessment, biology, compliance, deposition, discharge, environmental effects, estuaries, hydrology, lakes, metals, monitoring, NPS related, NPDES, nutrients, permits, pesticides, point source(s), rivers, sediment, streams, surface water, test/analysis, TMDL related, toxicity

MODEL	LINK	DESCRIPTION
HSPF Toolkit	www.epa.gov/athens/research/modeling/ftable	Assessment, compliance, discharge, environmental effects, hydrology, permits, rivers, sediment, streams, surface water, TMDL related, toxicity
PRZM3	www.epa.gov/ceampubl/gwater/przm3	Assessment, discharge, environmental effects, hydrology, land use management, metals, pesticides, surface water, test/analysis
QUAL2K	www.epa.gov/athens/wwqtsc/html/qual2k.html	Aquatic biology, assessment, compliance, discharge, environmental effects, hydrology, NPS related, point source(s), surface water, test/analysis, TMDL related
SERAFM	www.epa.gov/ceampubl/swater/serafm	Exposure, assessment, mercury, hg, surface water, pond, stream, river
Visual Plumes	www.epa.gov/ceampubl/swater/vplume	Surface, water, jet, plume, model, quality, contaminant, TMDL
WASP	www.epa.gov/athens/wwqtsc/html/wasp.html	Aquatic biology, assessment, compliance, discharge, environmental effects, hydrology, metals, NPS related, point source(s), surface water, test/analysis, TMDL related
HEC-RAS	http://www.hec.usace.army.mil/software/hec-ras/	The Hydrologic Engineering Centers River Analysis System (HEC-RAS) is a computer program that models steady flow, unsteady flow, sediment transport/mobile bed computations, and water temperature through natural rivers and other channels. The program is one-dimensional, meaning that there is no direct modeling of the hydraulic effect of cross-section shape changes, bends, and other two- and three-dimensional aspects of flow
HEC-ResSim	http://www.hec.usace.army.mil/software/hec-ressim/	Hydrologic Engineering Center Reservoir System Simulation program, to model reservoir operations at one or more reservoirs whose operations are defined by a variety of operational goals and constraints
GSFLOW	http://water.usgs.gov/software/lists/surface_water	Groundwater and surface-water flow model. It can be used to evaluate the effects of such factors as land-use change, climate variability, and groundwater withdrawals on surface and subsurface flow. Incorporates simulating runoff and infiltration from precipitation; balancing energy and mass budgets of the plant canopy, snowpack, and soil zone; and simulating the interaction of surface water with ground water, in watersheds
SMS (Surface Water Modeling System)	www.ems-i.com. (available in Spanish)	The Surface Water Modeling System (SMS) is a comprehensive environment for one-, two-, and three-dimensional hydrodynamic modeling. A pre- and post-processor for surface water modeling and design, SMS includes 2D finite element, 2D finite difference, and 3D finite element and 1D backwater modeling tools. The model allows for flood analysis, wave analysis, and hurricane analysis. SMS also includes a generic model interface, which can be used to support other models which have not been officially incorporated into the system

MODEL	LINK	DESCRIPTION
Watershed Modeling Software (WMS)	www.ems-i.com.(available in Spanish)	The Watershed Modeling System software is a comprehensive graphical modeling environment for all phases of watershed hydrology and hydraulics. The WMS software includes powerful tools to automate modeling processes such as automated basin delineation, geometric parameter calculations; GIS overlay computations (CN, rainfall depth, roughness coefficients, etc.), cross-section extraction from terrain data, and other. Hydraulic models supported in the WMS software include HEC-RAS and CE QUAL W2
IBM In-stream Flow Assessment	http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=404&RaiseDocID=TR	Habitat based modeling for fisheries. Individual-based Stream Fish Models can improve the cost-effectiveness conduction in-stream flow assessment traditionally conducted using IFIM
PHABSIM	http://www.fort.usgs.gov/Products/Software/PHABSIM/ http://www.fort.usgs.gov/products/Publications/15000/chapter1.html#overview	PHABSIM is a collection of hydraulic and habitat models used to determine the relative value of a targeted habitat for a particular fish species or other aquatic organism over a range of flows. PHABSIM is a component of the larger IFIM (Instream Flow Incremental Methodology), which is a problem-solving process for addressing water resource issues. Field data to input into the models include measurements of flow, velocity, and depth; substrate composition; and visual habitat use observations of targeted fish species
MARS	http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=404&RaiseDocID=000000000001008490&RaiseDocType=Abstract_id	Models contaminated surface water sediments. Three interconnected hydrodynamic, sediment, and chemical fate and transport models simulate the fate and transport of organic compounds, while allowing evaluation of site remediation alternatives such as natural attenuation, dredging, and capping
SNTEMP	http://www.fort.usgs.gov/Products/Software/SNTEMP/	Stream Network and Stream Temperature Model simulates steady-state stream temperatures throughout a dendritic stream network handling multiple time periods per year. Helps formulate instream flow recommendations, assess the effects of altered stream flow regimes, assess the effects of habitat improvement projects, and assist in negotiating releases from existing storage projects
BASINS	http://water.epa.gov/scitech/datait/models/basins/index.cfm	The Watershed Model System software is comprehensive for both point and non-point sources. a multi-purpose environmental analysis system that integrates a geographical information system (GIS), national watershed data, and state-of-the-art environmental assessment and modeling tools into one convenient package

4.2 Groundwater Impact Assessment Tools

If groundwater is extracted for use in facility then a thorough understanding of the site hydrogeology is required to adequately characterize and evaluate potential impacts. Aquifer pump tests and drawdown tests of wells need to be conducted under steady-state or transient conditions to determine aquifer characteristics. If possible, it is important that these tests be performed at the pumping rates that would be used by a tourist activity for durations adequate to determine regional impacts from drawdown and potential changes in flow direction. These tests require prior installation of an appropriate network of observation wells. Transmissivities, storage coefficients and vertical and horizontal hydraulic conductivities can be calculated from properly designed pump tests. These measurements are necessary to determine the volume and rate of groundwater discharge expected during operations at a facility to evaluate environmental impacts (need to mention example – large water user tourist project like a swim park or golf course could result in salt water intrusion in the coastal setting). Tests should be performed for all aquifers that could be affected by the project to ensure adequate characterization of the relationships between hydrostratigraphic units (US EPA, 2003).

Characterization studies should define the relationships between groundwater and surface water, including identifying springs and seeps. Significant sources or sinks to the surface water system also need to be identified. Hydrogeological characterizations should include geologic descriptions of the site and the region. Descriptions of rock types, intensity and depth of weathering, and the abundance and orientation of faults, fractures, and joints provide a basis for impact analysis and monitoring. Although difficult to evaluate, the hydrological effects of fractures, joints, and faults are especially important to distinguish. Water moves more easily through faults, fractures and dissolution zones, collectively termed secondary permeability, than through rock matrices. Secondary permeability can present significant problems for some projects because it can result in a greater amount of groundwater discharge than originally predicted. For example, faults that juxtapose rocks with greatly different hydrogeological properties can cause abrupt changes in flow characteristics that need to be incorporated into facility designs.

As with air and surface water resources, there analytical and numerical approaches can be used in assessing groundwater.

4.2.1 Analytical Approach

A common method to analyze groundwater in relation to a project that uses substantial amounts of water relies on a simple analytical solution in which the facility operation is approximated as a well. This method uses the constant-head Jacob-Lowman (1952) equation to calculate flow rates. It generally yields a conservative overestimate of the pumping rates required to satisfy cooling requirements (Hanna et al., 1994). In addition, an understanding of groundwater can be gained by developing a water balance for the site as described above. Finally, implications of the effects of groundwater quality can be gained based on field studies.

4.2.2 Numerical Approach

The use of computer models has increased the accuracy of hydrogeological analyses and impact predictions and speeded solution of the complex mathematical relations through use of numerical solution methods. However, computer modeling has not changed the fundamental analytical equations used to characterize aquifers and determine groundwater quantities. Models are used to determine drawdown in the aquifer due to consumptive use, contaminate transport, surface water quality, and other factors. Table F-3 presents a brief description of groundwater models used to assess impacts of discharges and consumptive water use that are available through the public domain and commercially.

Table F- 3: Groundwater and geochemical computer models

MODEL	LINK	DESCRIPTION
MODFLOW	http://water.usgs.gov/software/lists/groundwater	MODFLOW is a finite-difference code developed by the United States Geological Survey (McDonald and Harbaugh, 1988). MODFLOW is a widely accepted numerical flow modeling code and has been used around the world to evaluate the impacts of activities that may result in disturbance of large surface areas. MODFLOW translates conceptual model(s) of the site into numerical models using discretization of space and time. Discretization of the spatial domain is done by constructing a grid designating cells of specified width, length, and thickness.
MT3D	http://water.usgs.gov/software/lists/groundwater	MT3D is a solute transport code also linked to the MODFLOW base model. The flow domain using MODFLOW is linked to MT3D, which then simulates contaminant transport using dispersion and chemical reactions.
Visual MODFLOW	www.visual-modflow.com. (available in Spanish)	Allows for applications in 3D groundwater flow and contaminant transport modeling utilizing an easy to use graphical user interface. Information is available for this package through Scientific Software Group.
GW Vistas	www.esinternational.com/groundwater-vistas.html (classes are available in Spanish)	This software is for 3D groundwater flow and contaminant transport modeling, calibration and optimization using the MODFLOW suite of codes. The advanced version of Groundwater Vistas provides the ideal groundwater risk assessment tool. Information of this software is available through ESI Lt.
GMS (Groundwater Modeling System)	www.ems-i.com	GMS provides software tools for every phase of a groundwater simulation including site characterization, model development, calibration, post-processing, and visualization. GMS supports both finite-difference and finite-element models in 2D and 3D including MODFLOW 2000, MODPATH, MT3DMS/RT3D, SEAM3D, ART3D, UTCHEM, FEMWATER, PEST, UCODE, MODAEM and SEEP2D. Information is available through Environmental Monitoring Systems, Inc.
HYDROGEOCHEM	http://www.scisoftware.com/products/hydrogeochem_overview/hydrogeochem_overview.html	HYDROGEOCHEM is a coupled model of hydrologic transport and geochemical reaction in saturated-unsaturated media.

MODEL	LINK	DESCRIPTION
MIKE SHE	http://www.crwr.utexas.edu/gis/gishyd98/dhi/mikeshe/Mshemain.htm	MIKE SHE is an advanced integrated hydrological modeling system. It simulates water flow in the entire land based phase of the hydrological cycle from rainfall to river flow, via various flow processes such as, overland flow, infiltration into soils, evapotranspiration from vegetation, and groundwater flow. MIKE SHE has been applied in a large number of studies world-wide focusing on e.g. conjunctive use of surface water and ground water for domestic and industrial consumption and irrigation, dynamics in wetlands, and water quality studies in connection with point and non-point pollution.
SEAWAT	http://water.usgs.gov/ogw/seawat/	This a combined version of MODFLOW and MT3DMS, is used to simulate the variable-density flow patterns due to saltwater intrusion. It is designed to simulate three-dimensional variable-density groundwater flow coupled with multi-species solute and heat transport. The program has been used for a wide variety of groundwater studies including those focused on brine migration in continental aquifers as well as those focused on saltwater intrusion in coastal aquifers.

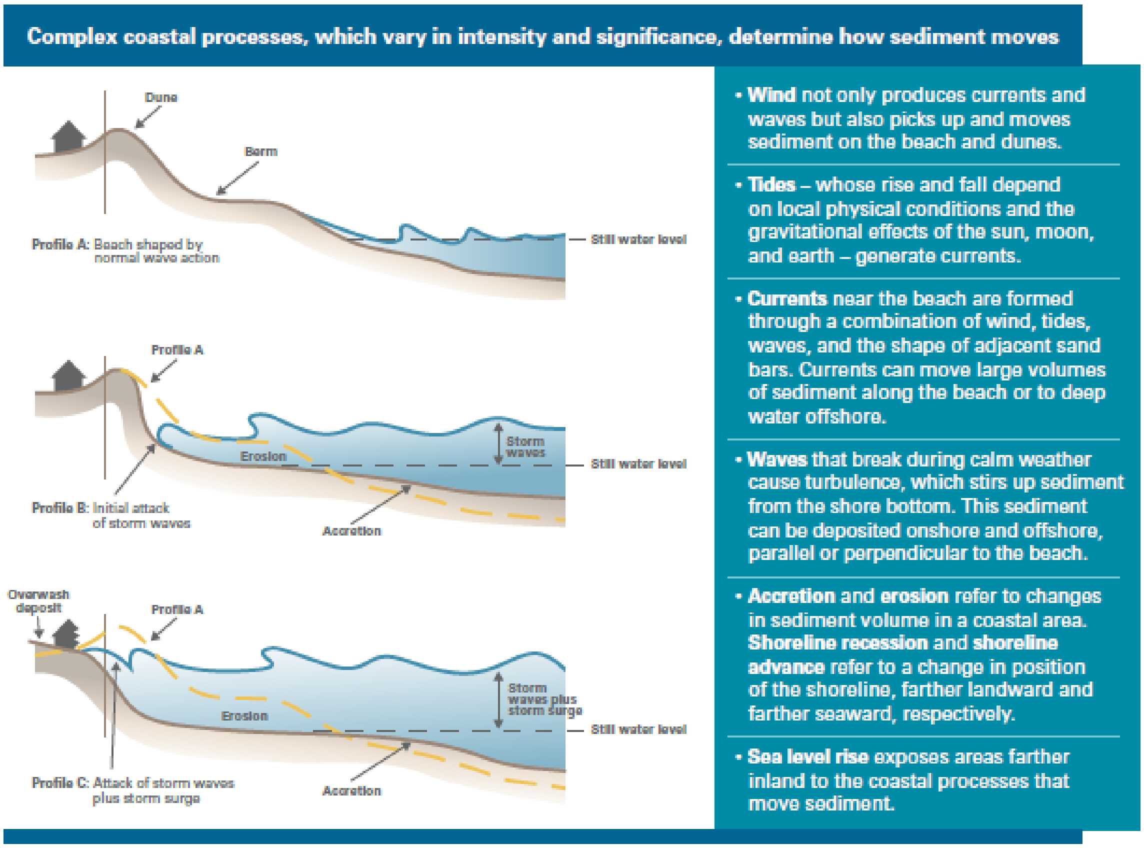
4.3 Coastal Waters Resource Impact Assessment Tools

Coastal development is difficult since it is construction on a dynamic foundation. Natural processes of wind, wave, currents, etc. are constantly changing the contours of the development site. (See diagram below). Not only the facility, but also measures taken to stabilize the site must be analyzed for impacts. For example, a breakwater designed to protect a dock or marina may cause sand deposition in an area containing cultural artifacts or natural aesthetics for snorkeling. Any water or near water construction will impact the natural processes at the shoreline.

One comprehensive document which covers all aspects of coastal engineering is the U.S. Army Corps of Engineers, Coastal Engineering Manual (CEM) (*EM 1110-2-1100) which* provides a single, comprehensive technical document that incorporates tools and procedures to plan, design, construct, and maintain coastal projects. It can be downloaded for free at http://chl.erdc.usace.army.mil/cem. This engineering manual includes the basic principles of coastal processes, methods for computing coastal planning and design parameters, and guidance on how to formulate and conduct studies in support of coastal flooding, shore protection, and navigation projects. Additional sections are being added on navigation and harbor design, dredging and disposal, structure repair and rehabilitation, wetland and low-energy shore protection, risk analysis, field instrumentation, numerical simulation, the engineering process, and other topics.

Many coastal resorts incorporate a beachfront area. In-water supporting construction (dock, breakwaters, etc.) often alter the sand deposition patterns and beach nourishment is required. The guidance document “Shore Protection Assessment - Beach Nourishment” can be found at http://chl.erdc.usace.army.mil/Media/7/4/7/HowBeachNourishmentWorks.pdf. It explains the normal coastal processes and provides guidance on best management practices. It can be useful in predicting impacts of various construction layouts and methodologies.

Figure F-3 Complex coastal processes



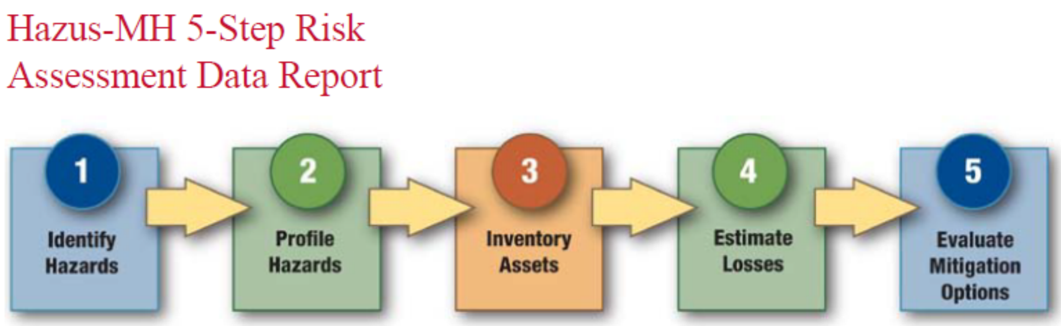
Source: USACE , 2007 "Shoreline Assessment- Beach Nourishment"

Hazards Vulnerability. Another layer of concern for coastal development is that tourism activities often take place in regions prone to natural hazards. The hazard potential needs to be assessed when planning tourism projects so that projects can have appropriate layout and structural designs and evacuation planning and routes are factored in for the large non-native populous. Some of these hazards include:

- Tropical Weather Systems
- Hurricanes
- Storm Surges
- Earthquakes/Tsunamis
- Volcanic Eruptions
- Electrical Storms and Forest Fires
- Floods and Landslides
- Sea Level Rise

The United States' Federal Emergency Management Agency's (FEMA) Hazus-MH model combines science, engineering and mathematical modeling with GIS technology to estimate losses of life and property and shows those losses on a map (Figure F-4). Hazus estimates impacts to the physical, social, and economic vitality of a community from earthquakes, hurricane winds, and floods. It creates customized maps and graphics to show buildings, roads, rivers, coastlines, and infrastructure damages. Visualizing the hazard risk compels planners to recognize the need for mitigation and emergency planning.

Figure F- 4: Hazus-MH 5-step risk assessment



HAZUS-MH Capabilities	Earthquake Ground Shaking Ground Failure	Flood Frequency Depth Discharge Velocity	Hurricane Pressure | Missile | Rain
Direct Damage			
General Building Stock	✔	✔	✔
Essential Facilities	✔	✔	✔
High Potential Loss Facilities	✔		
Transportation Systems	✔	✔	
Utility Systems	✔	✔	
Induced Damage			
Fire Following	✔		
Hazardous Materials Release	✔		
Debris Generation	✔	✔	✔
Direct Losses			
Cost of Repair	✔	✔	✔
Income Loss	✔	✔	✔
Crop Damage		✔	
Casualties	✔	Generic Output	
Shelter Needs	✔	✔	✔
Indirect Losses			
Supply Shortages	✔	✔	
Sales Decline	✔	✔	
Opportunity Costs	✔	✔	
Economic Loss	✔	✔	

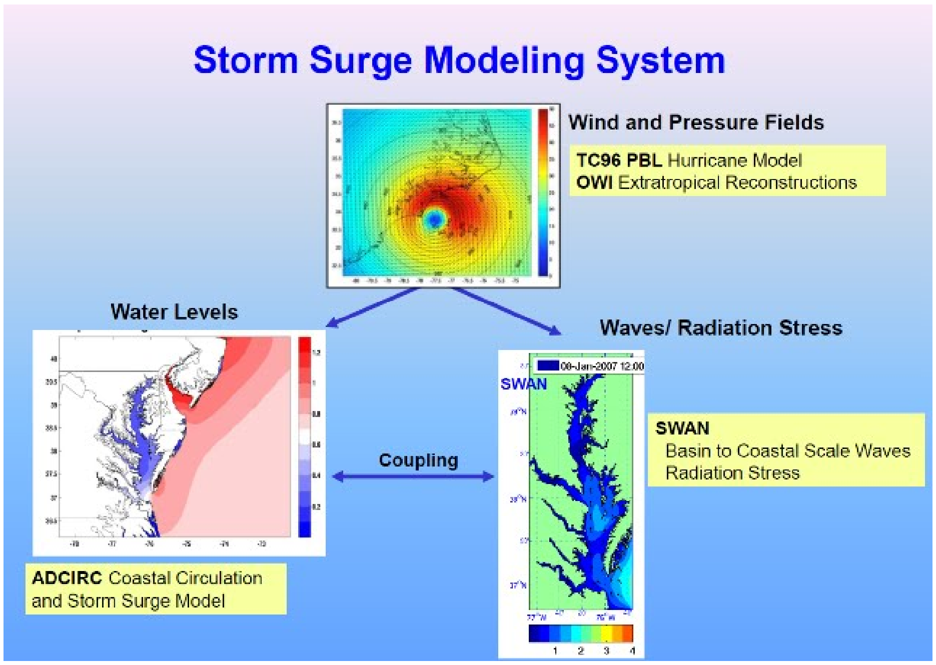
Source: http://www.fema.gov/plan/prevent/hazus/hz_overview.shtm

Both tourism development impacts assessment and hazards analyses can be and often are aided by the use of physical, analytical, numerical and statistical models. Some of the models available are listed in the table below. These include models for storm surges, hurricanes, wind and pressure fields, scour around bridge abutments, etc. Additional, coastal, hydraulic, hydrologic and statistical models which may be useful are listed on the FEMA website http://www.fema.gov/plan/prevent/fhm/en_coast.shtm.

Models are often linked together to analyze a situation. For example, FEMA routinely utilizes models to perform Hazard Analysis and Mapping for their National Flood Insurance Program. For a floodplain-mapping project FEMA used a suite of state-of-the-art numerical wind, wave, and surge models to compute still water elevations along the coast. The model suite (Figure F-5) consists of the Hurricane

Boundary Layer (HBL) wind model for tropical storms (hurricanes) and Planetary Boundary Layer (PBL) model for extra-tropical storms; the wave-field model Simulating Waves Nearshore (SWAN), and the storm surge and tidal model ADvanced CIRCulation for Model for Oceanic, Coastal and Estuarine Waters (ADCIRC). FEMA also uses the offshore wave model WAM and the nearshore wave transformation model STWAVE for flood mapping projects.

Figure F- 5: FEMA flood plain mapping model suite



Source: FEMA http://www.r3coastal.com/home/storm-surge-study/numerical-model-setup

These sophisticated modeling systems are capable of assessing the storm damage reduction potential of natural features such as wetlands and barrier islands. For more information see Wamsley et al. 2009 and Wamsley et al. 2010.

Table F- 4: Hazards analysis and coastal models

MODEL	LINK	DESCRIPTION
SMS Surface Water Modeling System	http://chl.erdc.usace.army.mil/sms	The Surface Water Modeling System (SMS) is a comprehensive environment for one-, two-, and three-dimensional hydrodynamic modeling. A pre- and post-processor for surface water modeling design, SMS includes 2D finite element, 2D finite difference, 3D finite element and 1D backwater modeling tools. The numeric models supported in SMS compute a variety of information applicable to surface water modeling. Supported models include the USACE-ERDC supported TABS-MD (GFGEN, RMA2, RMA4, SED2D-WES), ADCIRC, ADH, CGWAVE, CMS-Flow (formally M2D) and CMS-Wave, STWAVE, and PTM models. Primary applications of the models include calculation of water surface elevations and flow velocities for shallow water flow problems, for both steady-state or dynamic conditions. Additional applications include the modeling of contaminant migration, salinity intrusion, sediment transport (scour and deposition), wave energy dispersion, wave properties (directions, magnitudes and amplitudes) and others.
RMA2	http://chl.erdc.usace.army.mil/rma2	RMA2 is a two dimensional depth averaged finite element hydrodynamic numerical model. It computes water surface elevations and horizontal velocity components for subcritical, free-surface flow in two dimensional flow fields. RMA2 computes a finite element solution of the Reynolds form of the Navier-Stokes equations for turbulent flows. Friction is calculated with the Manning's or Chezy equation, and eddy viscosity coefficients are used to define turbulence characteristics. Both steady and unsteady state (dynamic) problems can be analyzed. The program has been applied to calculate water levels and flow distribution around islands; flow at bridges having one or more relief openings, in contracting and expanding reaches, into and out of off-channel hydropower plants, at river junctions, and into and out of pumping plant channels; circulation and transport in water bodies with wetlands; and general water levels and flow patterns in rivers, reservoirs, and estuaries.

MODEL	LINK	DESCRIPTION
BOUSS-2D	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=SOFTWARE;23	BOUSS-2D is a comprehensive numerical model for simulating the propagation and transformation of waves in coastal regions and harbors based on a time-domain solution of Boussinesq-type equations. The governing equations are uniformly valid from deep to shallow water and can simulate most of the phenomena of interest in the near shore zone and harbor basins including shoaling/ refraction over variable topography, reflection/diffraction near structures, energy dissipation due to wave breaking and bottom friction, cross-spectral energy transfer due to nonlinear wave-wave interactions, breaking-induced long shore and rip currents, wave-current interaction and wave interaction with porous structures. Many processes at inlets and harbors can be studied using BOUSS-2D. BOUSS-2D can be applied to a wide variety of coastal and ocean engineering problems, including complex wave transformation over small coastal regions (1-5 km), wave agitation and harbor resonance studies, wave breaking over submerged obstacles, breaking-induced near shore circulation patterns, wave-current interaction near tidal inlets, infra-gravity wave generation by groups of short waves, and wave transformation around artificial islands.
WAM - Wave Prediction Model	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=SOFTWARE;8	The global ocean Wave prediction Model called WAM is a third generation wave model. WAM predicts directional spectra as well as wave properties such as significant wave height, mean wave direction and frequency, swell wave height and mean direction, and wind stress fields corrected by including the wave induced stress and the drag coefficient at each grid point at chosen output times. The model is continually updated to incorporate the latest results of research. The verification has been carried out in three areas where National Oceanic and Atmospheric Administration (NOAA) moored buoys are available on the Global Telecommunications System (GTS). It is hoped that the buoys chosen will allow the identification of both successes and failures in WAM model physics and will minimize shortcomings due to sub-grid scale effects. Model Assumptions: ▪ Time dependent wave action balance equation. ▪ Wave growth based on sea surface roughness and wind characteristics. ▪ Nonlinear wave and wave interaction by Discrete Interaction Approximation (DIA). ▪ Free form of spectral shape. ▪ High dissipation rate to short waves.

MODEL	LINK	DESCRIPTION
ADCIRC – The Advanced Circulation Model	http://chl.erdc.usace.army.mil/adcirc	The ADvanced CIRCulation model (ADCIRC), is a two-dimensional, depth-integrated, barotropic time-dependent long wave, hydrodynamic circulation model. ADCIRC can be applied to computational domains encompassing the deep ocean, continental shelves, coastal seas, and small-scale estuarine systems for simulations that require months to years' time. In a single simulation, ADCIRC can provide tide and storm surge elevations and velocities corresponding to each node over a very large domain encompassing regional domains such as the western North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico.
CGWAVE	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=SOFTWARE;21	CGWAVE is a general-purpose wave prediction model for simulating the propagation and transformation of ocean waves in coastal regions and harbors, and appropriate for modeling the most significant physical processes in channels, inlets and harbors, open coastal regions, around islands and structures.
WISWAVE	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=SOFTWARE;7	The WISWAVE is a second generation wave model developed under the WIS. The model predicts directional spectra as well as integrated wave properties such as significant wave height, peak wave period, vector mean wave direction, and sea and swell components according to atmosphere wind input. Wave Information Studies provides a national resource of long-term wavefield climatologies for U.S. coastal waters that synthesizes observations, multi-decade hindcasts and storm event archives to meet tomorrow's coastal engineering needs today.
STWAVE (Steady State spectral WAVE)	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=SOFTWARE;9	STWAVE is an easy-to-apply, flexible, robust, half-plane model for nearshore wind-wave growth and propagation. STWAVE simulates depth-induced wave refraction and shoaling, current-induced refraction and shoaling, depth- and steepness-induced wave breaking, diffraction, parametric wave growth because of wind input, and wave-wave interaction and white capping that redistribute and dissipate energy in a growing wave field. STWAVE is being extended from a half-plane model to a full-plane model (including propagation and generation from all directions).
SED 2D	http://chl.erdc.usace.army.mil/sed2d	SED 2D a two-dimensional numerical model for depth-averaged transport of cohesive or a representative grain size of non cohesive sediments and their deposition, erosion, and formation of bed deposits.

MODEL	LINK	DESCRIPTION
SWAN Model Delft University of Technology, The Netherlands.	http://www.citg.tudelft.nl/live/pagina.jsp?id=f928097d-81bb-4042-971b-e028c00e3326	SWAN is a third-generation wave model that computes random, short-crested wind-generated waves in coastal regions and inland waters. The current version of SWAN is 40.81. ▪ Wave propagation in time and space, shoaling, refraction due to current and depth, frequency shifting due to currents and non-stationary depth. ▪ Wave generation by wind. ▪ Three- and four-wave interactions. ▪ White capping, bottom friction and depth-induced breaking. ▪ Dissipation due to vegetation. ▪ Wave-induced set-up. ▪ Propagation from laboratory up to global scales. ▪ Transmission through and reflection (specular and diffuse) against obstacles. ▪ Diffraction.
Empirical Simulation Technique (EST)	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=SOFTWARE;27	Empirical Simulation Technique (EST) is a statistical model to compute site-specific stage versus frequency relationships for site specific locations. EST is a statistical procedure for simulating life-cycle risk analysis of events such as storms and their corresponding environmental impacts. The EST is based on a "bootstrap" resampling-with-replacement, interpolation, and subsequent smoothing of observed and/or computed site-specific historical events.
GENESIS	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=SOFTWARE;34&g=14	GENESIS (GENEralized Model for simulating Shoreline Change) - simulates the long-term platform evolution of the beach in response to imposed wave conditions, coastal structures, and other engineering activity (e.g., beach nourishment).
SHARP	http://water.usgs.gov/software/SHARP/	A quasi-three-dimensional, numerical finite-difference model to simulate freshwater and saltwater flow separated by a sharp interface in layered coastal aquifer systems.
SEAWAT Version 4	http://water.usgs.gov/ogw/seawat/	SEAWAT is a generic MODFLOW/MT3DMS-based computer program designed to simulate three-dimensional variable-density groundwater flow coupled with multi-species solute and heat transport. The program has been used for a wide variety of groundwater studies including those focused on brine migration in continental aquifers as well as those focused on saltwater intrusion in coastal aquifers. SEAWAT uses the familiar structure of MODFLOW and MT3DMS.
SBEACH	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=Software;31	**SBEACH** (**S**torm-induced **BEA**ch **CH**ange Model) - simulates cross-shore beach, berm, and dune erosion produced by storm waves and water levels. The latest version allows simulation of dune erosion in the presence of a hard bottom.

MODEL	LINK	DESCRIPTION
Beach-fx	http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=PUBLICATIONS!461	Beach-fx is a comprehensive new analytical framework for evaluating the physical performance and economic benefits and costs of shore-protection projects, particularly, beach nourishment along sandy shores. The model has been implemented as an event-based Monte Carlo life cycle simulation tool that is run on desktop computers.

5 AIR RESOURCES IMPACT ASSESSMENT TOOLS

In evaluating the potential impacts of a tourist project on ambient air quality, prediction should be made to determine the extent to which ambient air quality standards may be compromised. The predictions should assess the likelihood of air pollution from the facility, transportation to and from the area (land-based and water-based), dumps, and materials storage and handling facilities, identify the areas of maximum impact, and assess the extent of the impacts at these sites. Although analytical approaches can be used, international experience indicates that numeric modeling is the most appropriate method to evaluate the impacts of a tourism project on air resources. Quantitative models can be used to calculate the contaminants in air and to compare the results to numerical air quality standards.

At the facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic and air quality data should be applied when modeling dispersion.

Initially, the Gaussian analytical model was developed in the 1930's and still is the most commonly used model type. It assumes that the air pollutant dispersion has a Gaussian distribution, meaning that the pollutant distribution has a normal probability distribution. Gaussian models are most often used for predicting the dispersion of continuous, buoyant air pollution plumes originating from ground-level or elevated sources. Gaussian models may also be used for predicting the dispersion of non-continuous air pollution plumes (called puff models). The primary algorithm used in Gaussian modeling is the Generalized Dispersion Equation for a Continuous Point-Source Plume and can be found in Turner (1994).

Over time, other numeric air dispersion models have been developed. These include screening models for single source evaluations (SCREEN3 or AIRSCREEN), as well as more complex and refined models (AERMOD or ADMS). Model selection is dependent on the complexity and geomorphology of the project site (e.g. mountainous terrain, urban or rural area). Table F-5 presents a list of commonly used models. Note that models are continuously updated and improved. Also note that certain models are appropriate for specific applications, such as in complex terrain, shoreline environments, for point, area, line and or mobile sources, and for specific pollutants (e.g., gases, particles, heavier than air gases). A general summary of appropriate applications is provided in the "Description" column of Table F-4. Most of these models are free to the public, readily available on the US EPA APTIC Website and can be down loaded following the links presented in the "Link" column.

Table F- 5: Air pollution models

MODEL	LINK	DESCRIPTION
AERMOD	http://www.epa.gov/scram001/dispersion_prefrec.htm#rec	A steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.
CALPUFF	http://www.epa.gov/scram001/dispersion_prefrec.htm#rec	A non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation, and removal. CALPUFF can be applied for long-range transport and for complex terrain.
BLP	http://www.epa.gov/scram001/dispersion_prefrec.htm#rec	A Gaussian plume dispersion model designed to handle unique modeling problems associated with aluminum reduction plants, and other industrial sources where plume rise and downwash effects from stationary line sources are important.
CALINE3	http://www.epa.gov/scram001/dispersion_prefrec.htm#rec	A steady-state Gaussian dispersion model designed to determine air pollution concentrations at receptor locations downwind of highways located in relatively uncomplicated terrain.
CAL3QHC/ CAL3QHCR	http://www.epa.gov/scram001/dispersion_prefrec.htm#rec	CAL3QHC is a CALINE3 based CO model with queuing and hot spot calculations and with a traffic model to calculate delays and queues that occur at signalized intersections; CAL3QHCR is a more refined version based on CAL3QHC that requires local meteorological data.
CTDMPLUS	http://www.epa.gov/scram001/dispersion_prefrec.htm#rec	Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS) is a refined point source Gaussian air quality model for use in all stability conditions for complex terrain. The model contains, in its entirety, the technology of CTDM for stable and neutral conditions.
ISC3	http://www.epa.gov/ttncatc1/cica/9904e.html (In Spanish)	The Industrial Source Complex Model (ISC3) is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. ISC3 operates in both long-term and short-term modes.
SCREEN3	http://www.epa.gov/ttncatc1/cica/9904e.html (in Spanish)	SCREEN3 is a single source Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources.
PCRAMMET	http://www.epa.gov/ttncatc1/cica/9904e.html (in Spanish)	PCRAMMET is a preprocessor for meteorological data that is used with the Industrial Source Complex 3 (ISC3) regulatory model and other EPA models.
Note: Other models used for vehicle emissions ,e.g. MODAL, and complex pollutant interactions and photochemical reactions.		

6 NOISE IMPACT ASSESSMENT TOOLS

BENCHMARKS FOR NOISE	
Activity/Object	**dB(A)**
Quiet Bedroom	20-30
Daytime levels in quiet residential area	35-45
Conversation at 1 meter	50
Busy central office	50-60
Lawn mower at 15 meters	70
Jack hammer at 1 meter	100
Jet aircraft taking off at 25 meters	140

According to the Occupational Safety and Health Administration OSHA (2006) exposure to high levels of noise for long durations may lead to hearing loss, create physical and psychological stress, reduce productivity, interfere with communication, and contribute to accidents and injuries by making it difficult to hear warning signals. To estimate noise emissions during construction and operation of a tourism facility, baseline monitoring and operational monitoring may be necessary. This information can be analyzed using empirical or numerical modeling technique. Point source propagation can be analyzed using basic analytical equations based on attenuation of sound energy as the inverse of the square of the distance from the noise source. Numerical modeling techniques have also been developed for the additive effect of multiple sources. The results of the models are then compared to the appropriate standards. For instance, the maximum permissible occupational noise exposure limit in the range of 90-85 A-weighted decibels (dB(A)) Leq for 8 hour per day (40 hour per week). The A-weighted decibel scale approximates the sensitivity of the human ear to various frequencies from 32 to 20,000 Hertz (Hz).

Most advanced models provide graphic outputs of noise impacts (isophons), which can then be overlaid on maps of critical receptors. Noise standards are typically expressed as dB(A) – however, it is advisable to produce impacts based octave bands as well, as dB(A) are based on a weighted summation of all bands, and knowledge of the octave band analysis from specific sources is useful in devising the proper noise control strategy.

Just as there are many types and sources of noise, there are many noise models. The most broadly applicable noise model is the Computer Aided Noise Abatement (CadnaA) model. http://www.datakustik.com/en/products/cadnaa There are also simpler models based on the sound pressure levels (SPL) measured at known distances and at known directions from a noise source, with subsequent calculation of attenuation as a function of distance from the noise source. Traffic-specific models are also available, for example the US Federal Highway Administration (FHWA) Traffic Noise Model (TNM) http://www.fhwa.dot.gov/environment/noise/tnm/index.htm

Outdoor Entertainment Venues: Noise from live performances and entertainment venues can disturb household activities, disrupt sleep and interfere with business activities. If the noise is particularly loud, penetrating or prolonged, the impacts can cause irritation and annoyance. It is essential that noise from live music and entertainment venues is managed in a way that promotes and ensures a balance between the use and enjoyment of music venues and the protection of amenity for surrounding businesses and neighboring households.

Patron Noise: Noise from patrons approaching or leaving entertainment venues is a frequent cause of complaint. Planning authorities should consider the impact of patron noise and other behavior on the amenity valueamenity value of the locality when assessing proposals to develop tourism entertainment venues.

Car Park Noise: Car parks associated with entertainment venues tend to be a gathering place for patrons as they arrive at or leave the venue. Venue patrons often have little regard for the amenity of residents in properties adjacent the car park. The noise of slamming car doors, revving car engines and squealing tires can be disturbing.

7 AESTHETIC /VISUAL RESOURCE IMPACT ASSESSMENT TOOLS

It is recommended that a project be graphically superimposed on baseline panoramic views of the proposed project site from different potential viewpoints such as communities, roads, and designated scenic viewing areas, to provide a better understanding of potential visual impacts as a function of direction, distance and time of day.

Zone of Visual Influence (ZVI) maps show the extent of visibility of a proposed development from the surrounding landscape. They can also be used to assess the cumulative visual impact of similar developments within an area. Wireframe views give an outline image of the contours of the land from a selected viewpoint. This gives a picture of the proposed development without obstruction from surrounding buildings and vegetation Photomontages are computer aided 'photographs' of a proposed development, showing a picture of how a development will appear after construction. An image of the proposed development is superimposed onto the photograph (http://www.fehilytimoney.ie/expertise-services/visual-impact-assessment-zvi-maps-wireframe-views.html). The color photomontage is probably the most frequently used technique. Such a technique has the advantage of accurately portraying the landscape in a meaningful and easily recognizable form. In video montage techniques have been developed to demonstrate the important effects of movement. This is basically a video record of a site over which a computer-generated animated photomontage is superimposed (Thomas 1996). Computer programs such as GIS, CAD, Autodesk 3DS Max, Adobe Photoshop, Adobe Illustrator software and other specialized software, used to model the visual impact of developments. These models are described in Table F-6.

Table F- 6: Visual impact analysis tools

TOOL	DESCRIPTION
ArcGIS	Arc GIS is a suite of GIS tools (ArcView, ArcGIS Server, etc.) for working with maps and geographic information. It is used for assembling, storing, manipulating and displaying geographically referenced data. ArcGIS is a powerful tool whereby layers of data on a variety of topics can be collated, sieved, selected or superimposed. U.S. EPA has developed an application for screening projects for EIA which uses the off the shelf software of ArcGIS Server to create instantaneous access to distributed sources of data, integrate the data spatially, and provide an analysis of key relationships of environment and social-economic-cultural features in both a standardized and flexible manner. This tool has been adapted for use in CAFTA-DR countries and deployed throughout the region.
AutoCad	In computer-aided design (CAD), users employ interactive graphics to design components and systems of mechanical, electrical, electromechanical, and electronic devices, including structures such as buildings, automobile bodies, airplane and ship hulls, very large-scale integrated (VLSI) chips, and telephone and computer networks. CAD has been around since the early 1960's; its use facilitates the design of objects through computers. Early CAD software packages only worked in wire frame (simple line models) on a 2D plane, nowadays they can operate in 3D using various shading techniques to produce realistic rendered images.
Autodesk 3DS Max, Maya, Bryce (Corel Corporation, 2002), Vue D'Esprit (E-on Software, 2002) and Lightwave (NewTek, 2002)	3D modeling and animation applications such as 3DS Max differ to CAD in that they have the ability to create realistic environments by means of complex animations, lighting and shadows, detailed surface texturing, reflective surfaces, environmental effects such as fog and rain and many other functions.
Photoshop (Adobe Systems Inc., 2011), Paint Shop Pro X3 (Corel 2010), CorelDRAW X5 (Corel Corporation, 2010) and Mattis and Kimball's (GIMP, 2010)	Image editing software applications are used to create and edit images. These software packages allow the user to develop photomontage and visualization of future projects.

Source: Based on Cox, 2003

8 FLORA, FAUNA, ECOSYSTEMS AND PROTECTED AREAS IMPACT ASSESSMENT TOOLS

As with soils and geology, biological impact assessment is based on studies, literature review and professional judgment. As to provide an understanding of the criticality of habitat and ecosystems and the sensitive life stages. A described in Section D, Environmental Setting. Results of soil, water, air, and noise impact modeling or other means of quantification should be overlaid on maps showing location of flora, fauna, ecosystems, threatened and endangered species habitats, and protected areas, to determine the possibility of adverse impacts. In addition, some computer models are available to help predict habitat impacts for aquatic and terrestrial flora and fauna. These are discussed at the end of this subsection. The design of the proposed project design also should be reviewed as to whether it will alter access to light (shade impacts), water, food sources and whether critical habitat will be fragmented.

Beyond looking at these components individually, an EIA needs to be integrated, i.e. to address the relationships between biophysical, social and economic aspects in assessing project impacts (IAIA 1999).

Addressing these relationships relies on an integrating the Environmental Setting with the impact assessment. This approach is called an Ecosystem Services Approach.

An ecosystem services approach recognizes the intrinsic and complex relationships between biophysical and socio-economic environments. It integrates these aspects by explicitly linking ecosystem services (the benefits people derive from ecosystems), their contribution to human well-being, and the ways in which people impact ecosystems' capacity to provide those services. The approach relies on a suite of tools such as a conceptual framework linking drivers of change, ecosystems and biodiversity, ecosystem services, and human well-being (MA 2005); guidelines for private sector companies to assess risks and opportunities related to ecosystem services (Hanson et al. 2008), and manual for conducting ecosystem services assessments (UNEP to be published).

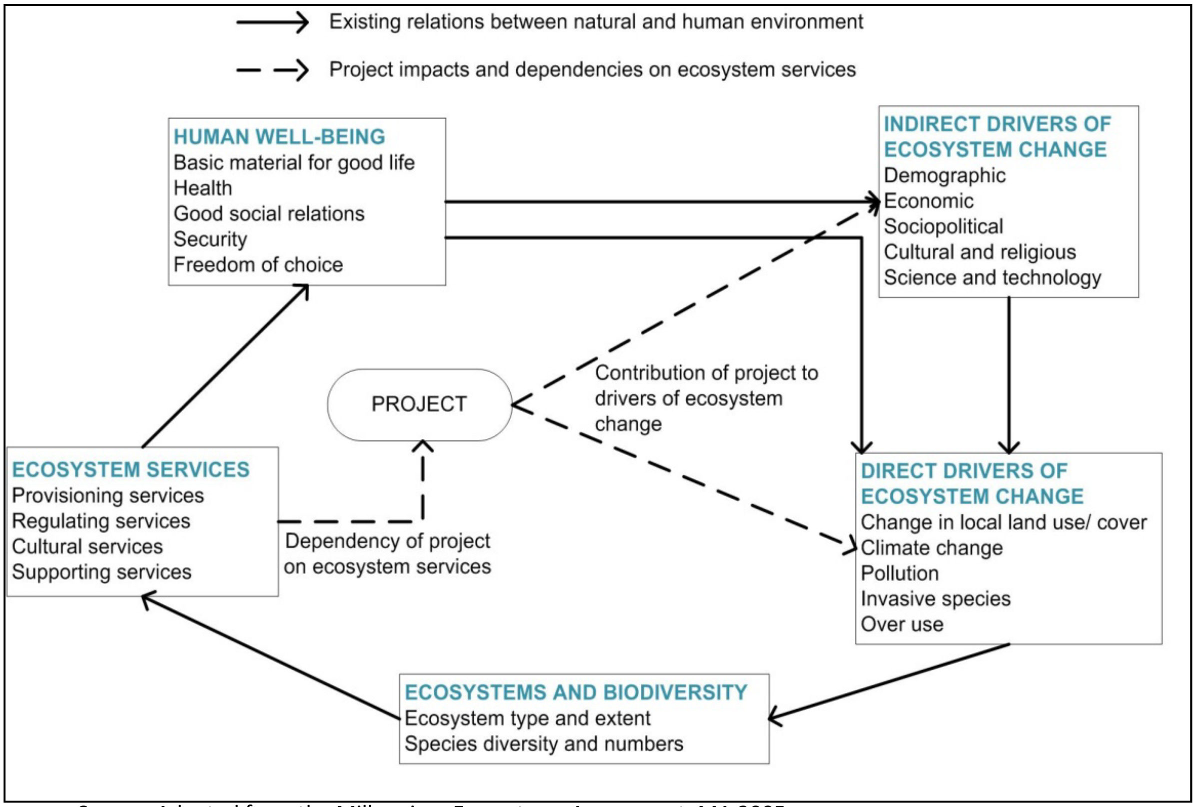
In the context of environmental impact assessments, the ecosystem services approach provides a more systematic and integrated assessment of project impacts and dependencies on ecosystem services and the consequence for the people who benefit from these services. It helps EIA practitioners to go beyond biodiversity and ecosystems to identify and understand the ways natural and human environment interrelates. This holistic understanding, from description of the Environmental Setting to the impact assessment, will lead the EIA practitioner through a new set of questions organized around the conceptual framework shown below:

- What are the ecosystem services important for local communities?
  - Which services will the project potentially impact in a significant way?
  - How does the impact on one ecosystem service affect the supply and use of other ecosystem services?
- What are the underlying level of biodiversity and the current capacity of the ecosystems to continue to provide ecosystem services?
- What are the consequences of these ecosystem service impacts on human well-being, for example what are the effects on livelihoods, income, and security?
- What are the direct and indirect drivers of ecosystem change affecting the supply and use of ecosystem services? How will the project contribute to these direct and indirect drivers of change?

Systematically examining all the boxes in the framework presented in Figure F-6 carries the following promises:

- Since ecosystem services by definition are linked to different beneficiaries, any ecosystem service changes can then be explicitly translated into a gain or loss of human well-being.
- It will highlight the impact on all important ecosystem services provided by the area such as erosion control, pollination, water regulation, and pollutant removal.
- It will ensure that the EIA accounts for the effects of the project on existing direct and indirect drivers of ecosystem change that in turn could impact the ecosystem services provided by the area.
- It will improve the project's management of risks and opportunities arising from ecosystem services.

Figure F-6: Conceptual framework to assess ecosystem services



Source: Adapted from the Millennium Ecosystems Assessment, MA 2005

8.1 Terrestrial Resources Impact Assessment Tools

Habitat-based approaches are commonly used to predict the impact of tourism development on terrestrial habitats. A habitat-based approach provides the ability to identify, document, predict, and compare anticipated changes in wildlife habitat for various development actions or alternatives. An example of a habitat-based approach is the Habitat Evaluation Procedures (HEP) developed by the US Fish and Wildlife Service. HEP provides a mechanism for predicting changes in quality and quantity of wildlife habitat for selected wildlife species over time under alternative future scenarios and for comparing environmental measures options. HEP relies on habitat suitability models that use measurements of important characteristics to rate habitat quality on a scale of 0 (unsuitable) to 1 (optimal). The index value is multiplied by the area of available habitat to determine habitat units under baseline and other scenarios. The HEP handbook is available online at http://www.fws.gov/policy/ESMindex.html

Predicted impacts on air and water quality, mechanical impacts on flora and fauna, and impacts of noise and light should then be graphically overlaid on the documented domains and ranges of plants and animals to assure that impacts are not likely to exceed those which might interfere with the long term health of impacted populations.

8.2 Aquatic Resources Impact Assessment Tools

The US Fish and Wildlife HEP approach can also be used for aquatic habitats. Development of other analytical models for assessment of aquatic resource impacts has primarily focused on establishing relationships between river flow and fish habitat quantity. Flow versus fish habitat models have generally been applied in situations of proposals for seasonal water storage and release associated with flood control or hydroelectric operation, and water diversions for irrigation, hydroelectric generation, and other water uses.

The models generally come in two types: standard setting and incremental. A standard setting model follows a fixed rule, and therefore, provides a single answer or “standard.” Standard setting models tend to be relatively generic (i.e., not site-specific), quick, and of low effort and cost. Incremental models predict a range of conditions for a range of inputs. Incremental models tend to be site-specific and of relatively high effort and cost to calibrate. Because incremental models provide a range of outputs, such models are useful where negotiations are desired or necessary. The need to evaluate the potential impacts to aquatic life of a tourism project is dependent of its proximity to rivers, lakes and other bodies of water. It is also dependent on if fishing or other water sports will be promoted in area. It may or may not be necessary to model the potential impacts depending on these factors. Table F-2 includes the most commonly used analytical models for assessment of aquatic resource impacts.

9 SOCIO-ECONOMIC-CONDITIONS, INFRASTRUCTURE AND LAND USE

When an activity, such as development or expansion of a tourism project is expected to accelerate social change at the local level, it is necessary to have detailed (sometimes household level) socio-economic and cultural data from the directly affected communities for the baseline, and to develop trend data to assess whether anticipated impacts will continue or alter those trends in a significant way.

Social impacts cannot usually be assessed through secondary data on infrastructure and social services. The results from detailed family level surveys, focus group discussions and key informant interviews, participant observation, stakeholder consultations, secondary data, and other direct data collection methods must be analyzed carefully (Joyce, 2001).

As data are collected, trends based on gender, age groups, economic status, proximity to the projects must be analyzed. This analysis can be accomplished using statistical models or, as what has been found more recently to be effective, the use of Geographical Information Systems (GIS). According to Joyce et al. (2001), the problem with using a strictly qualitative approach has issues:

- There is a greater difficulty of predicting social behavior and response as compared to impacts on the biophysical or biological elements, such as water or animals.
- The fact that social impacts are as much to do with the perceptions people or groups have about an activity as they are to do with the actual facts and substantive reality of a situation, and
- The fabric of social interactions and social well-being (today being recognized and labeled as “social capital”, which are in the end where many social impacts take place, can only be measured or evaluated through qualitative and participatory processes.
- As the causation gets more distant, it is less clear how directly responsible a given project or activity is for that impact and required environmental measures, and less clear how effective environmental measures taken by one player would be.

Again, according to Joyce, the measure of significance is the most difficult/critical part of socioeconomic impact assessment. Impacts must be described in terms of the level of intensity of an impact, the directionality (positive or negative), the duration, and its geographic extension. Significance is necessarily defined using professional judgment. Towards this end, categories of impacts are defined and a determination can be made as to what constitutes a short, medium and long term impact, and the reasons for the designation. This is where participation by the local population becomes important in determining what is significant to them particularly for socio-economic-cultural impacts. Section B.2 of these guidelines provide guidance on public participation and Appendix G includes example guidelines from the Dominican Republic on social impact assessment and the important role of public participation and consultation in that process.

Based on the significance of the impact(s) conclusions can be drawn and mitigation measures can be designed.

Other socioeconomic impacts which should be assessed include:

- **Land Use** -A tourism site if not restored properly can change the land use of an area forever. To understand the impacts of development of tourism projects on land use, it is important to be able to visualize and calculate potential changes which may occur. This can be done by developing maps which show pre-construction, operational and post-closure land use. In many countries, geographic information systems (GIS) are used extensively for this purpose. GIS captures, stores, analyzes, manages, and presents data that is linked to location. GIS applications are tools that allow users to create interactive queries (user created searches), analyze spatial information, edit data, maps, and present the results of all these operations. A GIS includes mapping software and its application with remote sensing, land surveying, aerial photography, mathematics, photogrammetry, geography, and other tools.
- **Population and Housing** - The key to understanding the potential impact to the local population and housing is having a good understanding the work force required for the operation. Simple calculations can then be made to determine changes in demographics over the life of the project.
- **Infrastructure Capacity** - Simple calculations comparing demands on roads, hospitals, wastewater treatment, water supply and waste management against capacity. However, these calculations must take into account direct demands from the project for every phase of the project including construction, operation and closure, demands from anticipated induced growth as an indirect impact of the proposed project and demands into the future in the absence of the project,
- **Employment** - Again having a good understanding of the work force required for each phase (construction, operation and closure) of a tourism project is required to determine what additional labor may be required for schools, hospitals, support industries, etc.
- **Transportation** - Transportation studies are required to determine impacts on traffic and roads due to commuting and the hauling of construction materials to the project site, delivery of fuel and removal of wastes if by rail, water or road, and increases in traffic associated with the work force servicing the project and providing support to that work force.
- **Public Health** - The potential for tourism project to impact communities is well documented in the literature. Tourism spread diseases to locals and visa or versa. Understanding the general health of community is important. In addition, the addition of tourist may stress local health services in an area.
- **Public Safety** - Additional traffic, construction activities, and other activities such as boating can impact public safety. In emergency situations such as earthquakes, tsunamis, or a volcanic eruption, the presence of tourist may impact the ability of a community to react.
- **Education** - Increase in worker population and their family may cause overcrowding of schools and impact education.

10 CULTURAL, ARCHEOLOGICAL, CEREMONIAL AND HISTORIC RESOURCES

Impacts are usually defined as direct or indirect alterations to characteristics of a cultural archeological, ceremonial or historic site or traditional use of a resource. Effects are adverse when the integrity is affected or the quality diminished. Impact assessment begins with overlaying all project activities on the map of cultural archeological, ceremonial or historic sites developed for the Environmental Setting, to identify all sites that may be directly impacted. In addition, noise, vibration and visibility (of and from the sites) impacts need to be estimated, using the results of the noise, vibration and visibility assessments discussed above. Impacts to historical and archeological sites and cultural resources are evaluated with respect to their magnitude and significance. For cultural resources, it is important to consider impacts that may affect the transmission and retention of local values. These potential impacts to the transmission and retention of local values may be caused by impacts to plants, animals, fish, geology and water resources that may be used for cultural purposes by certain populations for traditional purposes, as well as visual impacts.

11 VULNERABLE POPULATIONS

Vulnerable populations concerns are introduced in Chapter E section 4.5 as the potential of disproportionate high and adverse effects on certain populations, typically indigenous, minority and/or low income populations. Economic effects and cultural impacts are analyzed as part of the socioeconomic assessment and would include topics such as employment, revenue, economic development, etc. Environmental impacts are addressed in the environmental sections of the EIA. Special attention needs to be given to impacts that would most affect vulnerable populations and should be acknowledged. Generally, adverse impacts are more intense to the vulnerable populations, and the economic effects are usually greater.

There are two types of sources of impacts of concern related to vulnerable populations. The first type of impact derives from the differences in life style that might typically be found among indigenous peoples and minority groups. For example, these groups might rely more heavily on the affected environment for sustenance or have greater access to the environment which may increase their exposure to harmful substances where those are identified in the environmental impact assessment. Another context in which the analysis may be appropriate is to address minority and low income populations whose life styles or low income status may make them more vulnerable to adverse impacts. If they start with poor health or poor access to medical care, the impacts of adverse environmental impacts may fall more heavily on them. Often these populations live in locations in which many polluting sources may be co-located. They may lack the language or political access to represent their interests before the government. These populations are generally less resilient than the larger population's in the surrounding environment because of their economic circumstances in their ability to mitigate adverse impacts using their own resources.

12 HEALTH AND SAFETY IMPACT ASSESSMENT TOOLS

12.1 Health Impact Assessment Tools

Many studies have been done that link disease to the spread of diseases from tourists and workers to local communities. Table F-7 presents a partial list of such diseases that are commonly spread. The potential for the spread of disease can *impact* the basic health and vitality of a community. Tools which can be used to assess this potential impact include surveys which access the potential health of a community and its ability to cope with an outbreak do to the interaction of the local population with tourists. Such an assessment may take in to account proposed measures to reduce risks, but if that is done then the measures used to minimize or eliminate risk must be included in the mitigation measures section in terms that reflect commitment of the project operator to carry them out effectively. In addition, as mentioned earlier, dietary changes may occur to the local community due to the influence of tourists and outside workers. This potential also should be evaluated.

Table F- 7: Ease of spread of a range of diseases which can be transmitted from travelers to hosts and their level of impact on the host individual

EASE OF SPREAD	IMPACT ON HOST INDIVIDUAL*	DISEASES
High	Minor to Serious	• Sexually Transmitted Infections (STIs) • Gastro-intestinal Infections • Upper Respiratory Infections • Other Viral Infections
Medium	Minor to Serious	• Worm Infections (roundworms, tapeworms)
	Medium to Serious	• Cholera • Malaria • Dengue Fever • Yellow Fever • Filariasis • Leishmaniasis • Onchocerciasis • Oropouche Fever
	Serious	• AIDS • Other Viral Infections
Low	Medium	• Myiasis
	Medium to Serious	• Worm Infections (flukes)

*Key: Minor: acute illness with usually no complications, no or little temporary incapacitation, complete recovery
Medium: acute or chronic illness affecting an individual's ability to pursue the usual activities, complete recovery, no permanent incapacitation
Serious: acute or chronic illness with high possibility of serious or fatal complications, permanent incapacitation or disfiguration

Source: Bauer, 1999

12.2 Public Safety Impact Assessment Tools

Many of the models outlined above can be used to access the potential impacts to public safety. Hydrologic models can access the potential for flooding. Geologic models can determine the risk of landslide due to construction activities and transportation models can be used determine hazard from increase traffic due to resort development. Because emergency situations due to earthquakes, tsunamis, volcanic eruptions and others can occur at any time, an assessment should be made to determine the communities and resorts ability to cope with a disaster.

Because worker safety during construction and operation of a resort is also a concern, safety evaluations should be completed on a regular basis to ensure that the operation is in compliance with national regulations. These assessments should include not limited to factors leading to:

- Exposure to dust, noise, and chemicals
- Handling of chemicals
- Accidents while working with heavy or other equipment

13 CUMULATIVE IMPACTS ASSESSMENT METHODS

Predictive tools and methods used for cumulative impact assessment are similar to those used to predict impacts generally, but the input parameters are different in that they include all past, present and predicted future actions affecting the resource. The analysis is focused and applied where it is most useful through a process of identifying which resources may be significantly affected and applying more detailed assessments to those resources for which cumulative impact assessment is most important.

Three general steps, are recommended to ensure the proper assessment of cumulative impacts.

Step 1. Determination of the extent of cumulative impacts

a. Identify potentially significant cumulative impacts associated with the proposed activity;
b. Establish the geographic scope of the assessment;
c. Identify other activities affecting the environmental resources of the area; and
d. Define the goals of the assessment.

Step 2. Description of the affected environment

a. Characterize the identified environmental resources in terms of their response to change and capacity to withstand stress;
b. Characterize the stresses affecting these environmental resources and their relation to regulatory thresholds; and
c. Define a baseline condition that provides a measuring point for the impacts to the environmental resources.

Step 3. Assessment of cumulative impacts

a. An identification of the important cause-and-impact relationships between proposed activity and the environmental resources;
b. A determination of the magnitude and significance of cumulative impacts; and
c. The modification, or addition, of alternatives to avoid, minimize or mitigate significant cumulative impacts.

In reviewing cumulative impacts analysis, the United States EPA reviewers focus on the specific resources and ecological components that can be affected by the incremental effects of the proposed project and other actions in the same geographic area (USEPA, 1999). In general, reviewers focus on four main aspects. These include:

1. Resource and Ecosystem Components
2. Geographic Boundaries and Time Period
3. Past, Present, And Reasonably Foreseeable Actions
4. Using Thresholds to Assess Resource Degradation

The following presents a brief description of these.

13.1 Resource and Ecosystem Components

An EIA analysis should identify the resources and ecosystem components cumulatively impacted by the proposed action and other actions. In general, the reviewer determines which resources are cumulatively affected by considering:

1. Whether the resource is especially vulnerable to incremental effects;
2. Whether the proposed action is one of several similar actions in the same geographic area;
3. Whether other activities in the area have similar effects on the resource;
4. Whether these effects have been historically significant for this resource; and
5. Whether other analyses in the area have identified a cumulative effects concern.

The analysis should be expanded for only those resources that are significantly affected. In similar fashion, ecosystem components should be considered when they are significantly affected by cumulative impacts. The measure of cumulative effects is any change to the function of these ecosystem components. Therefore, EIA documents should consider only a limited number of resources that may be potentially affected by cumulative impacts.

To ensure the inclusion of the resources that may be most susceptible, cumulative impacts can be anticipated by considering where cumulative effects are likely to occur and what actions would most likely produce cumulative effects.

The EIA document should identify which resources or ecosystem components of concern might be affected by the proposed action or its alternatives within the project area. Once these resources have been identified, consideration should be given to the ecological requirements needed to sustain the resources. It is important that the EIA document consider these broader ecological requirements when assessing how the project and other actions may cumulatively affect the resources of concern. Often these ecological requirements may extend beyond the boundaries of the project area, but reasonable limits should be made to the scope of the analysis.

13.2 Geographic Boundaries and Time Period

With the resources identified, the EIA will need to identify the appropriate geographic and temporal scope of analysis for those resources. Without spatial boundaries (geographic), a cumulative effects assessment would be global, and while this may be appropriate for some issues such as global climate change, it is not appropriate for most other issues. The EIA should briefly describe how those resources might be cumulatively affected and explain the geographic scope of analysis.

To determine spatial boundaries, consideration must be given to the distance the effect can travel in the context of resource effects from other activities that might affect a wide area. Specifically, the EIA should:

- Describe how it determined the area(s) that will be affected by the proposed action (impact zone).
- List the cumulative effects resources within that area that could be affected by the proposed action.
- Determine the geographic area outside of the impact zone that is occupied by those resources.
- Consider the management plans and jurisdictions of other agencies for the cumulatively affected resource.

The EIA should:

- Discuss the location of other projects and major developmental activities within the area.
- Include a schematic diagram of these developments and/or list them in a table.
- Briefly describe how the proposed project interacts, affects, or is affected by, these other resource developments.

The length of discussion should reflect the significance of the interaction. Include details of the effects of these interactions in the Anticipated Impacts section.

13.3 Describing the Condition of the Environment

The EIA analysis should establish the magnitude and significance of cumulative impacts by comparing the environment in its naturally occurring state with the expected impacts of the proposed action when combined with the impacts of other actions. Use of a "benchmark" or "baseline" for purposes of comparing conditions is an essential part of any environmental analysis. If it is not possible to establish the "naturally occurring" condition, a description of a modified but ecologically sustainable condition can be used in the analysis. In this context, ecologically sustainable means the system supports biological processes, maintains its level of biological productivity, functions with minimal external management, and repairs itself when stressed.

While a description of past environmental conditions is usually included in EIA documents, it is seldom used to fully assess how the system has changed from previous conditions. The comparison of the environmental condition and expected environmental impacts can be incorporated into the Anticipated Impacts section of EIA documents. EIA reviewers should determine whether the EIA analysis accurately depicts the condition of the environment used to assess cumulative impacts. In addition, reviewers should determine whether EIA documents incorporate the cumulative effects of all relevant past activities into the Anticipated Impacts section. For the evaluation of the environmental consequences to be useful, it is important that the analysis also incorporate the degree that the existing ecosystem will change over time under each alternative.

Different methods of depicting the environmental condition are acceptable. The condition of the environment should, however, address one or more of the following:

1. How the affected environment functions naturally and whether it has been significantly degraded;
2. The specific characteristics of the affected environment and the extent of change, if any, that has occurred in that environment; and
3. A description of the natural condition of the environment or, if that is not available, some modified, but ecologically sustainable, condition to serve as a benchmark.

Two practical methods for depicting the environmental condition include use of the no-action alternative and an environmental reference point. Historically, the no-action alternative (as reflecting existing conditions) has usually been used as a benchmark for comparing the proposed action and alternatives to existing conditions. The no-action alternative can be an effective benchmark if it incorporates the cumulative effects of past activities and accurately depicts the condition of the environment.

Another approach for describing the environmental condition is to use an environmental reference point that would be incorporated into the Anticipated Impacts section of the document. The natural condition of the ecosystem, or some modified but sustainable ecosystem condition, can be described as the environmental reference point. In analyzing environmental impacts, this environmental reference point would not necessarily be an alternative. Instead, it would serve as a benchmark in assessing the environmental impacts associated with each of the alternatives. Specifically, the analysis would evaluate the degree of degradation from the environmental reference point (i.e., natural ecosystem condition) that has resulted from past actions. Then the relative difference among alternatives would be determined for not only changes compared to the existing condition but also changes critical to maintaining or restoring the desired, sustainable condition.

Determining what environmental condition to use in the assessment may not be immediately clear. Choosing and describing a condition should be based on the specific characteristics of the area. In addition, the choice of condition can be constrained by limited resources and information. For these reasons, the environmental condition described by the environmental reference point or no-action alternative should be constructed on a case-by-case basis so that it represents an ecosystem able to sustain itself in the larger context of activities in the region. In this respect, there is no predetermined point in time that automatically should represent the environmental condition. In addition, it may not be practical to use a pristine condition in many situations.

Depending on whether the information is reasonably obtainable, the environmental condition chosen may be a pristine environment, or at the very least, a minimally functioning ecosystem that will not further degrade. The use of the environmental condition to compare alternatives is not an academic exercise, but one that can most effectively modify alternatives and help decision making. Examples of conditions might include before project, before "substantial" development, or a reference ecosystem that is comparable to the project area. Selecting the best environmental condition for comparative purposes can be based on the following:

1. Consider what the environment would look like or how it would behave without serious human alteration;
2. Factor in the dynamic nature of the environment;
3. Define the distinct characteristics and attributes of the environment that best represent that particular type of environment (focus on characteristics and attributes that have to do with function); and
4. Use available or reasonably obtainable information.

13.4 Using Thresholds to Assess Resource Degradation

Qualitative and quantitative thresholds can be used to indicate whether a resource(s) of concern has been degraded and whether the combination of the action's impacts with other impacts will result in a serious deterioration of environmental functions. In the context of EPA reviews, thresholds can be used to determine if the cumulative impacts of an action will be significant and if the resource will be degraded to unacceptable levels. EIA reviewers should determine whether the analysis included specific thresholds required under law or by agency regulations or otherwise used by the agency. In the absence of specific thresholds, the analysis should include a description of whether or not the resource is significantly affected and how that determination was made.

Since cumulative impacts often occur at the landscape or regional level, thresholds should be developed at similar scales whenever possible. Indicators at a landscape level can be used to develop thresholds as well as assess the condition of the environment. Using the following landscape indicators, thresholds can be crafted by determining the levels, percentages, or amount of each that indicate a significant impact for a particular area. Examples of thresholds include:

The total change in land cover is a simple indicator of biotic integrity; thresholds for areas with high alterations would generally be lower than areas that are not as degraded; if open space or pristine areas are a management goal then the threshold would be a small percentage change in land cover.

Patch size distribution and distances between patches are important indicators of species change and level of disturbance. Thresholds would be set to determine the characteristics of an area needed to support a given plant or animal species.

Estimates of fragmentation and connectivity can reveal the magnitude of disturbance, ability of species to survive in an area, and ecological integrity. Thresholds would indicate a decrease in cover pattern, loss of connectivity, or amount of fragmentation that would significantly degrade an area.

Determining a threshold beyond which cumulative effects significantly degrade a resource, ecosystem, or human community is sometimes very difficult because of a lack of data. Without a definitive threshold, the EIA practitioner should compare the cumulative effects of multiple actions with appropriate national, regional, state, or community goals to determine whether the total effect is significant. These desired conditions can best be defined by the cooperative efforts of agency officials, project proponents, environmental analysts, non-governmental organizations, and the public through the EIA process. The integrity of historical districts is an example of a threshold that is goal related. These districts, especially residential and commercial historic districts in urban areas, are particularly vulnerable to clearance programs carried out by local governments, usually with use of federal funds. Though individual structures of particular architectural distinction are often present, such districts are important because they are a collection of structures that relate to one another visually and spatially; the primary importance of each building is the contribution that it makes to a greater whole. Often in conjunction with code enforcement programs to remove blighting influences and /or hazards to public safety, local governments condemn and demolish properties. Viewed in isolation as an individual action, such demolition of an individual structure does not significantly diminish the historic and architectural character of the district and indeed may be beneficial to the overall stability of the district. But the cumulative effect of a whole series of such demolitions can significantly erode the district. Continued loss of historic structures, often with resultant vacant lots and incompatible new construction, can reach a point where the visual integrity of the district is lost. Once this threshold is passed, subsequent demolitions become increasingly difficult to resist and ultimately the qualities of the historic district are lost.

Table F- 8: Primary and special methods for analyzing cumulative impacts

PRIMARY METHODS	DESCRIPTION	STRENGTHS	WEAKNESSES
1 Questionnaires, interviews, and panels	Questionnaires, interviews and panels are useful for gathering the wide range of information on multiple actions and resources needed to address cumulative effects. Brainstorming sessions, interviews with knowledgeable individuals, and group consensus building activities can help identify the important cumulative effects issues in the region.	▪ Flexible ▪ Can deal with subjective information	▪ Cannot quantify ▪ Comparison of alternatives is subjective
2 Checklists	Checklists help identify potential cumulative effects by providing a list of common or likely effects and juxtaposing multiple actions and resources; potentially dangerous for the analyst that uses them as a shortcut to thorough scoping and conceptualization of cumulative effects problems.	▪ Systematic ▪ Concise	▪ Can be inflexible ▪ Do not address-interactions or cause- effect relationships
3 Matrices	Matrices use the familiar tabular format to organize and quantify the interactions between human activities and resources of concern. Once even relatively complex numerical data are obtained, matrices are well-suited to combining the values in individual cells of the matrix (through matrix algebra) to evaluate the cumulative effects of multiple actions on individual resources, ecosystems, and human communities.	▪ Comprehensive presentation ▪ Comparison of alternatives ▪ Address multiple projects projects	▪ Do not address space or time ▪ Can be cumbersome ▪ Do not address cause-effect relationships
4 Networks and System Diagrams	Networks and system diagrams are an excellent method for delineating the cause-and-effect relationships resulting in cumulative effects; they allow the user to analyze the multiple, subsidiary effects of various actions and trace indirect effects to resources that accumulate from direct effects on other resources.	▪ Facilitate-conceptualization ▪ Address cause – effect relationships ▪ identify indirect effects	▪ No likelihood for secondary effects ▪ Problem of comparable units ▪ Do not address space or time
5 Modeling	Modeling is a powerful technique for quantifying, the cause-and-effect relationships leading to cumulative effects, can take the form of mathematical equations describing cumulative n processes such as soil erosion, or may constitute an expert system that computes the effect of various project scenarios based on a program of logical decisions.	▪ Can give unequivocal results ▪ Addresses cause – effect relationships ▪ Quantification ▪ Can integrate time and space	▪ Need a lot of data ▪ Can be expensive ▪ Intractable with many interactions
6 Trends Analysis	Trends analysis assesses the status of a resource, ecosystem, and human community over time and usually results in a graphical projection of past or future conditions. Changes in the occurrence or intensity of stressors over the same time period can also be determined. Trends can help the analyst identify cumulative effects problems, establish appropriate environmental baselines, or project future cumulative effects.	▪ Addresses accumulation over time ▪ Problem identification ▪ Baseline determination	▪ Need a lot of data in relevant system ▪ Extrapolation of system thresholds is still largely subjective

PRIMARY METHODS	DESCRIPTION	STRENGTHS	WEAKNESSES
7 Overlay Mapping	Overlay mapping and geographic information systems (GIS) incorporate location information into cumulative effects analysis and help set the boundaries of the analysis, analyze landscape parameters, and identify areas where effects will be greatest. Map overlays can be based on either on either the accumulation of stresses in certain areas or on the suitability of each land unit for development.	▪ Addresses spatial pattern and proximity of effects ▪ Effective visual presentation ▪ Can optimize development options	▪ Limited to effects based on location ▪ Do not explicitly address indirect effects ▪ Difficult to address magnitude of effects
8 Ecosystem Analysis	Ecosystem analysis explicitly addresses biodiversity and ecosystem sustainability. The ecosystem approach uses natural boundaries (such as watersheds and eco-regions) and applies new ecological indicators (such as indices of biotic integrity and landscape pattern). Ecosystem analysis entails the broad perspective and holistic thinking that are required for successful cumulative successful cumulative effects analysis.	▪ Uses regional scale and full range of components and interactions ▪ Addresses space and time ▪ Addresses ecosystem sustainability	▪ Limited to natural systems ▪ Often requires species surrogates for system= ▪ Data intensive ▪ Landscape ecosystem indicators still under development
9 Economic Impact Analysis	Economic impact analysis is an important component of analyzing cumulative effects because the economic well-being of a local community depends on many different actions. The three primary steps in conducting an economic impact analysis are (1) establishing the region of influence, (2) modeling the economic effects, and (3) determining the significance of the effects. Economic models play an important role in these impact assessments and range from simple to sophisticated.	▪ Addresses economic issues ▪ Models provide definitive quantified results	▪ Utility and accuracy of results dependent on data quality and model assumptions ▪ Usually do not address nonmarket values
10 Social Impact Analysis	Social impact analysis addresses cumulative effects related to the sustainability of human communities by (1) focusing on key social variables such as population characteristics, community and institutional structures, political and social resources, individual and family changes, and community resources; and (2) projecting future effects using social analysis techniques such as linear trend projections, population multiplier methods, scenarios, expert testimony, and simulation modeling.	▪ Addresses social issues ▪ Models provide definitive, quantified results	▪ Utility and accuracy of results dependent on data quality and model assumptions ▪ Social values are highly variable

14 CARRYING CAPACITY

Carrying capacity broadly refers to limits of levels of activity or tolerances beyond which a resource cannot sustain its intended use. In the context of tourism it is often used to refer to the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions that complement the purpose of concession, park, coastal area, or a sensitive ecosystem area.

There are no standard, scientifically available models for defining carrying capacity and the process relies heavily on professional judgment and individual circumstances. The overall process involves:

1. Examination of the needs and goals with an interdisciplinary team
2. Examination of the changes in use patterns

3. Assessment of the problems and threats facing the resource and proposed new activities
4. Identification of the most limiting variable to define limits
5. Identification of the greatest vulnerabilities, both specially and temporally.

At least in concept, carrying capacity is an important aspect of determining environmental impact of a tourism development. According to Cole (2005) of the United States National Park Service, it is important to have an understanding of the temporal and spatial distribution of visitor use as well as having an understanding of distributions optimal not only to enhance visitor experience, but also to provide protection to the resource and the environment. To meet these objectives it is important to develop methodologies not only to predict impacts but also to define indicators that are specific, measurable physical, ecological and social variables that reflect the overall condition of an area and can be used to access the impacts of visitors to a site. These in turn can be used to determine the carrying capacity of a specific area. However, data are often limited in terms of use, lengths of stay in various areas, crowding, underused or overused facilities, and other factors related to the health and wellbeing of an ecosystem, habitat, and/or species. And, regardless of how effectively carrying capacity may be assessed, there is general agreement that it is a dynamic process, requiring monitoring of impacts and adjustment of acceptable visitation and use.

Literature on carrying capacity is quite extensive. But determining how much decline or change is appropriate to sustain a viable touristic resource is a challenge in determining carrying capacity. This is particularly true where a sensitive ecological area has not been formally designated as a park or wilderness area and therefore there are no goals adopted for maintaining the ecosystem. One such measure which has been developed for public parks is known as “limits of acceptable change” (LAC) which is fundamental to addressing carrying capacity (USNPS, 1997) The basic logic of the of the LAC process according the US National Park Service is:

- Identification of goals in conflict. These goals may be protection of the environment conflicted by unrestricted access to a resource for recreational use. Two goals are often evaluated at a time.
- Establish how goals can be compromised. Determine if one or both goals can be compromised to meet objectives.
- Determine which goal will ultimately constrain the other. The goal of protecting the environment will almost always constrain unrestricted access.
- Develop LAC standards that express minimally acceptable conditions for the environment and for visitors.
- Compromise goals until standards are reached. Allow the environmental conditions and visitor experiences to degrade only to an acceptable standard.
- Compromise only to a point. Once standards for environmental conditions are met and visitor experiences are reach allow no more degradation.

Such an approach is viable if there is an on-going project or park where data can be collected and analyzed. However, problems do occur where sensitive areas are in the process of being developed in which case this dynamic approach has more limited applicability to prediction of impacts.

In most instances, sophisticated models are not employed, but rather professional judgment and assessment of the life cycles and threats to particular species are used to identify the most sensitive species and activities in both time and space. This will then be used to determine what activities; both temporally and specially may be supported.

Nevertheless, models have been developed to evaluate "carrying capacity" of wilderness areas as well as other touristic attractions. According to Cole (2005), the challenge of simulation modeling is to capture the essential behavior of the system being modeled. In outdoor recreation, this means capturing and representing the characteristics of the physical environment (for example, a system of trails, roads, waterways, and/or facilities), the biological environment (the species most sensitive to noise, activity, etc. mating and breeding season information, and modeling the behavior of visitors as they interact with the environment and with each other. Again according to Cole (2005), models have three components: (1) input variables that describe the system being modeled, (2) software and associated modeling approaches designed to process these input variables, and (3) output variables that are useful to planners, managers, and scientists. Models available are presented in Table F-9.

Table F- 9: Carrying capacity models

MODEL TYPE	DESCRIPTION	DESIGN FEATURES
Trace, Probabilistic and Rule-Based Agent simulations	Trace simulations directly simulate travel itineraries collected in the field. Visitor arrival, trip itineraries, and duration of stay at destinations are simulated directly from survey data rather than using probability distributions or random numbers. These simulations are useful for examining existing pattern of use.	Probabilistic simulation models are based on a representative sample of visitor trip itineraries. Probability models are the standard method for modeling baseline conditions. Probabilistic simulation assumes that the distribution of trip itineraries in the future will remain similar to the distribution today, regardless of how the system changes. Decision may be based due attractions such as scenic views, interpretive centers, picnic areas, or playfields, and detractors such as hazardous areas, extreme weather events, or other environmental factors that would constrain movement or cause visitors to avoid an area.
Terminating and Steady-State Simulations	A second important choice in simulation modeling approaches is whether to design simulations to be terminating or non -terminating (steady-state). Terminating simulations model events that have a specified length, while a steady-state simulation models situations in which there is no natural event to specify the length of a simulation run. A terminating simulation has a known initial state (usually zero) and a known ending state. For day use issues, it is clearly appropriate to use terminating simulations to describe what happens over a given day.	This type of situation might be modeled using a steady-state simulation. A simulation is called steady-state because the simulation, after an initial "warm up" period, is designed to replicate system behavior over the long run at a given level of production or capacity. Steady-state simulations are more challenging to conduct and analyze. They must be run over long periods to get a reliable average measure of system behavior that is not biased by short-term effects of random variables and auto-correlation.
General Purpose Simulation Software and Special Purpose Simulators:	Commercially available general purpose simulation software packages are usually developed with business, industry, and government applications in mind. However, it is possible to use this general software to model outdoor recreation behavior. Commercially available general purpose simulation software packages are usually developed with business, industry, and government applications in mind. However, it is possible to use this general software to model outdoor recreation behavior.	Several of the case studies described in the next chapter have adapted the simulation software; Extend developed by Imagine That, Inc., to recreational applications. Special purpose simulators, however, are developed specifically to handle specialized applications. Special-purpose Simulators have been designed to build simulations of recreation behavior on linear networks. Special-purpose simulators will have more automated features specific to the application of concern. General-purpose simulation software can also be modified to include automated features specific to the application of concern (modeling outdoor recreation.)

Source: Based on Cole 2005

G. MITIGATION AND MONITORING MEASURES

1 INTRODUCTION

Mitigation measures, sometimes referred to as “environmental measures,” are actions that can be taken to avoid, minimize, prevent and/or compensate for the impacts caused by Tourism projects. They can, among other actions, involve applying pollution control or prevention technologies, the replacement or relocation of impacted resources and the relocation of displaced persons. To elaborate on some of the basic concepts behind mitigation or environmental measures:

- Avoidance: Project proponents should be encouraged to avoid adverse impacts through good choice of location, site planning and engineering design and to focus mitigation measures on those adverse impacts that are otherwise unavoidable. Such environmental measures should be clearly explained early in the EIA process, and should include operational, monitoring and response plans should unexpected impacts occur.

- Mitigation: The consideration of mitigation of the impacts is necessary for all phases of construction, operation and closure in which adverse impacts cannot be avoided. It is important that the EIA identify and define all mitigation measures for a specific project. A mitigation measure could be the selection of a project site or design option that avoids a sensitive resource, different pollution control measures or processes or even resizing or phasing in construction in a different manner that may reduce, minimize or prevent impacts. To the extent that this may not be feasible, mitigation may also include measures to compensate for damages, losses or reduced value of resources. Results of monitoring may trigger further mitigation action if these results indicate there are problems that were not anticipated in the EIA.

- Compensation: In some circumstances compensation may be an acceptable means of addressing negative impacts. For socio-economic-cultural impacts such measures are used to compensate for economic loss or for the physical relocation of a population whether intended or incidental to the consequences of a proposed project in the form of remuneration for loss of income by farmers or fishermen , stipends for physical relocation, land swaps or actual provision of alternative housing. For physical resources such mitigation measures might also include land swaps or access to alternative water supplies. For biological resources compensation is a more complex undertaking, requiring a scientifically based likelihood of success and equal or more ecological value Compensation is usually considered a last resort because the intrinsic values of human communities, cultures and ecosystem functions are not entirely fungible and there has had limited success in reconstructing habitat and relocating flora and fauna. Progress has been made in identifying the factors which can lead to success in compensation schemes but all require careful assessment and ongoing management.

- Justification: The EIA should identify, define, quantitatively assess and provide technical and financial bases for all environmental measures proposed, particularly if there is a concern about the site or proposed measures are less than best available practices.

- Performance Standards: In the development of an EIA it is important that, wherever possible, quantitative performance standards are established. These standards should be clearly presented in the EIA. Environmental standards with which compliance is to be demonstrated should be based on local standards and in the absence of such standards, should be based on international norms. Examples of performance standards and requirements for countries and international organizations are presented in Appendix C to Volume 2 of these Guidelines.

- Financial Assurance of ability to sustain environmental measures and to implement corrective measures in the event of impacts in excess of those allowed also may need to be demonstrated depending upon the requirements of the country or institution.

- Contingency Plans: The identification and development of plans to address risks is an important part of the EIA process. Three types of contingency plans are identified including plans to respond to monitoring results which demonstrate that a standard or quantitative performance limit has been exceeded; response to natural disasters such as risks of flooding, mudslides, earthquakes and volcanic eruptions, fires, spills, hurricanes, tsunamis and the like; and response to other types of risks.

- Best Practices/Sustainable Development Standards: Best practices have been developed by various international and domestic organizations to both avoid and minimize adverse impacts. In the realm of tourism, they are often accompanied by industry certification programs that can attract tourists to environmentally and socially responsible" tourist developments (Appendix C). Governments may already require some of these practices but often they are voluntary. Increasingly social and economic pressure is favoring such establishments. In the context of EIA, some or all of these best practices might be integrated in project proposals and alternatives under consideration. The information on mitigation measures includes but is not limited to best practices.

However defined, one of the important outcomes of the EIA process is the commitment made to implement measures to avoid or otherwise mitigate adverse impacts and to ensure that they are carried out effectively. The particular language used to define and commit to implementing environmental measures, to achieving reasonably anticipated effectiveness and with appropriate timing is critical to successful outcomes, as are accompanying requirements for monitoring, reporting and record keeping. Mitigation measures should be auditable, and something government inspectors can confirm is in compliance. Countries vary as to whether it is the EIA document itself that includes the commitments for which project proponents are accountable or whether they are included in accompanying documents related to the EIA process, or incorporated into legally binding permits or licenses. Regardless of the vehicle, if the commitments are unclear or the basis for ensuring their effectiveness difficult to establish, the beneficial outcomes of the EIA process will not be secured.

Monitoring, and associated reporting, in the context of the EIA process, may be carried out to establish an appropriate baseline for impact assessment and/or for providing assurance that the mitigation measures are effective in achieving the level of performance attributed to them in the EIA. To support this requirement an environmental monitoring plan should be developed by the project proponent and approved by the government agency and other organizations having jurisdiction over project performance. Whether this is part of the mitigation chapter of the EIA or developed as part of a separate environmental management plan will depend on the specific country requirements.

The scope and extent of monitoring depends upon various aspects of the construction, operation and closure of the project and resultant impacts. The monitoring plan should clarify, in the form contingency plans, that results of compliance monitoring and reporting may trigger further action if results indicate there are problems that were not anticipated in the EIA. For example, monitoring may show that the environmental impacts are greater than the estimates in the EIA or that the mitigation measures were not as effective as anticipated. Monitoring plans are addressed in detail in subsection G.6, Monitoring and Oversight.

2 GENERAL MITIGATION AND MONITORING MEASURES

This subsection presents several mitigation and monitoring measures that may be generally applicable for tourism projects. It is unlikely that all of these measures presented here will be applicable to a specific proposed facility. The proposed facility technology, location and design, in addition any regulatory agency requirement, will determine the appropriate measures for a particular project. Mitigation measures including practices, goals, and policies for various activities as well as monitoring practices to ensure that development is done in an environmentally sound basis are presented in Tables G-1 through G-4. Tables G-1 through G-3 present a comprehensive list of mitigation and monitoring measures for impacts to the physical and biological environment common to the construction (G-1), operation (G-2) and decommissioning (G-3) of tourism projects. Table G-4 presents general mitigation measures for socio-economic impacts of tourism projects.

Table G-1: Mitigation and monitoring measures for physical and biological impacts common to construction of most tourism projects

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
SITE PREPARATION AND CONSTRUCTION ACTIVITIES			
Land clearing, earthmov-ing, terrain shaping (leveling, drainage, etc.) and associated activities (e.g., borrow pits, quarries)	Geology	**Landslide Hazards** • Identify and avoid unstable slopes and factors that can cause slope instability (groundwater conditions, precipitation, seismic activity, slope angles, and geologic structure). • Avoid creating excessive slopes during excavation and blasting operations. Obtain borrow material only from authorized and permitted sites.	• Perform regular site inspections to ensure that landslide areas are being avoided
	Oceanography	**Disturbance to Shoreline Structure** • Map impact areas and adjust accordingly • Minimize removal of shoreline stabilizing beach vegetation • Design without knowledge of shoreline processes can result in undesirable erosion and deposition patterns	• Perform regular site inspections • Monitor test plots which prevent entry compared vegetative cover to accessible areas

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING

	Soil	**Erosion and Soil Compaction**
		• Minimize the amount of land to be disturbed and vegetation to be removed.
		• Avoid locating facilities on steep slopes, in alluvial fans and other areas prone to erosion, landslides or flash floods.
		• Minimize design changes to existing topography.
		• Design runoff control features to minimize soil erosion.
		• Use special construction techniques in areas of steep slopes and erodible soils
		• Stage site clearance work so as to minimize the area of soil exposed at any time
		• Schedule land disturbing activities to avoid periods of heavy rainfall and reduce or halt operations during heavy rainfall episodes.
		• Remove, store and reuse topsoil to reclaim disturbed areas.
		• Contour exposed slopes.
		• Reestablish the original grade and drainage pattern to the extent practicable.
		• Restore or apply protective covering on disturbed soils as quickly as possible.
		  ○ Mulch or cover exposed areas.
		  ○ Promptly revegetate exposed areas with fast growing indigenous grasses.
		  ○ Temporarily berm exposed soil and redirect flows from heavy runoff areas that threaten to erode or result in substantial turbid surface runoff to adjacent fresh or marine waters.
			• Monitor areas of exposed soil during periods of heavy rainfall throughout construction phase to ensure that any incidents of erosion are quickly controlled
			• Monitor surface water periodically for turbidity and total suspended solids

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
		Soil Contamination from Spills and Fuel Leaks • Prepare a comprehensive list of all hazardous materials to be used, stored, transported, or disposed of during all phases of construction activity. • Design containment for storage, handling and dispensing of hazardous materials, including fuels, oils, greases, solvents and residues. • Prepare a Spill Prevention and Response Plan for storage, use and transfer of fuel and hazardous materials. • Train workers on the Spill Prevention and Response Plan • Provide onsite portable spill management, control and cleanup equipment and materials. • Containerize and periodically remove wastes for disposal at appropriate off-site permitted disposal facilities, if available. • Document accidental releases as to cause, corrective actions taken, and resulting environmental or health and safety impacts.	• Perform site inspection to identify drums that are leaking, oil sheen on puddled water, and organics in water
		Disposal of Cleared Debris • Require contractor to designate debris management areas; separating natural materials from those requiring licensed disposal • Ban burning of debris on-site • Dispose of cleared debris at an existing, approved disposal site or onsite in accordance with regulatory requirements. • Where allowed, lop or chip and scatter vegetative material and use as mulch to help control erosion and return nutrients to the soil.	• Perform routine inspections • Monitor air quality for particulate matter using high volume samplers.

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Water Quality	**Modification of Drainage Patterns** **Increased Runoff and Sedimentation** Same measures as Soil Erosion plus: • Properly direct (via channels, culverts and swales) and or impound run-off, and install energy dissipation devices where water velocities may be high enough to cause erosion or scouring. • Separate clean and sediment laden run-off flows so as to minimize the volume of water that will be treated. • Install drainage structures, check dams and silt fences to prevent or reduce offsite run-off if high rainfall periods cannot be avoided. • Clean and maintain drainage ditches and catch basins regularly. • Line deep channels and steep slopes with stabilizing materials. • Provide sanitary latrines.	• Perform a routine site inspection identifying areas of erosion and sedimentation. • Monitor turbidity and total suspended solids in surface water
		Water Contamination from Spills and Fuel Leaks Same measures as Soil Contamination from Spills and Fuel Leaks	• Same as Soil Contamination from Spills and Fuel Leaks

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Air Quality	**Dust** • Minimize disturbed areas. • Surface access roads and on-site roads with aggregate materials, wherever appropriate. • Use dust abatement techniques on unpaved and unvegetated surfaces to minimize airborne dust during earthmoving and blasting activities and prior to clearing, excavating, backfilling, compacting and grading. • Use blast blankets to reduce fly rock and dust emissions. • Keep soil moist and below the freeboard while loading into dump trucks. • Tighten gate seals and on dump trucks and cover dump trucks before traveling on public roads. • Cover construction materials and stockpiled soils if they are a source of fugitive dust. • Train workers to handle construction materials and debris to reduce fugitive emissions. • Post and enforce speed limits to reduce airborne fugitive dust from vehicular traffic. • Reestablish vegetation of disturbed areas as soon as possible after disturbance with timeframes set in the EIA.	• Monitor air quality for particulates using high volume samplers
		Equipment Emissions • Consider fuel efficiency, types of fuels, and emissions controls in the selection of equipment. • Assure proper tuning and carburetion of engines. • Check fuel supplies for impurities or adulteration.	• Monitor air quality for NOx, CO_2, and other parameters
		Other • Place signs and placards about wildfire conditions • Penalized people living near or on protective for burning slash and garbage • Prohibit uncontrolled burning of any type.	• Perform routine site inspections

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Noise and Vibration	• Locate facilities more than 0.8km from sensitive noise receptors (e.g., quiet recreation, churches, medical care facilities, schools, child care facilities, parks, residences, wildlife areas). • Locate facilities to take advantage of the natural topography as a noise buffer. • Acquire lands to serve as noise buffers around the proposed facilities. Use noise absorbing vegetative walls or physical barriers and other forms of noise insulation • Use barriers and shields during blasting or pile driving and operation of pneumatic equipment such as jackhammers. • Route the movement of heavy equipment and construction materials as far as possible away from residences and other sensitive receptors. • Identify pile driving areas • Prepare a Noise Monitoring and Mitigation Plan. • Train workers in Noise Monitoring and Mitigation Plan. Equip and train workers with personal noise protection • Limit noisy activities (e.g., use of heavy equipment and blasting) to the least noise-sensitive times of day (weekdays only between 8 a.m. and 7 p.m.). • Equip engines with properly designed and installed mufflers. • Notify nearby residents in advance when blasting or other noisy activities are required. • Whenever feasible, schedule different noisy activities (e.g., blasting and earthmoving) to occur at the same time.	• Implement noise monitoring to verifying construction phase noise levels

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Aesthetics	**Disruption of Views and Landscapes** • Avoid locating structures on ridgelines, summits or other locations where they would be silhouetted against the sky from important viewing locations. • Locate linear features to follow natural land contours rather than straight lines, particularly up slopes. • Locate facilities to take advantage of both topography and vegetation as screening devices to restrict views of projects from visually sensitive areas. • Design and locate structures and roads to minimize and balance cuts and fills. Minimize ground disturbance and control erosion by avoiding steep slopes and by minimizing the amount of surface disturbance needed for infrastructure (e.g., roads, electrical lines). • Keep equipment and vehicles within the limits of the initially disturbed areas. • Restore disturbed surfaces as closely as possible to their original contour and revegetate them immediately after or contemporaneously with disturbance activities. • Use dust suppression techniques to minimize impacts of vehicular traffic and wind on roads and exposed soils. • Maintain the right-of-way with low-growing natural vegetation that requires minimal maintenance and that is consistent with local vegetation. • Maintain the site during operation of the project. Inoperative equipment and poor housekeeping, in general, creates a poor image of the activity in the eyes of the public. • Depending on the situation, consider minimizing the amount of vehicular traffic and human activity. • Develop and implement a decommissioning program that includes the removal of all aboveground facilities and full restoration of the site. • Return access roads and the project site to as near natural contours as feasible. • Revegetate all disturbed areas with plant species appropriate to the site.	• Perform routine site inspections of all sites

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
		Light Pollution • Avoid to the extent practicable locations valued for unspoiled dark skies. • Design with down-lighting down lighting for security and construction activities ○ Minimize lighted signage and advertising • Use outdoor lighting fixtures endorsed by the International Dark-Sky Association (IDA) www.darksky.org. • Comply with local lighting policies and ordinances • Incorporate IDA lighting ordinances as appropriate.	• Perform routine site inspections • Monitor light pollution

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Terrestrial Flora and associated Ecosystems	**Habitat Degradation and Destruction** • Use existing facilities (e.g., access roads, parking lots, graded areas) and site new structures on previously disturbed lands to minimize new disturbance. • Devise Landscaping Plan .Minimize the amount of land to be disturbed and vegetation to be removed. Inventory existing plants and determine which are salvageable for re-use. Document them and detail how they should be correctly remove, stored and maintained until they can be transplanted back. Protect existing mature trees as much as possible, marking and protecting them. Include in contractor specifications – punitive penalties for violations of tree protection plan. • Landscape with native plants that encourage birds and butterflies. Ban use of imported or invasive species. • Select plantings suited to the environs, coastal plantings, alpine plantings, etc. • Locate facilities away from important ecological resources (e.g., wetlands, unique habitats, wildlife corridors, sensitive species populations). • Determine the need for and/or feasibility of conducting translocation of threatened or endangered species. • Locate facilities to minimize habitat fragmentation. • Avoid creating favorable conditions for nuisance or invasive species. • Use of certified weed-free mulching and prohibit use of fill materials from areas with known invasive species problems. • Clean vehicles before entering the project area to mitigate the introduction of invasive, exotic species.	• Monitor emergence of invasive, exotic species and respond appropriately. • Perform routine inspections of the site.
		Forest Resource Depletions • Use of local timber should be kept to a minimum and sources should be sought through the local Forestry Department • Steele scaffolding should be used in preference to timber • Contractor should ensure that sufficient quantities of prefab steel scaffolding are available for hire during the construction period.	• Track the amount of timber used on site. • Perform site inspection especially to prevent unnecessary depletion of forests.

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
		Wildfire • Provide for construction worker housing so that illegal camps and campfires do not become established • Prohibit uncontrolled burning of any type.	• Perform routine site inspections
	Terrestrial Fauna	**Behavioral Disruption and Loss of Diversity** • Locate and/or design facilities to minimize disturbance of migratory and connectivity corridors, and breeding, nesting and calving areas, and interference with access to watering holes. • Establish protective buffers to exclude unintentional disturbance of important resources. • Schedule activities to avoid disturbance of wildlife during critical periods of the day (e.g., night) or year (e.g., breeding or nesting season). • Implement a program to instruct employees, contractors, and site visitors to avoid harassment and disturbance of wildlife, especially during.	• Monitor fauna reproductive (e.g., courtship, nesting) seasons.
		Accidental Poisoning Same measures as Soil Contamination from Spills and Fuel Leaks	• Same as Soil Contamination from Spills and Fuel Leaks
	Aquatic Species and associated Ecosystems	**Wetland Destruction** • Locate facilities away from important ecological resources (e.g., wetlands, unique habitats, wildlife corridors, sensitive species populations). • Prohibit use of nearby wetlands for washing or waste disposal.	• Perform routine site inspections
		Degradation of Aquatic Ecosystems • Assess needs for sand and aggregate during construction; ensuring licensed borrow facilities are available. • Prohibit indiscriminant sand mining, require proof of source. Required contractor to have available at the site sources/quarries and copies of the relevant license for inspection. • Prohibit removal of sand from or adjacent protected areas and habitats.	• Monitor fish population for species diversity, habitat, and quantities.
		Accidental Poisoning Same measures as Soil Contamination from Spills and Fuel Leaks	• Same as Soil Contamination from Spills and Fuel Leaks

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Threatened and Endangered Species and Habitats	**Habitat Degradation and Destruction** Same measures as Terrestrial and Aquatic Species	• Same as Terrestrial and Aquatic Species
Construc-tion and landscaping of onsite facilities, structures and buildings	Same measures as land clearing, earthmoving and terrain shaping with the addition of the following:		
	Geology	**Seismic Events** • Construct all facilities to withstand a minimum magnitude event based on the seismicity of the area • Develop plans evacuation, protection and safety of guest should an event occur	
	Soil	**Erosion and Soil Compaction** • Same measure as site preparation • Landscaping to avoid wind erosion.	• Perform routine site inspections
		Disposal of Construction Debris • Ban on-site debris burning. • Develop a Debris Management Plan with designated areas for various types of debris Reuse or recycle construction where practicable. • Dispose of non-recyclable/reusable construction debris at an existing, approved disposal site or onsite in accordance with regulatory requirements. • Segregate hazardous wastes from the waste stream and dispose of in an approved hazardous waste disposal site, or in accordance with regulations.	• Perform routine site inspection
	Water Quantity	**Water Needs for Construction** • Secure necessary water rights. • Develop water quality needs estimate for construction activities such as dust control, on-site batch cement operations, sanitation. • Designate source of construction water. • Use water conservation practices. • Recycle water to the degree possible.	• Monitor levels in wells • Monitor flows in nearby streams.

<table>
<tr><th>ACTIVITY</th><th>AFFECTED ENVIRONMENT</th><th>MITIGATION MEASURES</th><th>MONITORING</th></tr>
<tr><td></td><td>Water Quality</td><td>Increased Runoff due to Compaction and Changes in Vegetative Cover
Runoff Carrying Sediment and associated contaminants
• Design utilizing pervious paving and landscaping to the extent possible.
• Use non-structural runoff abatement techniques (swales, pervious paving materials, gentle slopes, etc.)
• Develop construction stormwater management plans.
• Develop an erosion control plan tailored to the site. All erosion controls should be inspected routinely, especially during and immediately following significant rain events, to ensure no impacts to nearby surface waters and aquatic habitat. Immediate corrective action should be taken if erosion or sedimentation is observed.
• Maintain a naturally vegetated buffer (preferably 100 feet or greater) adjacent to any ditches or drainages to reduce erosion and protect water quality.
• Immediately revegetate any disturbed areas with a native species or an annual grass.
• To the extent feasible, complete any work that results in exposed earth during periods when significant rainfall is not predicted.
• Conduct any work that involves clearing large tracts of land in phases, where practicable, with rapid revegetation upon completion of each phase.
• If possible, locate all work at least 100 feet from any nearby intermittent or permanent streams to reduce sediment runoff and subsequent turbidity in the stream and downstream.
• Use silt curtains and other stormwater BMPS.</td><td>• Perform routine site inspections
• Monitor turbidity and total suspended solids in streams.</td></tr>
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ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
		Sediment Disturbances and Turbidity During Aquatic Area Constructions (pile driving, revetment construction and repair, construction of docs and marinas, etc.) • Utilize numerical models to predict probable degree of problem • Develop Management Plan to reduce problem • Utilize engineering controls to protect natural and cultural resources (coral reefs, archeological artifacts etc.) Utilize aquatic construction BMPs (PBS&J 2008) Use spill prevention during construction near water (CSWQA 2003)	• Perform routine site inspections • Monitor total suspended solids and turbidity in nearby streams
		Pipelines • Avoid placement of water mains in the floodplain or riparian zone to help protect water quality. • If wetlands or tributaries must be spanned by the pipeline, attach the pipeline to existing bridges or directionally drill under these water bodies.	• Perform routine site inspections
	Air Quality	**Dust** • Cover delivery loads of loose construction material • Utilize water trucks for dust control • Use covered or enclosed drop and material transfer points for onsite stone crushing and batch plants, operated at slight negative pressure if possible • Develop an air quality monitoring program that including high volume sampling for particulates	• Monitor particulates
		Emissions • Map wind patterns for dead zones • Evaluate fuel choices for construction vehicles • Minimize idling of vehicles • Check adjacent occupied off-site structures for fresh air intakes, plan construction activities to avoid these areas	• Monitor air for NOx, CO_2, and other parameters
	Noise and Vibration	• **Well Drilling** (if applicable) • **Pile Driving (if applicable)** • Restricted hours of operation if drilling is in a populated area. Use noise barriers during drilling near sensitive receptors.	• Implement noise monitoring to verifying construction phase noise levels

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Aesthetics	**Disruption of Views and Landscapes** • Low-profile structures should be chosen whenever possible to reduce their visibility. • Minimize the profile of all structures located within 0.4 km of scenic highways so that views from the highway are preserved. • Minimize the number of structures and co-locate structures where possible to minimize the need for additional pads, fences, access roads, lighting and other project features. • Design facilities, structures, roads and other project elements to match and repeat the form, line, color and texture of the existing landscape. • Design natural-looking earthwork berms and vegetative or architectural screening where screening topography and vegetation are absent. • Paint grouped structures the same color to reduce visual complexity and color contrast. • Plant vegetative screens to block views of facilities and right-of-ways.	• Perform routine site inspections
	Terrestrial Flora and Associated Ecosystems Land Resource	**Loss of Habitats -ecosystems loss due to swamp draining, wetland infilling, etc.** • Prohibit land expansion by wetland infilling or swamp draining	• Perform routine site inspections • Periodically evaluate ecosystems in the direct vicinity of the site

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Aquatic Species and Associated Ecosystems	**Runoff Carrying Sediment and associated contaminants** • Employ designs that divert runoff from landscaping **Dredging (channel and lagoon deepening) and substrate preparation** • Develop dredging and substrate disturbance plans to avoid /protect sensitive areas • Develop dredged material management plans • Develop long term dredge material plans that include maintenance dredging schedules, locations for dredge material disposal, sampling plans for sampling and analysis of dredged sediments from contaminants (most marinas and docks have sediments contaminated with heavy metals from algaecides, etc.)availability of maintenance dredging equipment **Wave and Current Control Structures** • Modify designs to lessen impacts based upon dation of determination of direct and indirect habitat impacts from changes in current and sediment deposition patterns	• Perform routine site inspections • Monitor water for turbidity and total suspended solids
Construc-tion and/or upgrade of access roads	Same as Construction and landscaping of onsite facilities, structures and buildings with the addition of the following:		
	Soil	**Erosion** • Use existing roads wherever possible. • Design roads to meet the appropriate standards and be no larger than necessary to accommodate their intended functions. • Place access roads to follow natural topography, and avoid or minimize side hill cuts. • Design roads to avoid excessive grades on roads, road embankments, ditches, and drainages, especially in areas with erodible soils. • Avoid going straight up grades in excess of 10%. • Use appropriate structures at culvert outlets to prevent erosion. • Provide regularly scheduled maintenance to clean drainage structures, maintain road surface, and ensure adequate slope stabilization.	• Perform routine site inspections. • Monitor surface water periodically for total suspended solids

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Water Quality Aquatic Species and associated Ecosystems	**Modification of Streams and Rivers Due to Crossings** • Locate roads to minimize river and wetland crossings. • Design bridges to minimize impacts on rivers during construction and to maintain river bank integrity, using free span bridges for water crossings wherever possible. • Design wetland crossings to maintain flows and functions within the wetland. • Restrict in-stream activities to periods of low water level, and during non-critical times with respect to lifecycles of flora and fauna. • Use special construction techniques in areas of stream crossings. • For in-stream works, isolate the work area using berms or diversions to flow. • Revegetate disturbed riparian zones with species appropriate to the native habitats and species.	• Perform routine site inspections
	Biological Environment	**Increased Access to Remote Areas** • Locate roads to avoid increasing access to remote areas. • Limit the overall addition roads. • Where roads are not public, use locked gates or other barriers to restrict access to authorized personnel. • Patrol or support local patrols to control illegal hunting and fishing. • Permanently close and stabilize unnecessary roads to reduce overall road density and impacts from fragmentation.	• Use cameras and other remote sensing devices to monitor traffic.
CONSTRUCTION CAMP AND ONSITE HOUSING ACTIVITIES (construction of camps and housing has the same impacts as identified above for other facilities)			
Camp manage-ment	Terrestrial and Aquatic Fauna and associated Ecosystems	**Animals Attracted to Garbage and Food Waste** Dispose of garbage and food waste in animal proof containers	• Perform routine site inspections.
		Behavioral Disruption • Locate and/or design camp to minimize disturbance of migratory and connectivity corridors, and breeding, nesting and calving areas, and interference with access to watering holes. • Implement a program to instruct employees, contractors, and site visitors to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship, nesting) seasons. • Control pets to avoid harassment and disturbance of wildlife.	• Monitor terrestrial and aquatic fauna periodically throughout the year to track seasonal and spatial changes

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
		Collection, Hunting and Fishing • Limit fuel wood collection to dead and down wood. • Prohibit hunting and fishing by employees in construction camps. Allow only legal hunting and fishing by employees living onsite at facilities	• Use cameras or other remote sensing devices to monitor activity
Solid and human waste disposal	Soil Water Quality Aquatic Species and associated Ecosystems	**Degradation of Soil and Water Quality** • Use existing, authorized wastewater treatment and solid waste disposal facilities if available. • Provide sufficient and sanitary latrines, bathrooms and showers and treat wastewater or discharge to a sanitary sewer system. • Design no- or low-water use human waste disposal systems. • Locate facilities to minimize impacts. • Line facilities where groundwater contamination is an issue. • Prepare a solid waste management plan for proper collection, storage, transport and disposal. Include map with locations of collections site and include collection schedules • Apply water conservation (e.g., reduce, reuse and recycle) measures to reduce water use and wastewater generation. • Implement a solid waste reduce, reuse and recycle program. Review carefully feasibility of recycling markets and transportation costs particularly from islands and remote areas. • Prohibit use of nearby water bodies or wetlands for washing or waste disposal.	• Monitor surface water for turbidity and total suspended solids
	Terrestrial Fauna	**Attraction of Wildlife and Pests to Solid Waste Disposal Sites** • Design sites to meet sanitary requirements. • Fence sites. • Apply and compact daily cover.	• Perform routine site inspections
Water supply	Water Quantity	**Water Needs** • Secure necessary water rights. • Use water conservation practices.	• Monitor groundwater levels and surface water flows

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
Fuel and chemical storage and handling	Soil Water Quality Terrestrial Fauna Aquatic Species and associated Ecosystems	**Contamination from Spills and Fuel Leaks** Same measures as Soil Contamination from Spills and Fuel Leaks for Land Clearing activities	Same as Soil Contamination from Spills and Fuel Leaks for Land Clearing activities
Energy Production Transporta-tion	Air Quality	**Vehicle and Generator Emissions** • Consider fuel efficiency, types of fuels, and emissions controls in the selection of equipment. • Assure proper tuning and carburetion of engines. • Check fuel supplies for impurities or adulteration.	• Monitor air quality of NOx, CO2, and other pollutants
	Water Quality	**Contamination from Spills and Fuel Leaks** Same measures as Soil Contamination from Spills and Fuel Leaks for Land Clearing activities	Same as Soil Contamination from Spills and Fuel Leaks for Land Clearing activities

Table G-2: Mitigation and monitoring measures for physical and biological impacts common to the operation of most tourism projects

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
Water Supply Infrastruc-ture	Water Quantity Aquatic Species and associated Ecosystems	**Water Needs** • Accurate estimate of water needs, firming of water rights, expansion of supply lines • Implement water use reduction strategies – low flow fixtures, aerators and restrictors on all taps, auto cut-off switches, hospitality industry strategies to reduce laundering, etc. • Educate staff and visitors to the water supply problems of the area and measure that they can voluntarily apply to reduce water use and wastewater production • Implement grey water re-use systems where appropriate for landscape irrigation • Landscape areas with native vegetation that require less supplemental water. • Plan for adequate supplies so that aquifers do not get stressed and saltwater intrusion is not exacerbated • Provide adequate water storage facilities to ensure adequate supplies for the facility (provide for emergency conditions as well) • Install gutters and collect rainwater from roofs and store for irrigation.	• Monitor surface water flow and groundwater levels.
Wastewater Systems	Soil Water Quality Terrestrial Fauna Aquatic Species and associated Ecosystems	**Degradation of Soil and Water Quality** • Accurate estimate of wastewater projected, expansion of sewers and wastewater treatment plants. • Implement wastewater generation reduction strategies – low flow fixtures, auto cut-off switches, hospitality industry strategies to reduce laundering, etc. • Provide remote area sanitation and regularly schedule pump-out and maintenance. • On-site treatment systems are problematic • Design septic systems to protect groundwater or surface water. • Operate packaged plants within normal compliance objectives. • Develop a training manual and Operations Manual for operations staff. • Train in effective operations and maintenance of the wastewater systems. • Develop a site specific monitoring plan for the system monitoring, effluent discharge monitoring and affected environment monitoring. • Choose a qualified contract laboratory for monitoring sample analysis • Train wastewater staff annually in monitoring of wastewater systems: record keeping, tolerance bounds, equipment maintenance schedule, environmental sampling, etc. • Implement a strict inspection routine to assure operations are functioning properly	• Perform routine system inspections • Monitor wastewater discharges for salinity, BOD5, COD, coliforms and other potential pollutants

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
Solid Waste Services	Soil Water Quality Terrestrial Fauna Aquatic Species and associated Ecosystems	**Degradation of Soil and Water Quality** • Aggressively manage litter and food waste daily • Develop site specific waste management plans • Set strict time schedules for waste pickup • Train employees to the waste management plan • Educate visitors and school children on proper waste reduction	• Perform routine site inspections
Energy Use	Air Quality	• Install timers, photoelectric cells, thermostat, etc. in room blocks and other facilities. • Institute energy savings plan • Install translucent shades and fluorescent lighting • Pipe insulation, tank lagging and heat recovery systems should be installed wherever practical	• Install sub-meters and real time energy monitoring equipment in room blocks and other facilities.
Energy Production	Air Quality	**Generator Emissions** • Consider fuel efficiency, types of fuels, and emissions controls in the selection of equipment. • Assure proper tuning and carburetion of engines. • Check fuel supplies for impurities or adulteration.	• Monitor air quality of NOx, CO2, and other pollutants
Fuel and/or Chemical Storage and Handling	Soil Water Quality Terrestrial Fauna Aquatic Species and associated Ecosystems	**Contamination from Spills and Fuel Leaks** • Design permanent onsite handling facilities for fuels, fertilizers, pesticides, herbicides, and other chemicals • Segregate chemicals in storage to avoid incompatibility issues • Develop specific materials management plans for each category of chemicals • Develop spill plans and train staff to work with local emergency response officials • Have emergency response available for spills • Have latest spill containment, oil boom, and other equipment set at convenient locations on-site including at marinas and port areas • Use proper sanitation facilities at rest stops	• Perform site inspection to identify drums that are leaking, oil sheen on puddled water, and organics in water • Monitor surface and ground water for pollutants of concern
Hotels, Resorts, Marinas, Seaports and Attractions	Noise and Vibration	**Noise from Air Conditioners and other Fixed Equipment Areas** • Install vibration isolation for mechanical equipment • Ensure that mechanical equipment mounting hardware is periodically tightened. • Implement program to record and respond to complaints. **Noise from Boats, Jet Skis, ATVs, other transportation equipment** • Restrict hours of operation • Restrict areas of operations **Noise from Entertainment venues** • Restrict hours of operation • Restrict areas of operations	• Perform routine system inspections • Implement noise monitoring to verifying operational phase noise levels.

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
		Preserve Natural and Cultural Soundscape (waterfall, crickets, birds, etc and music selection) • Match recreational uses with appropriate natural environments • Limit external noise • Select background music appropriate to the setting • Consolidate generators and other equipment at remote sites, away from natural areas • Utilize natural and artificial barriers around equipment • Train employees and educate visitors that sound is a natural resource	
	Aesthetics	**Disruption of Views and Landscapes** • Maintain the site during operation of the project (inoperative equipment and poor housekeeping, creates a poor image of the project in the eyes of the public) • Paint grouped structures the same color to reduce visual complexity and color contrast. • Maintain vegetative screens. • Prohibit the use of commercial symbols.	• Perform routine site inspections

		Light Pollution
		• Limit night-time lighting to avoid spill onto nearby residences.
		  ○ Prepare a Lighting Plan including actions to minimize the need for and amount of lighting on structures.
		  ○ Train employees to Lighting Plan
		  ○ Minimize illumination of the project and its immediate vicinity by including use of motion detectors or other controls to have lights turned off unless needed for security or safety
		  ○ Utilize means other than lighting to keep visitors safe
		  ○ Educate visitors to the low lighting philosophy
			• Perform routine site inspections
			• Have visitors fill out guest questionnaires
			  ○ Monitor light pollutions

	Terrestrial Fauna	**Animals Attracted to Garbage and Food Waste** • Dispose of garbage and food waste in animal proof containers	• Perform routine site inspections.
	Terrestrial and Aquatic Fauna and associated Ecosystems	**Collection, Hunting and Fishing** • Limit fuel wood collection to dead and down wood • Prohibit hunting and fishing by employees • Allow only legal hunting and fishing by guests • Ban collection of coral reef souvenirs	• Use cameras or other remote sensing devices to monitor activity.

<table>
<tr><th>ACTIVITY</th><th>AFFECTED ENVIRONMENT</th><th>MITIGATION MEASURES</th><th>MONITORING</th></tr>
<tr><td rowspan="2"></td><td></td><td>Behavioral Disruption
• Implement a program to instruct employees, contractors, and site visitors to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship, nesting) seasons.
• Control pets to avoid harassment and disturbance of wildlife.
• Where appropriate, design endangered species protection plans, for example:
• Enhance turtle nesting by providing planted shaded areas at the top of the beach that are protected from trampling and direct lighting
• Implement turtle watch programs with local schools and promote turtle nesting as an attraction
• Provide educational and environmental sensitization material on coral reefs tor guests and hotel staff
• Install boat mooring buoys at sites for use of dive boats, and ban boat anchoring on coral substrate</td><td>• Perform routine site inspections
• Monitor terrestrial fauna periodically throughout the year to track seasonal and spatial changes
• Monitor light pollutions</td></tr>
<tr><td></td><td>Accidental Poisoning
Same measures as Soil Contamination from Spills and Fuel Leaks</td><td>Same measures as Soil Contamination from Spills and Fuel Leaks</td></tr>
<tr><td>Golf Courses</td><td>Water Quantity</td><td>• Use native, naturalized or specialized drought-tolerant plant materials
• Implement grey water re-use systems for irrigation when available, economically feasible and agronomically and environmentally acceptable
• Develop Water Management Plan
  ○ Plan irrigation patterns and/or program irrigation control systems to meet the needs of the plant materials in order to minimize overwatering
  ○ Water at appropriate times to minimize evaporation and reduce the potential for disease
  ○ Manage water use effectively to prevent unnecessary depletion of local water resources
  ○ Train and require staff to implement Water Management Plan</td><td>• Periodic inspections of grey water systems
• Monitor surface water flow and groundwater levels</td></tr>
</table>

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING

	Water Quality
	
	Terrestrial and Aquatic Flora and Fauna and associated Ecosystems
		• Preserve and develop native plant buffer zones that are no entry to golfers
		• Educate visitors to the natural areas management strategy
		• Leave grass clippings and other organic materials in place whenever agronomically possible. If clippings are removed, compost and, if possible, recycle them.
		• Use nutrient products and practices that reduce the potential for contamination of groundwater and surface water. Strategies include: use of slow-release fertilizers, selected organic products, and/or fertilization.
		• Test and monitor soil conditions regularly and modify practices accordingly. Choose nutrient products and time applications to meet, not exceed, the needs of the turfgrass.
		• Develop Integrated Pest Management Plan
		  ○ Employ the principles of integrated pest management, a system for preventing and controlling pests (e.g., weeds, diseases, insects) in which non-chemical control measures should focus on practices such as the introduction of natural pest enemies (e.g., parasites and predators), utilizing syringing techniques, improving air movement, soil aeration techniques, and mechanical traps. The selection of chemical control strategies should be utilized.
		  ○ Store and handle all pest control and nutrient products in a manner that minimizes worker exposure and/or the potential for point or non-point source pollution. Employ proper chemical storage practices and use suitable personal protective equipment and handling techniques.
		• All plant protecting products should only be applied by or under the supervision of a trained, licensed applicator or as dictated by law.
		• Maintain excellence in the continuing education of applicators (including state licensing, professional association training and IPM certification). Training for non-English speaking applicators should be provided in the worker's native language.
		• Develop Chemical Management Plan
		  ○ Dispose of chemical rinsate in a manner that will not increase the potential for point or non-point source pollution. Methods include rinsate recycling or "spraying out" diluted compound in previously untreated areas.
		  ○ Dispose of chemical packaging according to label directions (e.g., triple rinsing, recycling or returning to manufacturer).
		  ○ Other waste products, such as used motor oil, electric batteries and unused solvents, should be recycled or disposed of according to the law and available community disposal techniques.
		  ○ Seek to reduce waste by purchasing products that minimize unnecessary packaging.
		• Train and require staff to implement Chemical Management Plan and Pest Management Plan
			• Monitor surface and ground water for pollutants of concern
			• Monitor terrestrial flora in terms diversification, density, and population on a yearly basis.

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
	Terrestrial Fauna	• Habitat for wildlife species that help control pests (e.g., bats, bluebirds, purple martins, etc.) should be protected. Additional habitat for these beneficial species should be created whenever feasible and environmentally desirable. • Manage habitat to maintain healthy populations of wildlife and aquatic species. • Species such as skunks, non-migratory Canada geese, and deer, when they become damaging, should be managed through non harmful means whenever possible. Non harmful control methods could include dogs, noisemakers, repellents, and trapping and removal. Managed hunting may be appropriate where legal and safe. • Develop wildlife management plan. • Train and require staff to implement Wildlife Management Plan. • Educate visitors to discourage molesting or feeding wildlife.	• Monitor population and diversity of various species in the area periodically. • Perform habitat evaluations on a yearly basis

Table G-3: Mitigation and monitoring measures for physical and biological impacts common to most the decommissioning of tourism projects

ACTIVITY	AFFECTED ENVIRONMENT	MITIGATION MEASURES	MONITORING
Same measures as Construction of Facilities with the addition of the following:			
General		• Engage in planning that involves the community and possible commercial users, to assure optimal reclamation and use. • Develop and implement a decommissioning program that includes removal or recon • Minimize maintenance requirements of land in transition • Provide fencing and other measures for health and safety concerns to the public • Control scavenging to ensure safety and safe use of recovered materials. Conditioning of all structures and reclamation of the site.	Perform routine site inspections
Removal and transport of machinery and equipment	Noise and Vibration	• Route the movement of heavy equipment and construction materials as far as possible away from residences and other sensitive receptors. • Prepare a Noise Monitoring and Mitigation Plan.	Perform routine site inspections
Removal or decommissioning of structures and buildings	Soil Water Quality Aquatic Species and associated Ecosystems	**Soil Contamination by Storage and Use of Hazardous Materials an Spills and Fuel Leaks** • Conduct soil sampling if deemed necessary, based on types of materials stored or handled. • Prepare a reclamation plan to treat contaminated soils to the extent required for subsequent proposed use. • Prepare a management plan for reclamation or proper disposal of hazardous materials such as oils, greases, solvents, caustics and acids, and other materials that may have been left behind. • Prepare contingency plans for handling and disposal of contaminated materials if discovered during decommissioning. • Remove and properly dispose of potentially hazardous materials such as asbestos and certain metals from structures prior to demolition	Perform routine site inspections Maintain monitoring program that was implemented during operations
Restoration of terrain and vegetation	Soil Aesthetics Terrestrial Flora and associated Ecosystems	• Return access roads and the project site to as near natural contours as feasible. • Revegetate all disturbed areas with plant species appropriate to the site. • Utilize interim measures for erosion control, dust mitigation, weed infestation, etc. while land is in transition	Perform routine site inspections Maintain monitoring program implemented during operations

Table G-4: Mitigation measures for impacts to the social-economic-cultural environment

AFFECTED ENVIRONMENT	MITIGATION MEASURES	
	DESIGN PHASE MITIGATION MEASURES	POST DESIGN MEASURES
Socio-Economic Conditions	**Population Displacement and Relocation** • Locate facilities to avoid displacement and relocation • Develop a compensation plan for land owners • Develop a compensation plan for displaced and relocated people **Worker Recruitment and Migration** • Forecast employment needs, fluctuations due to seasons and cruise ship visitation days • Estimate available employment pool of trained and trainable for the construction phase and hospitality industry	**Displacement** • Assure that new locations are culturally compatible • Assure that proper training and job opportunities are available or are created. • Provide counseling to assist in adaptation to the new surroundings. **Worker Recruitment and Migration** • Develop recruitment Plan • Develop Training Planning • Discourage Squatting and plan for worker housing • Account for seasonal fluctuations in employment needs
	Changes in Character of the Community and Crime Rates • Locate construction camps away from local communities.	**Changes in Character of the Community and Crime Rates** • Implement a program to instruct employees, contractors, and site visitors to avoid harassment and disturbance of local residents. • Ensure adequate security to protect residents from construction camp workers, and to protect the construction camp workers from themselves.
	Health and Safety • To the extent practicable locate the proposed project site relative to fire hazard severity zones. • Conduct a safety assessment to describe potential safety issues (e.g., site access, construction, work practices, security, emergency procedures, and fire control and management). • Develop a worker safety program to address all of the safety issues identified in the assessment and all applicable safety standards set forth by local governments and the relevant safety and health administration.	**Health and Safety** • Implement safety program. • Require periodic safety inspections of all vehicles • Provide preventive health for the workers • Training and introduction of care and rights
Infrastructure	**Transportation Infrastructure** Roads • Estimate traffic increases from workers, guests and service vehicles • Consult with local planning authorities regarding traffic, in general and specific issues (such as school bus routes). • Develop a Traffic Management Plan for site access roads and for use of main public roads to mitigate impacts of the project on traffic. • Provide for safe ingress and egress to/from the proposed project site. Aviation • Avoid locating any portion of a facility within a designated airport safety zone, airport influence area or airport referral area. • Estimate projected increase in airport traffic.	**Transportation Infrastructure** Roads • Limit traffic to roads indicated specifically for the project. • Instruct and require all personnel and contractors to adhere to speed limits to ensure safe and efficient traffic flow.

<table>
<tr><th rowspan="2">AFFECTED ENVIRONMENT</th><th colspan="2">MITIGATION MEASURES</th></tr>
<tr><th>DESIGN PHASE MITIGATION MEASURES</th><th>POST DESIGN MEASURES</th></tr>
<tr><td></td><td>Public health infrastructure
• Locate facilities so as not to directly impact or disturb activities at public infrastructure.
• Estimate local public health clinic capacity and ability to handle increase in tourism workers
Fire and Police Services
• Assess existing capacity and project increased needs
• Assess crime rate and project future
Communications Infrastructure
• Assess current capacity, reliability, emergency backup
Water
• Assess current capacity, reliability, emergency backup
Wastewater
• Assess current capacity, reliability, emergency backup
Solid Waste
• Assess capacity, reliability, emergency backup</td><td>Public health infrastructure
• Have health clinic on site with qualified personnel</td></tr>
<tr><td>Cultural, Archeological, Ceremonial and Historic Resources</td><td>• Inventory and secure areas
• Avoid any activities in sensitive areas that would degrade the resources
• If avoidance is not possible, conduct appropriate cultural resource recovery operations or alternate mitigations.
• Forecast daily use and fluctuations (e.g., cruise ship fluctuations)
• Prepare a Cultural Resources Management Plan, if cultural resources are present in the project area.
• Post signs and place labels on sensitive areas</td><td>• Train contractors and staff to implement the Cultural Resources Management Plan
• Educate workers and guests on identification of cultural, archeological, ceremonial and historic resources.
• Educate workers and guests and the public on the consequences of unauthorized collection of artifacts.
• Provides guides and escorts for all tours to heritage sites.
• Periodically monitor the condition of significant resources and report to authorities on any degradation, looting and vandalism.
• Use carrying capacity and other management strategies to manage heritage site visitation
• Levy taxes and entrance fees to support management of resources</td></tr>
<tr><td>Land Use</td><td>Construction
• Permanent or at least long term commitment of land to this sole purpose
• Scale down plans
• Phase construction</td><td></td></tr>
<tr><td>Citizen Concerns</td><td>• Inventory and address citizen concerns: land use, visual impacts, compatibility, security, traffic, and competition with existing businesses, positive/negative impacts to social and economic assets.</td><td>• Have a public relations personnel
• Be aware at all times of public concerns</td></tr>
</table>

3 SPECIFIC MITIGATION MEASURES

The following subsections provide additional information on some mitigation measures, for which the information in Tables G-1 through G-4 may not be sufficient. The measures elaborated upon include:

- Seismic events associated with geothermal developments
- Process and wastewater discharges
- Noise

The elaboration on these mitigation measures in no way indicates that they are more important than the other measures in Tables G-1 through G-4. They are elaborated upon here only because the EIA reviewer may need more information than is provided in the Tables to understand the application of the measures.

3.1 Seismic Events

Central America and the Dominican Republic are in highly seismic areas. Hotels and resorts should be constructed to withstand a minimum magnitude event based on the seismicity of the area. In addition, plans should be developed for evacuation, protection, and safety of guest should an event occur.

3.2 Process and Wastewater Discharges

Resorts and hotels often have their own waste water treatment plants. In addition, isolated ecotourism lodges have septic tanks or other treatment facilities. Project-specific performance levels for wastewater effluents should be set prior to designing wastewater treatment systems. The standards should comply with national standards, if they exist, and take into consideration the quality and volume of the receiving waters. Additional considerations that should be included in the setting of project-specific performance levels for wastewater effluents include:

- Process wastewater treatment standards should be consistent with applicable requirements for the specific area.
- Compliance with national or local standards for sanitary wastewater discharges or, in their absence, indicative guideline values applicable to sanitary wastewater discharges as shown in Appendix C.

In the context of their overall environmental health and safety management system, facilities should:

- Understand the quality, quantity, frequency and sources of liquid effluents in its installations. This includes knowledge about the locations, routes and integrity of internal drainage systems and discharge points.
- Assess compliance of their wastewater discharges with the applicable: (i) discharge standard (if the wastewater is discharged to a surface water or sewer) and (ii) water quality standard for a specific reuse (e.g., if the wastewater is reused for irrigation).

3.2.1 Protocol Concerning Pollution from Land-Based Sources and Activities (LBS Protocol, 1999) to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention, 1983)

References for the LBS Protocol:
http://www.cep.unep.org/cartagena-convention/lbs-protocol/lbs-protocol-english/view
http://www.cep.unep.org/cartagena-convention/lbs-protocol/lbs-protocol-spanish/view

Land and ocean-based sewage pollution is regulated in many different frameworks ranging from regional legislation, international non-binding and binding agreements, action plans and national legislation and regulations (UNEP 2006). The most important regional legal framework is the *Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region* (Cartagena Convention). The Convention entered into force in 1986 and is a legally binding, regional ultilateral environmental agreement for the protection and development of the wider Caribbean region.

The *Protocol Concerning Pollution from Land-Based Sources and Activities* (LBS Protocol) of the Cartagena Convention sets forward general obligations and a legal framework for regional co-operation, provides a list of priority source categories, activities and associated pollutants of concern and promotes the establishment of pollution standards and schedules for implementation. Annex III relates directly to domestic wastewater and establishes specific regional effluent limitations, a time table for the implementation of wastewater treatment. In addition to effluent limits, Annex III includes obligations for the each Contracting Party to (1) development of industrial pretreatment programs, (2) implement measures to ensure that household wastewater treatment systems are constructed operated an maintained to avoid contamination of surface and ground waters, and (3) ensure that new and existing domestic wastewater treatment systems are properly managed by trained personnel.

For the purpose of Annex III in the LBS Protocol, effluent limits are divided in two classes, depending on the water in which they are discharged. Class 1 waters are particularly sensitive to impacts from pollution while Class 2 waters are less sensitive (see full text on LBS Protocol for more details). The effluent limits for domestic wastewater in the LBS Protocol are shown in Table G-5.

Table G- 5: Legally-binding effluent limits defined in the LBS Protocol

PARAMETER	CLASS 1 WATERS	CLASS 2 WATERS
Total Suspended Solids*	30 mg/l	150 mg/l
Biochemical Oxygen Demand (BOD_5)	30 mg/l	150 mg/l
pH	5-10 pH units	5-10 pH units
Fats, Oil and Grease	15 mg/l	50 mg/l
Fecal Coliform Bacteria	200 most probable number/100 ml	Not applicable
E. coli Bacteria (freshwater)	126 organisms/100 ml	Not applicable
Entrerococci Bacteria (saline water)	35 organisms/100 ml	Not applicable
Floatables	Not visible	Not visible

*Does not include algae from treatment ponds.

Facilities and communities in each country must comply with the provisions of the LBS Protocol on a phased basis after the Protocol enters into force for that country. The timeline in Table G-6 is related to wastewater treatment facilities.

Table G- 6: Compliance timeline as defined in the LBS Protocol

YEARS AFTER ENTRY INTO FORCE	EFFLUENT SOURCES REQUIRED TO COMPLY WITH STANDARDS
0	All new domestic wastewater systems – public and private
10	Existing domestic wastewater systems other than community wastewater systems
10	Communities with 10,000 – 50,000 inhabitants
15	Communities with more than 50,000 inhabitants already possessing wastewater collection systems
20	Communities with more than 50,000 inhabitants not possessing wastewater collection systems
20	All communities except those relying exclusively on household (e.g. septic tanks) systems

Source: http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GeneralEHS/ $FILE/Final+-+General+EHS+Guidelines.pdf (English)

3.3 Noise

Noise prevention and environmental measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception. The preferred method for controlling noise from stationary sources is to implement noise control measures at the source. Methods for prevention and control of sources of noise emissions depend on the source and proximity of receptors. Noise reduction options that should be considered include:

- Siting
  - Siting permanent facilities away from community areas
  - Locating noise sources to less sensitive areas to take advantage of distance and shielding
  - Taking advantage of the natural topography as a noise buffer during facility design
- Design
- Selecting equipment with lower sound power levels
  - Installing vibration isolation for mechanical equipment
- Installing silencers for fans
- Installing suitable mufflers on engine exhausts and compressor components
- Installing acoustic enclosures for equipment casing radiating noise
- Improving the acoustic performance of constructed buildings by applying sound insulation
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the powerhouse walls, transformer bays or other enclosures within which a noise source may be operated
- Management
  - Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas
  - Reducing project traffic routing through community areas
  - Planning flight routes, timing, and altitude for aircraft (airplane and helicopter) flying over community areas
- Developing a mechanism to record and respond to complaints.

At the design stage of a project, equipment manufacturers should provide design or construction specifications in the form of "Insertion Loss Performance" for silencers and mufflers, and "Transmission Loss Performance" for acoustic enclosures and upgraded building construction. Barriers should be located close to the source or to the receptor location to be effective.

Noise impacts should not exceed the levels presented in Table G-5, or result in a maximum increase in background levels of 3 A-weighted decibels (dBA) at the nearest receptor location off-site. dB readings are weighted for varying frequencies. A-weighting is most commonly used and is intended to approximate the frequency response of the human hearing system. It weights lower frequencies as less important than mid- and higher-frequency sounds. Highly intrusive noises, such as noise from aircraft flyovers and passing trains, should not be included when establishing background noise levels.

Table G- 7: Noise level guidelines

SPECIFIC ENVIRONMENT	CRITICAL HEALTH EFFECT(S)	LAeq[1] [dBA]	TIME[2] BASE [hours]	LAmax[3] FAST [dBA]
Outdoor living area	Serious annoyance, daytime and evening Moderate annoyance, daytime and evening	55 50	16 16	- -
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School classrooms and preschools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	During class	-
Preschool bedrooms, indoors	Sleep disturbance	30	Sleeping time	45
School playground, outdoors	Annoyance (external source)	55	During play	-
Hospital ward rooms, indoors	Sleep disturbance, night-time Sleep disturbance, daytime and evenings	30 30	8 16	40 -
Hospitals treatment rooms, indoors	Interference with rest and recovery	As low as possible		
Industrial, commercial, shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Outdoors in parkland and conservation areas	Disruption of tranquility	†		

Notes:
[1]Equivalent continuous sound pressure level. Usually expressed as the sum of the total sound energy over some time period (T), thus giving the average sound energy over that period. Such average levels are usually based on integration of A-weighted levels.
[2]The time period (T) for the LAeq calculation.
[3]Maximum noise level.
†Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low.

Source: Berglund, Birgitta, Thomas Lindvall, and Dietrich H Schwela. 1999. Guidelines for Community Noise. World Health Organization, Washington. pg. 65 http://www.who.int/docstore/peh/noise/guidelines2.html

Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors should be located approximately 1.5 meters above the ground and no closer than 3 meters to the source being monitored. Noise monitoring should be carried out using a Type 1 or 2 sound level meters meeting all appropriate IEC standards. To any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

4 PROJECT SPECIFIC MITIGATION MEASURES

This subsection provides tables with additional mitigation measures for specific project types, for which the information in Tables G-1 through G-4 and subsection G.3 may not be sufficient. The types of projects included in these tables are:

- Hotels, Resorts and Attractions (Table G-6)
- Restaurants and Bars (Table G-7)

4.1 Golf Courses (Table G-8)

Table G- 8: Specific mitigation measures for hotels, resorts, restaurants and attractions

AFFECTED ENVIRONMENT	MITIGATION MEASURES
Noise and Vibration	**Noise from Air Conditioners and other Fixed Equipment Areas** • Install vibration isolation for mechanical equipment • Ensure that mechanical equipment mounting hardware is periodically tightened. • Implement program to record and respond to complaints
	Noise from Boats, Jet Skis, ATVs, other transportation equipment • Restrict hours of operation • Restrict areas of operations
	Noise from Entertainment venues • Restrict hours of operation • Restrict areas of operations
	Preserve Natural and Cultural Soundscape (waterfall, crickets, birds, etc and music selection) • Match recreational uses with appropriate natural environments • Limit external noise • Select background music appropriate to the setting • Consolidate generators and other equipment at remote sites, away from natural areas • Utilize natural and artificial barriers around equipment • Train employees and educate visitors that sound is a natural resource
Aesthetics	**Disruption of Views** and **Landscapes** • Maintain the site during operation of the project (inoperative equipment and poor housekeeping, creates a poor image of the project in the eyes of the public) • Paint grouped structures the same color to reduce visual complexity and color contrast. • Maintain vegetative screens. • Prohibit the use of commercial symbols
	Light Pollution • Limit night-time lighting to avoid spill onto nearby residences. • Prepare a Lighting Plan including actions to minimize the need for and amount of lighting on structures. • Train employees to Lighting Plan • Minimize illumination of the project and its immediate vicinity by including use of motion detectors or other controls to have lights turned off unless needed for security or safety • Utilize means other than lighting to keep visitors safe • Educate visitors to the low lighting philosophy

<table>
<tr><th>AFFECTED ENVIRONMENT</th><th>MITIGATION MEASURES</th></tr>
<tr><td>Terrestrial Fauna</td><td>Animals Attracted to Garbage and Food Waste
• Dispose of garbage and food waste in animal proof containers</td></tr>
<tr><td rowspan="3">Terrestrial and Aquatic Fauna and associated Ecosystems</td><td>Collection, Hunting and Fishing
• Limit fuel wood collection to dead and down wood
• Prohibit hunting and fishing by employees
• Allow only legal hunting and fishing by guests
• Ban collection of coral reef souvenirs</td></tr>
<tr><td>Behavioral Disruption
• Implement a program to instruct employees, contractors, and site visitors to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship, nesting) seasons.
• Control pets to avoid harassment and disturbance of wildlife.
• Where appropriate, design endangered species protection plans, for example:
o Enhance turtle nesting by providing planted shaded areas at the top of the beach that are protected from trampling and direct lighting
o Implement turtle watch programs with local schools and promote turtle nesting as an attraction
• Provide educational and environmental sensitization material on coral reefs tor guests and hotel staff
• Install boat mooring buoys at sites for use of dive boats, and ban boat anchoring on coral substrate</td></tr>
<tr><td>Accidental Poisoning
• Same measures as Soil Contamination from Spills and Fuel Leaks</td></tr>
</table>

Table G- 9: Specific mitigation measures for restaurants

AFFECTED ENVIRONMENT	MITIGATION MEASURES
Water Quantity	• Install water efficient kitchen, dining room and restroom equipment • Serve water only to customers when asked • Use pressure regulator to reduce volume to dishwater • Recover water from dishwater rinse cycle for use in new wash cycle • Run only full loads in dishwasher • Maintain equipment and repair leaks • Monitor bills for spikes or leaks. Train staff in water conservation
Soil Water Quality	**Solid Waste Management** • Discourage use of disposable utensils, plates and cups • Use biodegradable or recyclable take – out containers Compost food wastes • Recycle – glass, plastics, metal, cardboard, and aluminum • Purchase goods in returnable, reusable or recyclable containers **Wastewater Management** • Minimize use of garbage disposals • Use non-toxic cleaning supplies for dishes, linens, tables, floors, etc. Properly maintain grease traps and hoods to prevent overflows and emissions
Air Quality Energy Consumption/ Greenhouse Gas Emissions	• Install high efficiency equipment • Use CFL or LED lights • Use motion detectors for lights and fans in restrooms • Use programmable thermostats for HVAC controls for different days/ times weeks • Install controllers to schedule on/off kitchen equipment cycles • Keep entrance doors closed or use double doors • Keep condenser coils clean of dust and vapor coils free of frost Use locally grown food foods to reduce transport distances

Table G- 10: Specific mitigation measures for golf courses

<table>
<tr><th>AFFECTED ENVIRONMENT</th><th>MITIGATION MEASURES</th></tr>
<tr><td>Water Quantity</td><td>Reduce Water Demand
Use native, naturalized or specialized drought-tolerant plant materials wherever possible
For greens, tees and fairways use plant materials that: are well-adapted to local environmental conditions; can be efficiently managed; and provide the desired playing characteristic
Implement grey water re-use systems for irrigationwhen available, economically feasible and agronomically and environmentally acceptable
Develop Water Management Plan
Managing water use effectively to prevent unnecessary depletion of local water resources
Plan irrigation patterns and/or program irrigation control systems to meet the needs of the plant materials in order to minimize overwatering
When feasible, use modern irrigation technologies that provide highly efficient water usage
Water at appropriate times to minimize evaporation and reduce the potential for disease
Manage water use effectively to prevent unnecessary depletion of local water resources
Train and require staff to implement Water Management Plan
Inspect irrigation system regularly for leaks and monitor water usage
Use Grey Water Systems
Use grey water irrigation systems when available, economically feasible and agronomically and environmentally acceptable
(NOTE: Water reuse may not be feasible on some sites that drain into high quality wetlands or sensitive surface waters. Suitable soils, climatic conditions, groundwater hydrology, vegetative cover, adequate storage for treated effluent and other factors will all influence the feasibility of water reuse.)
Regularly monitor system to insure that the recycled water meets applicable health and environmental standards</td></tr>
<tr><td>Water Quality

Terrestrial and Aquatic Flora and Fauna and associated Ecosystems</td><td>Protect Native Vegetation
Preserve and develop native plant buffer zones that are no entry to golfers
Educate visitors to the natural areas management strategy
Manage Nutrient
Leave grass clippings and other organic materials in place whenever agronomically possible. If clippings are removed, compost and, if possible, recycle them.
Use nutrient products and practices that reduce the potential for contamination of groundwater and surface water. Strategies include: use of slow-release fertilizers, selected organic products, and/or fertilization.
Test and monitor soil conditions regularly and modify practices accordingly. Choose nutrient products and time applications to meet, not exceed, the needs of the turfgrass.
Use Integrated Pest Management Plan
Employ the principles of integrated pest management, a system for preventing and controlling pests (e.g., weeds, diseases, insects) in which non-chemical control measures should focus on practices such as:
Introduction of natural pest enemies (e.g., parasites and predators
Utilization of syringing techniques
Improving air movement
Soil aeration techniques
Mechanical traps
Select and use chemical pest control as supplement to nonchemical control
Treat problems at the proper time and under the proper conditions to maximize effectiveness with minimal environmental impact
Use spot treatments, rather than broadcast treatments, for early, effective control of problems before damage thresholds are reached
All plant protecting products should only be applied by or under the supervision of a trained, licensed applicator or as dictated by law.
Maintain excellence in the continuing education of applicators.
Develop Chemical Management Plan
Store and handle all pest control and nutrient products in a manner that minimizes worker exposure and/or the potential for point or non-point source pollution</td></tr>
</table>

AFFECTED ENVIRONMENT	MITIGATION MEASURES
	• Employ proper chemical storage practices and use suitable personal protective equipment and handling techniques • Inform golfers and guests about golf course chemical applications. Common methods include permanent signs on the first and tenth tee boxes and/or notices posted in golf shops and locker rooms • Dispose of chemical rinsate in a manner that will not increase the potential for point or non-point source pollution. Methods include rinsate recycling or "spraying out" diluted compound in previously untreated areas • Dispose of chemical packaging according to label directions (e.g., triple rinsing, recycling or returning to manufacturer • Other waste products, such as used motor oil, electric batteries and unused solvents, should be recycled or disposed of according to the law and available community disposal techniques • Seek to reduce waste by purchasing products that minimize unnecessary packaging • Train and require staff to implement Chemical Management Plan and Pest Management Plan
Terrestrial Fauna	• Habitat for wildlife species that help control pests (e.g., bats, bluebirds, purple martins, etc.) should be protected. Additional habitat for these beneficial species should be created whenever feasible and environmentally desirable. • Manage habitat to maintain healthy populations of wildlife and aquatic species. • Species such as skunks, non-migratory Canada geese, and deer, when they become damaging, should be managed through non harmful means whenever possible. Non harmful control methods could include dogs, noisemakers, repellents, and trapping and removal. Managed hunting may be appropriate where legal and safe. • Develop wildlife management plan. • Train and require staff to implement Wildlife Management Plan. • Educate visitors to discourage molesting or feeding wildlife.

Source: Beyond Pesticides 1996

4.2 Cruise Ships (Table G-11)

Table G- 11: Specific mitigation measures for cruise ships

AFFECTED ENVIRONMENT	MITIGATION MEASURES
Water Quality Aquatic Fauna and associated Ecosystems	**Wastewater Discharges (black water, grey water, swimming pools, kitchens, laundry, ship maintenance and deck washing)** • Establish treatment criteria for Marine Sanitation Devices (MSDs) • Establish discharge prohibition zones in coastal areas ○ Restrict discharges to be at least 1 nautical mile from coast, at speeds of at least 6 knots • Train staff on treatment and discharge requirements • Monitor discharges **Ballast Water** • Establish Ballast Water Management • Ensure that ballast water meets required standards before discharging **Solid Waste** • Separate recyclables from waste stream and dispose of responsibly at portside • Do not discharge of plastic or rubber within 3 miles of coast • Do not discharge any waste, food, or macerated waste into any marine sanctuary
Air Quality	• Establish and comply with exhaust emission standards • Establish Speed Reduction Zones • Use cleaner fuels • Use of electrical power dockside rather than shipboard diesel • Do not burn or incinerate waste in coastal waters

Source: California Cruise Ship Environmental Task Force 2003

Table G- 12: Marine development impacts, management and mitigation

ACTIVITY	IMPACTS	MANAGEMENT AND MITIGATION
Coastal tourism development		
Population pressures	Increased pressure on services such as sewage, transport, electricity Impacts on social values and amenity	Regional planning taking into account cumulative impacts
Construction of tourism developments	Effects on catchment water quality	Environmental impact assessment; Best-practice construction techniques; Monitoring (see Table G1)
Tourism infrastructure (island-based)		
Marina/ harbor development	Local, on affected reef area Water quality (antifoulants) Introduced pests Impacts on social values and amenity	Environmental impact assessment; Engineering design; Reactive monitoring; Water quality monitoring
Sewage discharge	Depends on treatment level Elevated nutrients and turbidity Freshwater input	Requirements for discharge levels; Water quality monitoring; Tertiary treatment; Land irrigation
Construction	Vegetation damage Loss of wildlife habitat Sediment runoff	Environmental impact assessment; Best-practice construction techniques; Water quality monitoring
Tourism activities	Focus for motorised and nonmotorised vessels and marine activities	As discussed below
Tourism infrastructure (marine-based)		
Pontoons	Shading of benthos Dragging of moorings Focus for tourist activities	Permit required; Appropriate design; Careful selection of location; Transplant susceptible biota away from site
Moorings	Local damage to benthos Reduce impacts from anchors	Encouraged to reduce anchor damage; Appropriate design; Liability and safety issues
Fish feeding	Focus of fish aggregations	Activity limited by permit; Best-practice for fish feeding
Boat-induced damage		
Anchoring	Local coral damage, oil spills Cumulative impacts	Installation of private and public moorings; Codes of practice in other areas; Anchor over sand; Spill Control and Prevention Plan in place, Spill control equipment nearby; education program
Ship groundings	Damage to reef structure Local benthos damaged Anti-fouling paint on reef Risk of oil or chemical spills	Education of private and charter users; Anchor over sand; Spill Control and Prevention Plan in place, Spill control equipment nearby
Litter	Potential harm to wildlife Aesthetics	Education program; Penalties
Waste discharge	Local nutrient enhancement Potential water pollution	Education program; Penalties; Storage tanks in boats
Vessel strike/ disturbance to wildlife	Injury/death and/or disruption to social bonds	Education program; Penalties; Speeds limits, especially in shallow seagrass areas

ACTIVITY	IMPACTS	MANAGEMENT AND MITIGATION
Water-based activities		
Diving	Local damage to fragile corals	Education program; Industry code-of-practice; Dive briefings; Site selection for inexperienced divers
Snorkeling	Local damage to fragile corals	Education program; Industry code-of-practice; Provision of resting buoys and flotation; Briefings
Reef walking	Coral breakage	Education program; Industry code-of-practice; Walking trails to focus damage
Fishing	Small relative to recreational and commercial	Zoning requirements; Industry code-of-practice
Wildlife Interactions		
Seabirds	Close contact can damage nesting sites and breeding	Legislation; Education program; Industry code code-of-practice; Limited access to breeding sites; Briefings
Turtle-watching	Uncontrolled access can affect breeding success	Education program; Industry code-of-practice; Briefings; Trained guides; Limit access to key breeding sites
Whale-watching	Potential for whales to be disturbed by uncontrolled contacts	Legislation; Education program; Industry code of-practice; Trained guides; Limit entry for ‘dedicated’ operators
Fish feeding by divers	Wrong diet; disease and enhanced capture risk; fish dependency; human; danger	Education program; Legislation; Guidelines; Briefings; Permit conditions

Source: Harriott, VJ. 2002. *Marine tourism impacts and their management on the Great Barrier Reef*. CRC Reef Research Centre Technical Report No 46. CRC Reef Research Centre, Townsville.

5 MONITORING AND OVERSIGHT

Monitoring plans for the affected resources are necessary to assure that methods used and results obtained can be used to:

- Confirm the implementation of mitigation measures and other aspects of project design as proposed in the EIA
- Confirm that the mitigation measures are performing to the level assumed in the EIA
- Confirm that the project is meeting a country’s regulations and standards
- Establish the need for additional mitigation measures where there was uncertainly about whether some additional actions may be necessary assure that criteria established in the EIA are met.

The monitoring plan should address all phases of the Tourism project: siting, construction, operation, closure and site reclamation. Monitoring plans should include a clear statement of purpose; the methods, frequency and location of monitoring; criteria for evaluation of results; and any required reporting of results. Methods used should be carried out by competent professionals following scientifically accepted methods. The monitoring plan should also include contingency plans identifying actions that will be taken should monitoring results indicate that a performance limit has been exceeded.

The scope of monitoring depends on the location, complexity of the operation and the severity of the potential impacts. Monitoring results will determine if:

- Environmental measures are performing as required and results are as predicted, thus triggering release of financial assurance by the regulatory authority.
- Environmental measures need to be adjusted to reach the criteria goals.
- Enforcement is needed.

As such, the monitoring plan should be designed to meet the following objectives:

- To demonstrate compliance with the standards in the approved EIA and other national and local environmental laws and regulations
- To provide early detection of potential problems
- To supply information that will assist in directing corrective actions should they become necessary, including after the Tourism facility is closed

Where applicable, the monitoring should include:

- Details on type and location of monitoring devices.
- Sampling parameters and frequency.
- Analytical methods and detection limits.
- Quality assurance and quality control procedures.
- Reporting procedures (to whom, how often, etc.).
- Who will conduct and pay for monitoring.
- Procedures to respond to adverse monitoring results.

One of the values of a monitoring program is the early detection of potential problems. A good way to mitigate air or water quality impacts, for example, is to detect trends in samples and take early corrective action before violations of the performance standards occur. The monitoring plan should be tied to the environmental measures plan so that, if monitoring indicates problems (e.g., if air or water quality standards are violated or are about to be violated), specific corrective action procedures will be implemented by the owner/operator. It should not be left vague (e.g., "the company will work with the ministry to resolve the problem" is too vague).

The plan should also include the standards and criteria that should be met. Examples of monitoring programs which may be necessary include:

- Air quality
- Surface and ground water quality and quantity
- Revegetation success
- Noise levels
- Visual impacts
- Wildlife mortality and other wildlife impacts

Financial assurances may be required to ensure adequate funds will be available to implement the monitoring plan and mitigate detected problems if any, both during and after the generation and transmission projects. Some problems may not become evident for many years (e.g., groundwater contamination), so in some cases monitoring may need to be conducted for the duration of the project and even after closure. How long the funds are held can vary based on the type of operation and the modeling predictions.

6 FINANCIAL ASSURANCE

Financial assurance is usually required of mine operations because of the long term nature of post-closure environmental measures and the economic uncertainties that can accompany mining given the markets for non-metal and metal minerals. Their application to tourism projects will depend upon the nature of the project and country practices. In such cases a financial guarantee may be required as a component of ongoing mitigation or monitoring measures and post-closure process to cover the costs of closure or operation of critical equipment for monitoring and treatment should the project owner be unable to do so. Since these costs are the responsibility of the project owner/operator, these costs are not included in the budgets of regulatory agencies, nor should they be. In addition, if monitoring, maintenance, and/or treatment activities will be required after power plant closure over a long-term (decades or even in perpetuity), a long-term trust fund should be established at the start of the project to ensure funds will be available as long as they are needed to conduct this work.

6.1 Financial Guarantees for Mitigation and Monitoring Measures and Restoration

Government agencies need financial sureties that are readily available to ensure that environmental measures and site restoration occur, if needed. Should the project owner default on environmental measures or restoration commitments, funds may be required immediately for an outside contractor to operate and maintain key facilities such as water treatment plants. Restoration and post-closure activities conducted by an outside contractor cost more than activities conducted by the owner because the contractor or the government itself will have mobilization and other costs that the company did not have while it was operating the development. Therefore, the cost estimate upon which the surety is based should be calculated to include the costs of a third party conducting the work. It should also be accurate and up to date. Unfortunately, errors in these calculations have required millions of dollars of taxpayer subsidy to close bankrupt operations.

Governments have employed a number of financial vehicles to meet surety requirements. These vehicles generally take two forms: independently guaranteed sureties and sureties guaranteed by power generation companies. Because tourism companies can and do go bankrupt, NGOs and governments favor sureties that are independent of the company operating the project, usually in the form of a bond, irrevocable letter of credit, cash deposit or some combination of these instruments. Where a financial surety is guaranteed by the tourism project operator through corporate guarantee, governments should assess the additional risks posed by relying on these instruments since they would be unavailable should the company go bankrupt.

The financial sector has not developed specific requirements for sureties, although banks risk significant loss of capital if a company were to declare bankruptcy while still holding outstanding loans. Finally, considerable information is available on the calculation of the financial surety for any project. Because of problems encountered with financial sureties some academics and leading NGOs have urged for more government and public scrutiny, some of their recommendations are presented in Table G-13.

Table G- 13: NGO recommendations for financial guarantees

OPERATIONAL AND REGULATORY MEASURE	DESCRIPTION
Review	Financial sureties should be reviewed and upgraded on a regular basis by the permitting agency, and the results of the review should be publicly disclosed. The power generation industry and governments should work more closely with NGOs to implement realistic review schedules and procedures for reviewing financial sureties.
Public Awareness	The public should have the right to comment on the adequacy of the restoration and closure plan and the long-term post-closure plan, the adequacy of the financial surety, and completion of restoration activities prior to release of the financial surety.
Guarantees	Financial surety instruments should be independently guaranteed, reliable, and readily liquid. Sureties should be regularly evaluated by independent analysts using accepted accounting methods. Self-bonding or corporate guarantees should not be permitted.
Release	Financial sureties should not be released until restoration and closure are complete, all impacts have been mitigated, and cleanup has been shown to be effective for a sufficient period of time after project closure.

Source: Adopted from Miranda et al. 2005

7 AUDITABLE AND ENFORCEABLE COMMITMENT LANGUAGE

An acceptable EIA document should not merely repeat the list of generic environmental measures listed in the preceding subsections. The accompanying text describes the level of detail necessary for a reviewer to assure that the proposed environmental measure meets its intended purpose, that the environmental measure will be adequate to address the underlying environmental, economic or social issues. Auditors and compliance and enforcement authorities require specific and legally binding language to assure that obligations have been met or to determine whether the project proponent is fulfilling its responsibility and commitments.

The wording and detail in the EIA document becomes even more critical in the absence of a connected permit or other means for government to independently craft and/or negotiate commitment language for proposed environmental measures. Therefore, understanding the extent to which a country will rely on the EIA document itself to hold project proponents accountable for environmental measures is important. This section provides examples of the kinds of detail a reviewer should look for in determining whether commitment language will be sufficient to ensure that promised actions will be taken by a project proponent and that their adequacy can be determined over time.

The proposed environmental measures should be clear about:

Who: The party responsible for taking action should be clearly assigned.

- Is the project proponent relying on the community to take certain actions?
- What is to happen when the project proponent is gone, after closure?

When: Timing issues are very important. Without a timeframe nothing will happen and whatever does happen may not be adequate:

- How long after the closure of a resort would the project proponent monitor emissions and effluents? X years following closure? Until emissions and effluents are proven to be negligible?
- When would revegetation and re grading take place, if deemed necessary?
- When would remedial action be taken if monitoring indicates there is a problem? Would it be within days? Weeks? Months? Would the plant or transmission segment need to modify operations or shut down in the interim? Who would decide this and what are the penalties of non-compliance?

What: Effectiveness will depend largely on what is being proposed:

- What performance standards will be used to interpret monitoring results?
- What level of treatment/control will be purchased and installed?
- What technology will be used and will it be sufficient to prevent, treat, or control the kind of contaminants that will be found in the effluent? Or emissions?
- What size wastewater treatment plant or drinking water treatment plant will be built and will it be sufficient for the expected flow?
- Are the species being used for revegetation indigenous to the area?

How: What resource commitment will be made to ensure that measures will be undertaken at the levels indicated?

- What financial commitments are made? What financial instrument is being used to guarantee adequate funds will be available to implement all commitments? How will financial guarantees be increased if they need to be adjusted during or after operations?
- Specify the staffing, management and oversight commitments.
- Specify all equipment commitments.

The following subsections present examples of language for financial assurance, water quality monitoring, restoration, and revegetation that could be used to ensure that the commitment language in the EIA is reviewable, auditable and enforceable.

7.1 Construction Practices

a. Construction impacts will be confined to the minimum area necessary to complete the project.
b. Alteration or disturbance of the stream banks and existing riparian vegetation will be minimized to the greatest extent possible.
c. No herbicide application should occur as part of this action. Mechanical removal of undesired vegetation and root nodes is permitted.
d. All existing vegetation within 45 meters of the edge of bank should be retained to the greatest extent possible.

e. Temporary access roads.
    i. Steep slopes. Do not build temporary roads mid-slope or on slopes steeper than 30 percent.
    ii. Temporary stream crossings.
f. Do not allow equipment in the flowing water portion of the stream channel where equipment activity could release sediment downstream, except at designated stream crossings.
g. Minimize the number of temporary stream crossings.
h. Design new temporary stream crossings as follows:
    i. Survey and map any potential spawning habitat within 90 meters downstream of a proposed crossing.
    ii. Do not place stream crossings at known or suspected spawning areas or within 90 meters upstream of such areas if spawning areas may be affected.
    iii. Design the crossing to provide for foreseeable risks (e.g., flooding and associated bedload and debris) to prevent the diversion of stream flow out of the channel and down the road if the crossing fails.
    iv. Vehicles and machinery will cross riparian buffer areas and streams at right angles to the main channel wherever possible.
i. Obliteration. When the project is completed, obliterate all temporary access roads, stabilize the soil, and revegetate the site. Abandon and restore temporary roads in wet or flooded areas by the end of the in-water work period.
j. Vehicles. When heavy equipment will be used, the equipment selected will have the least adverse effects on the environment (e.g., minimally sized, low ground pressure equipment).
k. Site preparation. Conserve native materials for site rehabilitation.
    i. If possible, leave native materials where they are found.
    ii. If materials are moved, damaged, or destroyed, replace them with a functional equivalent during site rehabilitation.
    iii. Stockpile any large wood, native vegetation, weed-free topsoil, and native channel material displaced by construction for use during site rehabilitation.
l. Isolation of in-water work area. If adult or juvenile fish are reasonably certain to be present, or if the work area is less than 300 ft upstream of spawning habitats, completely isolate the work area from the active flowing stream using inflatable bags, sandbags, sheet pilings, or similar materials.
m. Earthwork. Complete earthwork (including drilling, excavation, dredging, filling, and compacting) as quickly as possible.
n. Excavation. Material removed during excavation will only be placed in locations where it cannot enter sensitive aquatic resources. Whenever topsoil is removed, it should be stored and reused on site to the greatest extent possible. If culvert inlet/outlet protecting riprap is used, it will be class 350 metric or larger, and topsoil will be placed over the rock and planted with native woody vegetation.
o. Drilling and sampling. If drilling, boring, or jacking is used, the following conditions apply.
    i. Isolate drilling activities in wetted stream channels using a steel pile, sleeve, or other appropriate isolation method to prevent drilling fluids from contacting water.
    ii. If it is necessary to drill through a bridge deck, use containment measures to prevent drilling debris from entering the channel.
    iii. If directional drilling is used, the drill, bore, or jack hole will span the channel migration zone and any associated wetland.
    iv. Sampling and directional drill recovery/recycling pits, and any associated waste or spoils, will be completely isolated from surface waters, off-channel habitats, and wetlands. All drilling fluids and waste will be recovered and recycled or disposed to prevent entry into flowing water.

p. Site stabilization. Stabilize all disturbed areas, including obliteration of temporary roads, following any break in work, unless construction will resume within 4 days.

7.2 Flow Releases and Monitoring

7.2.1 Wastewater

A detailed monitoring program shall be implemented to ensure that discharges for wastewater treatment facilities discharges into rivers, streams, groundwater, and ocean bodies meet appropriate standards.

7.2.2 Air

An air quality monitoring program shall be implemented to ensure that emissions from power plants, vehicles, and other emitters meet appropriate standards.

7.3 Endangered Species Management

To protect endangered bird species from disturbance, the project shall be constructed and maintained according to the following schedule:

7.3.1 Construction

a. January 1 through February 28--Operation of heavy equipment is permitted between the hours of 10:00 AM to 4:00 PM. Lightweight passenger vehicles may enter the area and personnel may conduct activities deemed to be of low-disturbance potential (e.g., install wiring, program computers, and interior finish work) between the hours of 8:00 AM and 5:00 PM.
b. March 1 through August 31--Blasting/boring of dam is prohibited. Operation of heavy equipment is permitted only between the hours of 10:00 AM to 4:00 PM. Lightweight passenger vehicles may enter the area and personnel may conduct activities deemed to be of low-disturbance potential (e.g., install wiring, program computers, and interior finish work) between the hours of 8:00 AM and 5:00 PM.
c. In-stream work shall occur during the autumn to avoid temporary disturbance to the prey base during the nesting season.

7.3.2 Operation

With the exception of safety related emergencies, any maintenance or repairs requiring the use of blasting or boring equipment shall be scheduled from September 1 to February 28 to avoid the sensitive nesting season. Maintenance or repairs that require the use of heavy equipment from March 1 through AugusT 31 shall be limited to the hours of 10:00 AM to 4:00 PM.

H. ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) serves to combine elements of environmental management that are built into the design of the tourism projects or are identified as monitoring and measures. The EMP, which in some CAFTA-DR countries is referred to as an Environmental Management Program, consists of a series of components or plans required either as an enforceable component of the Environmental Impact Assessment (EIA), an attachment or separate document. As presented in Table H-1, an EMP includes: plans for water management, vegetation removal, site preparation, construction, plans for monitoring and mitigation measures, and other components.

Throughout these guidelines, approaches are presented to assist reviewers of these plans to ensure that they meet the goals of the overall Environmental Impact Assessment process. Table H-1 presents inputs and measures that should be considered in these plans. The basic concepts presented in this table should be considered when developing environmental management components for various types of tourism projects adjusted of course by country specific requirements.

An EMP would also include contingency plans to reduce the risk and respond to threats of natural disasters and accidents. The spill prevention and control plan described in the text box is such a plan.

Table H- 1: Components of an environmental management plan: program and plan elements

PLAN		INPUT
WATER MANAGEMENT	General	• Describe measures to be implemented to manage water. • Identify and assess how to divert natural runoff away from site to prevent pollution of this water.
	Water Use and Recycling	• Describe methods to be used to minimize the volume of fresh water that is used for operations and irrigation and to maximize the recycling of water. • Describe what to avoid or minimize the use of fertilizers, herbicides and pesticides that have the potential to run-off site or percolate to groundwater. • Describe water conservation methods to be implemented during operations (i.e. low flow toilets, low volume shower heads, collection of grey water for use in irrigation). • Describe educational strategies for staff and visitors to reduce water consumption (ie. Discourage daily linen and towel exchanges, invoke conservation practices for laundry operations).
	Diversion and Wastewater Stream Consolidation	• Define how best to consolidate treatment for all wastewater sources. • Describe methodologies such as the use of ditches or dikes to divert all clean streams and drainage runoff away from areas of possible contamination locating these structures on maps. • Define and locate on maps effluent discharge points and their relationship to environmentally sensitive areas. • Show typical ditches and water holding facilities designed for extreme runoff events (100-yr or maximum probable runoff events).
	Water quality	• Predict run-off from fuel storage and impervious ground cover. • Present timing and conditions during which such run-off may be expected to occur. • Determine other potentially harmful components in run-off, including fertilizers, herbicides, pesticides, detergents, oils and greases.
	Monitoring	• Provide the design for a water monitoring program indicating the locations on site maps of potential water and seepage sampling stations on the facility. • Develop a Sampling and Analysis Plan for water sampling, handling and analyses protocols (where analyses are completed by outside laboratories, the owner/operator or their consultants should have copies of the protocols used). • Develop a database that is updated as sampling is undertaken including hydro-climatological data including but not limited to rainfall, air temperature, solar radiation, relative humidity,

PLAN		INPUT
		wind direction, speed, evaporation, water levels in wells, stream flow and water quality. • Provide a methodology to calibrate hydrological models that were used in planning the water management system.
	Erosion and Sediment Control	• Determine site erosion potential and identifying water bodies at risk. • Develop a re-contouring plan designed to reduce the susceptibility of soil to erosion. • Define a program for revegetation and maintenance of buffer zones adjacent to water bodies for erosion control. • Develop a plan to divert site drainage away from cleared, graded, or excavated areas. • Define how the facility will use and maintain sediment barriers or sediment traps to prevent or control sedimentation. • Directing surface runoff from erodible areas to a settling pond prior to discharge to the environment. • Present a monitoring and maintenance program to ensure that erosion and sediment control measures are effective.
	Wastewater	Develop a wastewater treatment plan based on: • The water management plan. • The results of prediction of wastewater quality. • Relevant regulatory requirements for effluent quality. • Relevant environmental performance indicators, including any water quality objectives.
	Domestic Wastewater and Sewage Disposal	• Develop a plan for sewage or domestic wastewater treatment with the objective of these facilities is to prevent the contamination of surface water and groundwater, including drinking water supplies, and to meet all applicable regulatory standards. Sludge from the treatment of sewage and domestic wastewater should be disposed of in an acceptable manner.
BIOLOGICAL RESOURCES	Vegetation Clearing	• Develop a plan to minimize areas to be cleared. • Define on maps buffer zones of natural vegetative cover showing that at least 100 m of natural buffer zones are retained wherever possible between cleared areas and adjacent bodies of water. • Provide similar plans for sensitive coastal and aquatic zones. • Present a plan to show that the time between clearing of an area and subsequent development is minimized. • Prohibit the burning of vegetations, slash and other combustibles on-site.
	Revegetation	A revegetation plan should be developed for the tourism facilities and transportation corridors, taking into consideration the following: • Re-establishing soil cover on the site with consideration being given to the characteristics of the soil that will be used as well as the soil requirements of the vegetation to be established on the site. • Species used in revegetation and the resulting plant community should be consistent with the goals of site closure and the intended post-closure use of the site. Species native to the area around the site should be used for this purpose, and invasive species should never be used. • Monitoring programs should be designed and implemented during plant or corridor closure to ensure that closure activities and any associated environmental effects are consistent with those predicted in the closure plan and to ensure that the objectives of closure plan are being met.

PLAN		INPUT
	Environmentally Sensitive Areas	• Show on plan view and use of typical drawings that all facilities are located and designed to avoid land-based and aquatic environmentally sensitive areas. The determination of environmentally sensitive areas should be undertaken in consultation with appropriate stakeholders, local communities and government officials. • Determine site erosion potential and identifying water bodies at risk. • Develop a re-contouring plan designed to reduce the susceptibility of soil to erosion. • Define a program for revegetation and maintenance of buffer zones adjacent to water bodies for erosion control. • Develop a plan to divert site drainage away from cleared, graded, or excavated areas. • Define how the facility will use and maintain sediment barriers or sediment traps to prevent or control sedimentation. • Directing surface runoff from erodible areas to a settling pond prior to discharge to the environment. • Present a monitoring and maintenance program to ensure that erosion and sediment control measures are effective.
GEOLOGY AND SOILS	Geologic Materials	• Develop a site-specific program for the identification and description of rock and other geological materials that will be or have been moved or exposed as a result of construction activity should include, for each material: ○ Spatial distribution of the material, as well as the estimated mass of material present. ○ Geological characterization of the material, including its mineral and chemical composition. ○ Physical characterization of the material, including grain size, particle size and structural characteristics including fracturing, faulting and material strength. • Develop an inventory of earth materials that will be needed for construction and operations. • Identify reputable and licensed sources of these materials. • Require the contractor to certify that the materials were obtained from licensed and approved quarries. • Require that have available for inspection on site copies of the license and manifest for haul loads. • Construction site management plan should include a materials management plan that includes a site map which provides for storage of fine – grained materials (sand and marl) in bermed areas away from shorelines and drainages.
WASTE MANAGEMENT	Solid Waste	• Develop a plan for the disposal of solid waste generated by tourist operation. This would include the location and design of a solid waste landfill and the separation of potentially hazardous wastes from the disposed of solid waste. • Define a disposal program for on site or in a landfill disposal. Plan for wastes from on-site kitchen and dining facilities should be disposed of in a manner that does not attract wildlife. • Develop measures that should be put in place to ensure that all food wastes and food containers are properly disposed of, including those used away from kitchen and dining facilities. • Define training programs to ensure that all employees and on-site contractors are aware of the importance of proper disposal of food wastes and the importance of not feeding wildlife on site. • Construction Management plan should include designated waste storage areas (food, solid, recyclables, hazardous, etc.), collection and removal schedules, identification of approved disposal sites and a system for supervision and monitoring. • Likewise the same should be required in the Tourism Operations Plan.

PLAN		INPUT
	Spill Prevention and Control	Develop a plan to design and construct chemical storage and containment facilities to meet the appropriate standards, regulations and guidelines of pertinent regulatory agencies and the owner/operator's environmental policy, objectives and targets. As a minimum, chemical storage and containment facilities should: • Site-specific chemical management procedures should be developed and implemented for the safe transportation, storage, handling, use and disposal of chemicals, fuels and lubricants. • Be managed to minimize the potential for spills. • Provide containment in the event of spillage and be managed to minimize opportunities for spillage. • Comply with international standards. • Ensure that incompatible materials are stored in ways to prevent accidental contact and chemical reactions with other materials. • Minimize the probability that a spill could have a significant impact on the environment. • Evaluated periodically to determine possibilities to reduce the quantities of potentially harmful chemicals used. • Ensure for maintenance shops that potential contaminants, such as used lubricants, batteries and other wastes, are properly managed with appropriate disposal mechanisms for these materials. Stores should be managed such that potentially hazardous materials are handled in accordance with procedures detailed in the environmental management system for the facilities.
ECONOMIC INFRASTRUCTURE	Access Roads	Define measures that will be designed and implemented to prevent and control erosion from roads associated with all facilities. These measures should include: • Providing buffer zones of at least 100 m between roads and water bodies to the extent practicable. • Designing road grades and ditches to limit the potential for erosion, including avoiding road grades exceeding 12% (5% near water bodies). • Designing and constructing stream crossings for roads in a manner that protects fish and fish habitat preventing sedimentation of the streams and not obstructing movement of fish.
	Pipelines	• Provide the routes of pipelines and transmission lines on maps. Routes should be selected so as to limit risk of harm to aquatic, terrestrial ecosystems and animal migration routes in the event of a failure. • Show that pipelines will be designed to reduce the risk of failure. • Define measures to limit impacts in the event of a failure. • Develop an inspection plan for pipelines with inspections taking place on a regular basis to ensure they are in good condition. • Define monitoring systems to alert operators in the event of a potential problem.
	Decommissioning	• Describe a decommissioning program for the tourism-related facilities showing that any contamination associated with facility operations, vehicle and equipment operations and maintenance will be remediated. • State how signs will be posted warning the public of potential dangers associated with the site. • Develop a plan that shows how on-site facilities and equipment that are no longer needed will be removed and disposed of in a safe manner. • Develop a plan for the rehabilitation of roads, runways or railways that will not be preserved for post-closure use with bridges, culverts and pipes being removed so that natural stream flow is restored, and stream banks are stabilized with vegetation or by using rip-rap. In addition, the plan should show that surfaces, shoulders, escarpments, steep slopes, regular and irregular benches, etc., are be rehabilitated to prevent erosion with surfaces and shoulders being scarified, graded into natural contours, and revegetated. • Define a program that shows how infrastructure will be dismantled and removed, except in cases where this infrastructure is to be preserved for post-closure land use or will be needed for post-closure monitoring, inspection and maintenance.

PLAN		INPUT
AIR QUALITY AND CLIMATE	Emissions Control	Develop site-specific plans to be implemented to minimize releases of air borne emissions, including greenhouse gases. Plans should describe: • Potential sources of releases of air borne emissions, including greenhouse gases. • Factors that may influence releases of air borne emissions, including greenhouse gases. • Measures to minimize releases of air borne emissions, including greenhouse gases. • Monitoring and reporting programs for releases of air borne emissions, including greenhouse gases. • Mechanisms to incorporate the results of monitoring programs into further improvements to measures to minimize releases. • Mechanisms to periodically update the plans.
	Particulates	Develop site-specific plans to be implemented to minimize releases of airborne particulate matter. These plans should describe: • Potential sources of releases of airborne particulate matter, including specific activities and specific components of operation. • Factors that may influence releases of airborne particulate matter, including climate and wind. • Potential risks to the environment and human health from releases of airborne particulate matter. • Measures to minimize releases of airborne particulate matter from the sources identified. • Monitoring programs for local weather, for consideration in the ongoing management of releases of airborne particulate matter. • Monitoring and reporting programs for releases of airborne particulate matter and for environmental impacts of releases. • Mechanisms to incorporate the results of monitoring programs into further improvements to measures to minimize releases. • Mechanisms to periodically update the plans. • Consistent with national or international standard for particulate matter (PM), by way of example in Canada the concentration of particulate matter less than 2.5 microns in size (PM2.5) should not exceed 15 ìg/m3 (24-hour averaging time) outside the boundary of the facilities. • Engines in vehicles and stationary equipment should be maintained and operated in a manner that minimizes emissions of criteria air contaminants, particularly: total particulate matter (TPM); particulate matter less than or equal to 10 microns (PM10); particulate matter less than or equal to 2.5 microns (PM2.5); sulphur oxides (SOx); nitrogen oxides (NOx); volatile organic compounds (VOCs); and carbon monoxide (CO).
	Climate Change (Carbon reduction)	Develop strategies for reducing carbon releases to the atmosphere and how they will be implemented. The carbon reduction plan should include the use of heavy equipment and vehicles that are fuel efficient and/or use alternative fuel. Increased thermal or mechanical efficiencies, reduction of losses of methane, if natural gas is a fuel, and proper stoichiometry of combustion to reduce formation of N2O are also means of reducing GHG emissions. Sample methods for reduction in greenhouse gas emissions are as described under the Emission Control Plan.
NOISE AND VIBRATION	General	Define site-specific assessments to be conducted to identify sources, or potential sources of noise and vibrations, and measures should be implemented to reduce noise levels from these sources. Such measures should include consideration of: • Elimination of noise and vibration sources. • Locate and align activity areas so that noise does not project toward known receptors. • The purchase of equipment with improved noise characteristics. • Proper maintenance of equipment. • Enclosure or shielding of sources of noise. • Suppression of the noise at source. • Locating noise sources to allow natural attenuation to reduce levels to potential recipients. • The operation of noise sources only during hours agreed to in consultation with local communities. Monitoring should be conducted to assess the effectiveness of these measures and if national or related International standards are exceeded so that improvements in noise reduction can be made improvements in noise reduction.

PLAN		INPUT
		• Provide safety protocols that ensure their use during construction blasting operations such as safety zones to prevent unauthorized entry, warning signals to alarm nearby workers and residents of impending blasts and all clear signals to note when the area is safe to reenter. • Define the size of explosive charges to minimize vibrations. • Ensure that blasts do not exceed acceptable national or international vibration criteria --by way of example limit ground vibrations to below 12.5 mm/s (peak particle velocity) and limit air vibrations to 133 dB. • Allow for natural attenuation to reduce noise and dust or debris at the source and impacts to nearby residents. • Provide for the enclosure or shield sources of noise including planting vegetative barriers, construction of berms and walls. • Ensure that piling operations do not impact nesting, breeding , calving and other sensitive aquatic habitats. • Provide for designated areas where Tourism operations known to produce noise and vibrations (motor boats, jet skis, off-road vehicles.) • Institute "carrying capacity" limits for the same activities in sensitive areas.
MONITORING	Facilities Monitoring	• Develop a monitoring program to check and report on the performance, status and safety of water management facilities. • Define a pipeline inspection program to evaluate flow and hydraulic integrity. • Describe inspection measures for drainage ditches and dikes to evaluate sediment accumulation and bank erosion and damage. • Provide construction controls, including the use of a construction management program. • Procedures for dust control. • Quality assurance and quality control measures for all aspects of operations, monitoring and inspections. • Develop a plan to collect data required for modeling. • Describe how to evaluate the effectiveness of measures that have been implemented to prevent and control potential surface seeps and groundwater contamination. • Develop a plan to identify potential sources of water pollutants and monitor accordingly. • Develop a plan to monitor freshwater source depletion in coastal areas and prevent saltwater intrusion.
	Temporary and Long-term Project Closure	• Develop a program that the anticipated costs of site closure are re-evaluated regularly throughout the project life cycle. The owner/operator should ensure that adequate funds are available to cover all closure costs, and the amounts of any security deposits should be adjusted accordingly. • Describe a program for sites where it is determined that long-term monitoring, maintenance or effluent treatment will be necessary post closure, mechanisms should be identified and implemented that will ensure that adequate and stable long-term funding is available for these activities. In determining funding levels required, consideration should be given to contingency requirements in the event of changes in economic conditions, system failures, or major repair work post closure. • Develop a plan for the care and maintenance of the site in the event that operations are suspended. The plan should include continued monitoring and assessment of the environmental performance of the site, as well as the maintenance of all environmental controls necessary to ensure continued compliance with relevant regulatory requirements. • The Final closure plan should address the following environmental aspects: surface and ground water, revegetation, and fauna.
	Long-term Monitoring and Maintenance	At sites where long-term risks are identified a maintenance plan should be developed and implemented, as appropriate, to ensure post-closure monitoring and maintenance of these facilities. This plan should include the following elements: • Identification of roles and responsibilities of persons to be involved in monitoring and maintenance. • Identification of aspects to be monitored and the frequency. • Identification of routine maintenance activities to be conducted and the frequency. • Description of contingency plans to address any problems identified during routine maintenance and monitoring.

CONTINGENCY PLANS	Contingency plans are those put in place to address predicted risks should other mitigation measures in the environmental management plan fail to be adequate. It assumes that risk identification and risk reduction have been addressed in other parts of the EIA.	
	Performance-related Contingency Plans	Plans to describe the steps that will be taken to respond to results that indicate: • Environmental Standards are not being met. • Impacts are greater than predicted. • The mitigation measures and/or rehabilitation are not performing as predicted. Contingency Plans should include steps to ensure: • Persons responsible and accountable for response, their roles, contact information. • Steps to be taken to minimize adverse environmental and socio-economic-cultural harm. • Timely response. • Commitment of staff and resources such as equipment on hand or accessible as needed for response. • Appropriate notification of officials. • Appropriate notification of the public.
	Contingency Plans for Risks from Natural Disasters	For risks identified within the impact assessment, including risks from: • Hurricanes • Flooding • Mudslides • Seismic activity--earthquakes • Tsunamis • Volcanic Activity Contingency plans should include: • Persons responsible and accountable for response, their roles, contact information and alternates. • Steps to be taken to minimize adverse environmental and socio-economic-cultural harm. • Coordination with national and local response efforts. • Equipment on hand and needed for response. • Relevant training programs. • Relevant notification requirements for government and the public.
	Other Risks	These might include risks that may not be adequately covered in the other elements of the Environmental Management Plan, such as (but not limited to): • Storage and management of hazardous or toxic chemicals • Leaching into groundwater • Dam or impoundment breaches

I. GLOSSARY AND REFERENCES

1 GLOSSARY

Accommodation capacity: The measure of accommodation stock at a defined destination. May be given by various different measures: e.g.number of establishments; number of main units within an establishment (e.g. rooms, caravan stances); capacity in terms of residents (e.g. bedspaces).

Action: Activity to meet a specific purpose and need, which may have effects on the environment and may potentially be subject to governmental control or responsibility. For this document, the term action applies to a specific project.

Adaptive management: A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs and incorporating new information.

Adventure tourism: A form of tourism in natural areas that incorporates an element of risk, higher levels of physical exertion, and the need for specialised skills.

Aesthetic quality: A perception of beauty of natural or cultural landscape.

Affected environment: The existing conditions of the human and natural environments in the areas that could potentially have impacts.

Aesthetic quality: A perception of beauty of natural or cultural landscape.

Alternatives: In an EIA this term refers to options for the project.

Alternative energy: Renewable energy sources such as wind, water, solar, biomass as an alternative to nonrenewable resources such as oil, gas, and coal.

Alternative tourism: In essence, tourism activities or development that are viewed as non-traditional. It is often defined in opposition to large-scale mass tourism to represent small-scale sustainable tourism developments. AT is also presented as an 'ideal type', that is, an improved model of tourism development that redresses the ills of traditional, mass tourism

Ambient: The environment surrounding a body but undisturbed or unaffected by it. For example, ambient air is the air surrounding the site.

Aquatic: Growing or living in or near the water.

Aquaculture: Cultivation of fish, molluscs and other aquatic organisms in fresh or salt water for human use.

Aquifer: A water-bearing rock unit that yields water in a usable quality to a well or spring.

Archeological site: A discrete location that provides physical evidence of past human use.

Assets: Anything that a business owns that will benefit future operations. Assets can be tangible items (e.g., buildings, canoes, equipment) or intangible things (e.g., intellectual property in the form of a patent).

Beach renourishment: A technique used to restore an eroding or lost beach, involving placing appropriately sourced sand on the shoreline to widen the beach, for the purpose of protecting adjoining natural and man-made assets.

Bench mark: A fixed point of reference.

Best management practices: A suite of techniques that guide or may be applied to management actions.

Bioaccumulation: Refers to the accumulation of substances, such as pesticides, or other organic chemicals in an organism. Bioaccumulation occurs when an organism absorbs a toxic substance at a rate greater than that at which the substance is lost.

Bioavailability: Bioavailability refers to the difference between the amount of a substance or chemical, to which a plant or animal is exposed and the actual dose of the substance the entity receives.

Biodiversity: Refers to the variation of life forms within a given ecosystem. Biodiversity is often used as a measure of the health of the biological system.

Biofouling: The undesirable settlement and growth of microorganisms, plants, algae, and animals on submerged structures, especially ships' hulls. Biofouling also occurs on the surfaces of living marine organisms

Biological diversity (biodiversity): The variety of life forms and genes they contain, and the ecosystems they form. Biodiversity is usually considered at four levels; genetic diversity, species diversity, community diversity, and ecosystem diversity.

Cadaster:A public register showing the details of ownership and value of land; also spelled "cadastre"

Cadastral survey: A survey which creates, marks, defines, retraces or reestablishes the boundaries and subdivisions of the public land of the United States. It is derived from the word cadastre, meaning a public record, survey, or map of the value, extent, and ownership of land as a basis of taxation

CAFTA-DR countries: Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras and Nicaragua.

Capacity management: A process that seeks to ensure that their organisations operate at optimum capacity whilst maintaining customer satisfaction levels.

Catchment: The area of land that drains to a watercourse or estuary.

Carrying capacity: The amount of visitor activity that a site or destination can sustain.

Carrying-capacity analysis: Originally a term applied in ecology referring to the maximum number of animals of a given species that a particular habitat could support. In the context of tourism, it refers to the maximum number of tourists a destination can support.

Climate change: Changes in climate attributed to the human-induced increase in concentration of greenhouse gases in the atmosphere. Climate change involves increases in temperature, sea level, and increased frequency of severe weather events such as storms.

Coastal Action Plan: A plan that identifies strategic directions and objectives for use and development in a region or part of a region to facilitate recreational use and tourism, and to provide for protection and enhancement of significant features coast, including the marine environment.

Coastline: Generally where the land meets the sea.

Code of Ethics / Conduct / Practice: Recommended practices based on a system of self regulation intended to promote environmentally and/or socio-culturally sustainable behaviour.

Collateral: The security given to a bank to ensure that a loan is repaid. Some examples of assets that may be used as collateral with lenders are buildings, vehicles or boats. Land is often not acceptable as collateral for loans for ecotourism organizations because it might be difficult to resell.

Community: Community refers to a heterogeneous group of people who share residence in the same geographic area and access a set of local natural resources. The degree of social cohesion and differentiation, strength of common beliefs and institutions, cultural diversity and other factors vary widely within and among communities (Schmink, 1999).*

Community Stakeholder Analysis or Human Context Analysis: This is a study that identifies key information about communities near an ecotourism site pertinent to ecotourism development within the community and in the adjacent ecotourism site. It is essential for full implementation of anEcotourism Management Plan.

Competitive Advantage: The characteristics of an organization that allow it to be more successful in selling and delivering an ecotourism experience than competing businesses. Examples include exclusive access to protected areas, the skills of key personnel or having a name that is more widely recognized by tourists.

Competition Analysis: An analysis performed during business or market planning to determine the organizations, services or activities that may compete for customers. The analysis should identify the strengths and weaknesses of potential competitors and help identify positioning strategies that can differentiate the business.

Concession: An agreement between protected area managers and a private sector business that authorizes the business to offer ecotourism services such as accommodations, restaurant services or the sale of souvenirs within a protected area in exchange for a fee or percentage of sales.

Concessionaire: The provider of a concession service.

Conservation: Can be broadly interpreted as action taken to protect and preserve the natural world from harmful features of tourism, including pollution and overexploitation of resources.

Conservation Area Planning (CAP): A process developed by The Nature Conservancy that is used to identify primary conservation targets for a particular conservation site, then determine the major threats, sources of threats and strategies for mitigating those threats. Previously known as Site Conservation Planning (SCP).

Coral: A general term used to describe a group of cnidarians; indicates the presence of skeletal material that is embedded in the living tissue or encloses the animal altogether.

Coral assemblage: A group of corals.

Coral bleaching hotspot: A region of sea surface temperature (SST) that exceeds the climatological maximum for a region by 1 deg C or more. These conditions may cause sufficient stress to coral reefs to result in coral bleaching.

Coral growth line: A minute growth line on the outer surfaces of corals that have a calcified outer wall. The carbonate is produced by zooxanthellae which create a series of diurnal growth increments.

Cultural resources: Remains of human activity, occupation or endeavor as reflected in districts, sites, buildings, objects, artifacts, ruins, works of art, architecture and natural features important in human events.

Cumulative impact: The impact on the environment that results from the incremental impact of the action when added to other past, present and reasonably foreseeable actions.

Day visitors: Visitors who arrive and leave the same day, irrespective of why they are travelling.

Deforestation: The clearance of naturally occurring forests by the processes of logging and/or burning of trees in a forested area.

Degradation: Any decline in the quality of natural or cultural resources, or the viability of ecosystems, that is caused directly or indirectly by humans.

Destination: The place to which a traveler is going. In the travel industry, any city, area, or country which can be marketed as a single entity for tourists.

Direct impact (or effect): This impact is caused by an action that occurs at the same time and same place as the activity.

Discharge: Outflow of surface water in a stream or canal. Discharge may come from an industrial facility and may contain pollutants.

Diversification: The process of developing new products for new markets, in order to achieve business growth.

Diversity: variety: Multiplicity; range; assortment.

Domestic tourism: Travel within the country of residence.

Drainage: Artificial or natural removal of surface water or groundwater from a certain area.

Drawdown: The decrease in the elevation of the water surface in a well, or local water table or the pressure head of an artesian well due to the removal of groundwater or decrease in the aquifer's recharge.

Ebb current (ebb): The movement of a tidal current away from shore or down a tidal river or estuary.

Ebb strength: Phase of the ebb tidal current at the time of maximum speed; also, the speed at this time.

Ebb tide: Period of tide between a high water and the succeeding low water; falling tide.

Ecology: The relationship between the environment and living organisms.

Ephemeral stream: A stream that flows only in direct response to precipitation.

Ecoregion: An area that is defined by its ecology and covers relatively large areas of land or water, and contains characteristic, geographically distinct assemblages of communities and species.

Ecosystem: A complex system of a community of plants, animals and the system's chemical and physical environment.

Eosystem Based Management (EBM):EBM integrates knowledge of ecological interrelationships to manage impacts within an ecosystem. Effective implementation of EBM should: (1) consider ecological processes that operate both inside and outside ecosystem boundaries, (2) recognize the importance of species and habitat diversity, and (3) accommodate human uses and associated benefits within the context of conservation requirements.

Ecotourism: Defined by The International Ecotourism Society as 'responsible travel to natural areas that conserves the environment and sustains the well-being of local people'.

Ecotourism Advisory Committee: A group of private and public stakeholders who have an interest, economic or otherwise, in the efficient and effective functioning of the ecotourism program at the ecotourism site. They will provide advice and support to the Head of the Ecotourism Program.

Ecotourism Management Plan (EMP): A specific plan directed at guiding the development of ecotourism in a specific site/protected area. It should follow from larger scale plans such as a General Management Plan or Site Conservation Plan.

Ecotourism Site: A location, large or small, where ecotourism activity or activities occur. In this document, may be used interchangeably with "protected area" or "site." However, site usually refers to a location where the activity is focused and is small in extent.

Effect (or impact): A modification of the existing environment caused by an action of the project. The effect, or impact, may be direct, indirect or cumulative.

Effluent: A liquid, partially or completely treated or in its natural state, flowing from a water or sewage treatment plant.

Emission: Matter discharged into the atmosphere and used as a measure of air quality.

Endangered species: A plant or animal that is in danger of extinction throughout all or a significant portion of its range.

Environment: The diverse community activities and cultures of a country's inhabitants, as well as its scarce and sensitive natural resources.

Environmental auditing: Inspection of a tourism organisation to assess the environmental impact of its activities.

Environmental education: Formal and informal learning processes that are designed to raise awareness and teach new values, knowledge and skills, in order to encourage more sustainable behaviour.

Environmental Impact Assessment (EIA): A document prepared to analyze the impacts of a proposed action and released to the public for review and comment.

Environmental impact: The effects that a community has on the environment as a consequence of its activities.

Environmental Justice: Fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the enforcement of environmental laws and policies. Fair treatment means that no group should bear a disproportionate share of negative environmental consequences.

Environmental management systems: Systems established by tourism organisations with the aim of mitigating negative environmental impacts.

Environmental scanning: The process of collecting information to carry out a systematic analysis of the forces effecting the organisation and identifying potential threats and opportunities with view to generating future strategies.

Erosion: Wearing away of land by water, wind, ice or other geologic agents.

Escort: (1) a person, usually employed or subcontracted by the tour operator who accompanies a tour from departure to return, acting as a troubleshooter. This term is often incorrectly interchanged with courier, conductor, host, manager, director, or leader, since each term designates different duties although they do perform the escort function.

Esturary: The zone where a river meets the sea, influenced by river flows and tides and characterized by a gradient from fresh to salt water.

Exotic plants: Plants whose genetic stock comes from beyond the area in which they are found.

Financing: Money raised by an ecotourism business to start or expand the business in a way other than through sales. Financing can be obtained through traditional means, such as seeking investments or bank loans, or by pursuing special opportunities that may exist for ecotourism, such as grants from donor organizations.

FishBase: A repository of available information on the taxonomy, biology, ecology, occurrence and utilization of fishes. It holds published information on almost all of the estimated 25,000 existing fish species. The information is arranged in 55 subject tables. It can be accessed through the Internet (http://www.fishbase.org) or installed on a PC from a CD-ROM. At the heart of FishBase is the authoritative taxonomic fish classification established by W.N. Eschmeyer (California Academy of Science). It ensures that all information is assigned to current scientific names, even if a publication uses an outdated name.

Floodplain: The part of a stream or river valley adjacent to the channel that is built of sediments and becomes inundated when the stream or river tops its banks.

Foreshore: The coastal fringe; generally the land between the coastal road and the low water mark.

Franchise: the right to market a product or service, often exclusively for a specified area by a manufacturer, developer, or distributor in return for a fee.

Frequent Independent Traveler: FIT: custom designed, pre-paid tour with many individualized arrangements. Also used as foreign independent traveler.

Full Site Diagnostic: A phase of the planning process during which planners gather the information needed to make good decisions regarding, in this case, ecotourism development in the protected area/ecotourism site.

Gale: A storm with wind speeds between 34 to 40 knots.

Gamefish: A species of fish considered to possess sporting qualities on fishing tackle.

Gap Analysis: A Geographic Information System (GIS) methodology to identify the distribution of biodiversity over large spatial areas. It was developed in 1988 by the U.S. Geological Survey in an effort to ensure that regions rich in species diversity are conserved with the hope that this will eliminate the need to list species as threatened or endangered in the future. The gap analysis approach uses maps of vegetation and predicted animal distributions to locate centers of species richness outside areas currently managed for biodiversity protection. These are considered the "gaps" of gap analysis. Thus far, its use primarily has been in the terrestrial sphere.

General Management Plan (GMP): A planning document that evaluates all the information available for a given protected area or ecotourism site and defines overall management objectives, goals and strategies. If ecotourism is identified as a strategy for appropriate management, then an Ecotourism Management Plan is recommended.

Geographic information system: A system of computer software, hardware, data and applications that capture, store, edit and analyze and has the capability to graphically display a wide array of geospatial information.

Geomorphology: Science of the evolution of landforms and geological formations and the processes that shape them.

Geologic formation: A distinct rock unit that is distinguished from adjacent rock by a common characteristic such as its composition, origin, or fossils associated with the unit.

Grassland community: An area where the vegetation is dominated by grasses and other non-woody plants. In temperate latitudes, grasslands are dominated by perennial species, whereas in warmer climates annual species form a greater component of the vegetation.

Green Globe/Green Globe 21: GREEN GLOBE 21 is the worldwide benchmarking and certification programme which facilitates sustainable travel and tourism for consumers, companies and communities. It is based on Agenda 21 and principles for Sustainable Development endorsed by 182 governments at the United Nations Rio de Janeiro Earth Summit in 1992. www.greenglobe21.com.

Greenhouse gas: A component of the atmosphere that contributes to the warming of the planet. Greenhouses gases may include water vapor, carbon dioxide, ozone, methane, nitrous oxide, sulfur hexafluoride and chlorofluorocarbons.

Ground water: Underground water that is generally found in the pore space of rocks or sediments and that can be collected with wells, tunnels, or drainage galleries, or that flows naturally to the earth's surface via seeps or springs. The term is not applied to water that is percolating or held in the top layers of the soil, but to that water in the zone of saturation below the water table.

Grubbing: Removing all plants including the roots, stems and trunks in order to clear the land.

Habitat: A set of physical conditions in a geographical area that surrounds a species or group of species or a large community. With respect to wildlife management, major components of habitat are food, water, cover and living space.

Habitat Affinity Index:A index that- defines habitat affinity based on the relative concentration of a species in a particular habitat, compared with the availability of that habitat in a given study area.

Halophyte: A plant that grows in soils that have a high content of various salts.

Hazardous waste: A discarded material which contains substances known to be toxic, mutagenic, carcinogenic, or teratogenic to humans or other life; ignitable, corrosive, explosive, or highly reactive alone or with other materials.

Heritage: Things of value that are inherited which people want to keep. Heritage can be natural, cultural, tangible, intangible, personal or collective. Natural heritage is often conserved in places such as reserves and national parks. Cultural heritage practices are often conserved through ongoing traditions and practices.

Historic Place: Site, building or group of buildings with aesthetic, historic, scientific or social value for present or future generations.

Hurricane: An intense tropical cyclone in which winds tend to spiral inward toward a core of low pressure, with maximum surface wind velocities that equal or exceed 33.5 m/sec (75 mph or 65 knots) for several minutes or longer at some point.

Hurricane surge: A rise in the sea surface on an open coast, often resulting from a hurricane.

Hydrograph: In surface water hydrology a hydrograph is a time record of the amount of discharge of a stream, river or watershed outlet. Rainfall is typically the main input to a watershed and the stream flow is often considered the output of the watershed; a hydrograph is a representation of how a watershed responds to rainfall over time.

Hydrology: The science of water, standing or flowing on or beneath the surface of the earth.

Hydrological cycle: The movement of water in all of its phases (gas, liquid, solid) from the Earth to the atmosphere and back to the Earth.

Impervious cover: Applied to a bed or stratum or artificial material through which water will not move under ordinary hydrostatic pressure. In hydrology it is applied to a rock that does not admit the passage.

Impoundment: A naturally formed or artificially created basin that is closed or dammed to retain water, sediment or waste.

Indirect impact (or effect): An impact caused by the initial action later time or father removed in distance, but still reasonably foreseeable.

Infrastructure: Physical structures which facilitate use of the coast, such as roads, paths, piers, toilet blocks.

Impacts: Effects, which may be either positive or negative, felt as a result of tourism-associated activity. Tourists have at least three kinds of impacts on a destination: economic, sociocultural and environmental. Tourism also has effects on tourists, in terms of possible attitude and behaviour changes.

Inbound Tour Operator: A tourism operator who organizes the services provided to a visitor within the country being visited.

Indigenous people: Indigenous peoples are those who are descendants of the original inhabitants of an area or region.

Indigenous species: A species that occurs at a place within its historically known natural range, and forms part of the natural biological diversity of a place.

Industry Analysis: Performed during the early stages of a feasibility study or business plan to determine the conditions and sales potential of tourism in the region. The analysis will often include a review of macro elements, such as a region's economic or political situation, and micro elements, such as programs being offered by local tourism organizations.

Integrated coastal zone management: A framework that attempts to integrate planning and management in a region, such as the State of Victoria, across the land and sea interface and the private and public land interface, to treat the coastal zone (which includes the catchment) as one biophysical entity.

Interpretation: Revealing the significance and meanings of natural and cultural phenomena to visitors, usually with the intent of providing a satisfying learning experience and encouraging more sustainable behavior.

Intertidal zone: Area between low and high tide which is subject to daily changes in physical and biological conditions from tide movement (also known as littoral zone).

Introduced species: A translocated or alien species found at a place outside its historically known natural range, as a result of the intentional or accidental dispersal by human activities. Includes genetically modified organisms.

Invasive species: An animal pest, weed or disease that can adversely affect indigenous species and ecosystems.

Jetty: A structure extending into the ocean to influence the current or tide in order to protect harbors, shores, and banks.

Keystone species: Species that plays a critical role in maintaining the structure of an ecologicalcommunity and whose impact on the community is greater than would be expected based on its relativeabundance or total biomass.

Knot: The unit of speed used in navigation that is equal to 1 nautical mile (6,076.115 ft or 1,852 m) per hour.

Landsat Program: The Landsat Program (NASA) provides the world's scientists and application engineers with a continuing stream of remote sensing data for monitoring and managing the Earth's resources. Landsat 7 has produced an uninterrupted multispectral record of the Earth's land surface since 1972. Along with data acquisition and the USGS archival and distribution systems, the program includes the data processing techniques required to render the Landsat 7 data into a scientifically useful form. Special emphasis has been placed on periodically refreshing the global data archive, maintaining an accurate instrument calibration, providing data at reasonable prices, and creating a public domain level one processing system that creates high level products of superior quality.

Liability: The financial obligations of a business which must be paid over a set period of time. Examples include debt, such as bank loans, credit from suppliers and taxes owed.

Limits of Acceptable Change (LAC): A methodology for measuring specific visitor impacts by establishing indicators and standards applicable to specific situations. A standard indicates a specific level beyond which stakeholders have determined that an impact is unacceptable and management action must be taken.

Long-term impacts: Effects that substantially remain beyond short-term ground-disturbing activities.

Mangrove: A general name for several species of halophyte belonging to different families of plants (including trees, shrubs, a palm tree and a ground fern) occurring in intertidal zones of tropical and subtropical sheltered coastlines and exceeding one half meter in height. The term is applied to both the individual and the ecosystem, the latter of which is termed mangal. Mangroves provide protected nursery areas for juvenile reef fishes, crustaceans, and mollusks. They also provide a feeding ground for a multitude of marine species. Many organisms find shelter either in the roots or branches of mangroves. Mangrove branches are nesting areas for several species of coastal birds. The root systems harbor organisms that trap and cycle nutrients, organic materials and other important chemicals. Mangroves also contribute to higher water quality by stabilizing bottom sediments, filtering water and protecting shorelines from erosion. They protect reefs from land runoff sedimentation. Conversely, coral reefs protect mangroves and seagrasses from erosion during heavy storms and strong wave action. The nations with the largest mangrove areas include Indonesia (with 21% of global mangroves), Brazil (9%), Australia (7%), Mexico (5%), and Nigeria (5%).The global area of mangroves – 150 000 square kilometers – is equivalent to the area of the state of Illinois, or half the area of the Philippines. About one fifth of all mangroves are thought to have been lost since 1980, and although loss rates are declining, they are still 3 to 4 times higher than average global forest loss estimates.

Marine debris: Debris composed primarily of plastics, nets, lines, other fishing gear, glass, rubber, metal, wood and cloth. Sources of debris are people on beaches, storm drains, fishing boats, waste treatment sites, and industrial facilities. These materials have damaging effects on coral reefs.

Marine Tourism: Those recreational activities that involve travel away from one's place of residence and which have as their host or focus the marine environment (where the marine environment is defined as those waters which are saline and tide-affected).

Mitigation: The reduction or abatement of an impact to the environment by (a) avoiding actions or parts of actions, (b) using construction methods to limit the degree of impacts, (c) restoring an area to its pre-disturbance condition, (d) preserving or maintaining an area throughout the life of a project, (e) replacing or providing substitute resources, (f) gathering data on an archeological or paleontological site prior to disturbance.

Mud: A fine sediment often associated with river discharge and buildup of organic material in areas sheltered from high-energy waves and currents.

Mud flat: A relatively level area of fine silt along a shore (as in a sheltered estuary) or around an island, alternately covered and uncovered by the tide, or covered by shallow water.

National Oceanic and Atmospheric Administration (NOAA): The National Oceanic and Atmospheric Administration (NOAA) is a federal agency within the US Department of Commerce that is dedicated to predicting and protecting the environment. NOAA's overall mission is to understand and predict changes in the Earth+s environment, protect life and property, provide decision makers with reliable scientific information, conserve and manage the Nation+s living marine and coastal resources to meet our Nation+s economic, social, and environmental needs, and foster global environmental stewardship. To achieve its mission, NOAA+s focus through 2008 will be on four mission goals:

1. Protect, restore, and manage the use of coastal and ocean resources through ecosystem-based management
2. Understand climate variability and change to enhance society+s ability to plan and respond
3. Serve society+s needs for weather and water information

4. Support the Nation+s commerce with information for safe, efficient, and environmentally sound transportation.

Natural area: Areas that exist in or are formed by nature which are not artificial, and can include cultural aspects.

Natural attraction: a tourist attraction that has not been made or created by people.

Natural disaster: a destructive force (e.g. earthquake, flood, volcanic eruption).

Nature Tourism: Tourism directed primarily at natural features but that does not necessarily embrace the concepts of ecotourism: low impact, economic benefits for conservation and local people, and education.

Negligence: Failing to exercise what is legally considered to be reasonable care.

NPDES: National Pollution Discharge Elimination System. As authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating the discharge of pollutants into waters of the United States.

Oil plume: Underwater globules of oil that do not float to the surface of the ocean. Heavy use of chemical dispersants, which breaks up surface oil, is said to contribute to the formation of these plumes, which may pose a threat to the marine ecosystem.

Oil slick: A layer of oil floating on the surface of water.

Oil spill: The accidental release of oil into the environment.

On-site management: Management of visitor impacts and behaviour on-site through the use of signs, formed tracks or board-walks, barriers and the physical presence of management staff.

Outbound Tour Operator: A tourism operator who organizes tours and transportation for visitors who are going to another country, and who usually partners with an inbound operator in the destination country.

Owners: The people or organizations that hold a legal interest in a business. In a sole proprietorship, the owner is the proprietor. In a corporation or cooperative, the owners are those people who have purchased shares.

pH: Denotes logarithmically the concentration of hydrogen ions in solution.

PM10: Particulate matter with an aerodynamic diameter smaller than 10 micrometers. The designation is useful because the size may outstrip the body's ability to keep them out of cells.

Preliminary Site Evaluation (PSE): A process consisting of a few basic questions by which planners can determine whether a particular site is appropriate for ecotourism development.

Promotion: An activity that raises awareness or makes an ecotourism service more attractive to potential customers. Common promotional activities include: newspaper advertising, listings in travel directories, an Internet web site, and trade shows. Promotions also include offering discounts or packaging an ecotourism service as a single product with airfare or transportation expenses.

Protected Area: A large, legally-protected expanse of territory, usually administered by a government entity with specific conservation objectives, but whose day-to-day management may be delegated to the private sector or a coalition of government and private interests.

Phytoplankton: An aquatic microorganism that serves as the base of the aquatic food web providing an essential ecological function for all aquatic life. When present in high enough numbers, they may appear as a green discoloration of the water due to the presence of chlorophyll within their cells.

Quality: The degree to which a set of inherent characteristics of a product fulfils customer requirements (ISO, 2000a).

Quarry: An open or surface working usually for the extraction of building materials such as slate and limestone or sand and gravel.

Recharge: Replenishment of an aquifer by the addition of water through natural or artificial means.

Regulation: Control through formalized processes.

Renewable energy: Energy sources those are practically inexhaustible. For example solar, hydro and wind energy.

Resort: A hotel, motel or condominium complex located in an area associated with recreation and leisure, such as the mountains or the seashore. Normally offer facilities for sports and recreational activities.

Responsibility clause: That section of a brochure that spells out the conditions under which a tour is sold. The clause should name the party responsible for the tour financially.

Responsible tourism: Type of tourism which is practiced by tourists who make responsible choices when choosing their holidays. These choices reflect responsible attitudes to the limiting of the extent of the sociological and environmental impacts their holiday may cause.

Restoration: After mining ceases, bringing the disturbed land back to its original use or condition or to alternative uses. Restoration activities include removing structures; grading and restabilizing slopes, roads, and other disturbed areas; covering disturbed areas with growth medium or soil; and revegetating disturbed areas.

Revegetation: Establishment of a self-sustaining plant cover.

Rill: A very small channel that changes location with each flow event.

Riparian: Usually used to refer to plants of all types that grow around or in bodies of water.

Run-on: A hydrologic term that refers both to the process whereby surface runoff infiltrates the ground as it flows, and to the portion of runoff that infiltrates. Run-on is common in arid and semi-arid areas with patchy vegetation cover and short but intense thunderstorms.

Runoff: The portion of the rainfall that is not absorbed and that may find its way to bodies of water as surface flow.

Salt water intrusion: The movement of salt from the sea into a fresh water aquifer often due to over pumping an aquifer.

Sediment: Insoluble material suspended in water that contains mainly particles derived from rock, soil and organic material.

Sewage: Household and commercial wastewater containing human or trade waste.

Sewerage: The system which facilitates the collection, transport, treatment and discharge of sewage.

Site Plan: A very detailed drawing that locates all significant natural and cultural features of a site where intensive ecotourism activity will take place and then determines where infrastructure will be located.

Special interest tour: a tour designed to appeal to clients with a curiosity or concern about a specific subject. Most special interest tours provide an expert tour leader and usually visit places and/or events only relevant to that interest.

Stakeholders: Social actors who have a direct or indirect involvement in an activity that affects the biodiversity systems of a site. This involvement may arise from geographical proximity, historical association, economic activity, institutional mandate, social interest, cultural traditions or a variety of other reasons.

Stakeholder Analysis: The TNC stakeholder analysis prioritizes stakeholders linked to critical threats and profiles a number of key characteristics about the activities in which stakeholders are engaged.

Storm Water: Rainwater that runs off streets and gutters, enters drains and waterways and is eventually discharged to the sea or other water body.

Sustainable Development: Defined by the United Nations Brundtland Report "Our Common Future" as "Development thatmeets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable tourism: According to the World Tourism Organization, this is "envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled with maintaining cultural integrity, essential ecological processes, biological diversity, and life support systems."

Terrestrial ecosystem: A system of interdependent organisms which live on land and share the same habitat, functioning together with all of the physical factors of the environment.

Threshold: A value that is used as a benchmark for data. Thresholds may be set by laws, regulations or policies for water quality, air quality, noise, etc.

Topsoil: A general term applied to the surface portion of the soil. It is not defined precisely to depth and productivity except in reference to a particular soil type.

Total dissolved solids: A measurement that describes the quantity of dissolved material in a sample ofwater.

Total suspended solids: A water quality measurement. It is measured by pouring a determined volume of water through a filter and weighing the filter before and after to determine the amount of solids.

Tour: Any pre-arranged journey to one or more destinations.

Tourism: The all-embracing term for the movement of people to destinations away from their place of residence for any reason other than following an occupation, remunerated from within the country visited, for a period of 24 hours or more.

Tourism Industry: Tourism Industry is an industry that would cease to exist or would continue to exist only at significantly reduced levels of activity in the absence of tourism.

Tourism infrastructure: Roads, railway lines, harbours, airport runways, water, electricity, other power supplies, sewerage disposal systems and other utilities to serve not only the local residents but also the tourist influx (suitable accommodation, restaurants and passenger transport terminals form the superstructure of the region).

Tour manual: (1) A summary of facts about a company s rules, regulations, and official procedures; (2) a compendium of facts about a destination, including its attractions, accommodations, geography, and special events, used by destination marketing organizations to attract tour operators and visitors and their area.

Urban growth boundary: A management tool used to contain urban areas and limit their expansion. It divides land that is urban - to be used for housing, shops, factories - from land that is non-urban and to be used for purposes such as conservation, agriculture, mineral extraction, airports and the like. An urban growth boundary encourages urban consolidation and protects valued non-urban areas from urban development.

Value Chain: The chain of organizations that connect ecotourism customers in the target market (such as in the United States) with the ecotourism experience in the destination country. For example, the chain could include the U.S. travel agent, U.S. outbound tour operator, the inbound tour operator and local ecolodge service provider, which each provide value and chargea fee to the customer.

Visitor Site: A relatively small location where intensive useand management occurs within a larger ecotourism/conservationcontext.

Wake: Waves generated in the water by a moving vessel.

Wall: The reef slope, which may suddenly drop off into deeper water, forming a nearly vertical wall.

Wash zone: The depth zone in which sediments are disturbed by wave action near the shoreline.

Watershed: The land and water within the confines of a drainage divide.

Wetlands: Vegetation that is adapted for life in saturated soil conditions. Examples of wetlands are marshes, swamps, lakeshores, bogs, wet meadows, estuaries and riparian areas.

World Heritage Area: Land of cultural and/or natural significance inscribed on the World Heritage List.

World heritage site: a site designated by UNESCO as being of special historical, cultural or natural importance.

Yield Management: "A revenue maximization technique which aims to increase net yield through the predicted allocation of available … capacity to predetermined market segments at optimal price" (Donaghy et al., 1997a).

Zoning: Zoning is a mechanism for assigning overall management objectives and priorities to different geographic areas (zones) within a protected area or other ecotourism site. By assigning objectives and priorities to these zones, planners are also defining what uses will or will not be allowed. These parameters are usually based upon the characteristics of the natural and cultural resource base, protected area objectives, and other factors.

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J. EXAMPLE TERMS OF REFERENCE (TOR)

Terms of Reference (TORs) are used by countries to describe both general and specific expectations for the preparation of an environmental impact assessment, in this instance tailored to proposed projects for tourism. Volume 1 Part 2 contains example TORs cross-referenced to Volumes 1 and 2 of the "EIA Technical Review Guideline for Tourism Projects". It is printed separately to facilitate use by countries as they prepare their own EIA program requirements for tourism-related projects.

Three example TORs are provided in Volume 1 Part 2:

- J-1 Hotel and Resort Tourism Projects
- J-2 Concessions Tourism Projects
- J-3 Marine and Coastal Tourism Projects

As appropriate, they may be used in combination depending upon the scope and configuration of a proposed tourism project.

In each of the example TORs there is an overview section that describes general expectations for the preparation of an environmental impact assessment. This is followed by sections addressing each element of the EIA analysis and documentation including details on what should be included in the description of the proposed project and alternatives; environmental setting; assessment of impacts; mitigation and monitoring measures; an environmental management plan; a signed commitment statement; and key supporting materials.