Environmental Impact Assessment Guidelines for Ports and Harbours

for

The Department of Ocean Development

Under the

ntegrated Coastal and Marine Area Management Program

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Foreword

- The 'EIA Guidelines for Ports and Harbours' has been developed as a part of the Coastal and Marine Area Management Component under the Project "Environment Management and Capacity Building" funded by the World Bank.

- The Technical Advisory Committee consisted of
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- The guidelines were reviewed by the following members in addition to review by the Technical Advisory Committee
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- The project team from NIOT consisted of Dr. Rajat Roy Chaudhury, Chithra Srinivasan and Vijaya Ravichandran

- This Guideline was developed on the basis of an initial assessment of

    - EIA's conducted in India since 1995 for coastal and offshore activities
    - Relevant Guidelines available in India and abroad

- A manual to aid in the EIA of Ports and Harbours has also been developed. This manual is essentially a detailed version of the guideline

1.0 INTRODUCTION

Environmental impact assessment (EIA) is the process of examining the environmental, social and health effects of a proposed development. It assesses the impacts of the proposed development on the environment and enables decision making with respect to environmental clearance.

Environmental Impact Assessment (EIA) for ports and harbours is a mandatory requirement as per the Ministry of Environment & Forests (MoEF) EIA notification (1994) and CRZ Notification (1991) since these projects can cause potentially significant environmental impacts.

The objectives of this guideline are

- To aid in the preparation of reports that are comprehensive in their content and to reduce cost of EIA.
- To protect the environment from costly and irreversible mistakes.
- To aid review of the reports
- To avoid time delays and cost overruns

1.1 Objective of an EIA

- To determine environmental compatibility of the project
- To evaluate and select the best project alternative from the options available
- To identify and evaluate the significant environmental impacts of the project
- To incorporate environmental management plans and monitoring mechanisms.
- To assess the environmental costs and benefits of the project to the community

1.2 Environmental Impact Assessment Process

The typical tasks involved in the EIA process are illustrated in Figure 1.1. These may be followed sequentially to perform a good EIA. The chapters that follow provide guidance to apply these tasks specifically to port and harbour projects.

1.3 Environmental considerations in project feasibility

The feasibility of a project is based on technical, economic and environmental considerations. While the technical and economic aspects address the specific project needs, the environmental aspect addresses the common resources to be shared and possibly, protected in an area. An EIA aims to incorporate environmentally sound measures during the planning, construction and operation phases.

EIA can be applied at all steps in the planning process – from conception to operation and to project decommissioning – with different levels of complexity. Incorporating the EIA process at the beginning of the project planning process will identify the possibility of a definite "no-go" alternative. Hence it is necessary that EIA be performed in parallel with technical and economic feasibility studies.

1.4 Concept of Screening

The process of determining the type of EIA required for a project is called screening. The extent of assessment required is also determined in this process.

Extent of EIA

A Rapid EIA report is submitted to the Impact Assessment Agency (IAA) based on one season data (other than monsoon) for examination of the project. Comprehensive EIA report may be submitted later, under the directions of the IAA

a. Rapid EIA: Is carried out for projects that are likely to cause only a limited number of adverse impacts. It is a preliminary assessment that involves limited baseline evaluation (i.e. collection of one season data), broad identification of impacts and prediction of impacts with simple methods. It is a quick process in terms of time spent on assessments of impact characteristics. Rapid EIA's are done for projects like captive jetty or projects that do not involve ancillary growth, resettlement issues, induced developments and projects located in non-critical habitats.

b. Comprehensive EIA: Some projects are likely to cause a range of significant adverse impacts affecting a number of environmental parameters. A comprehensive EIA is generally required when the project results in significant/seasonal changes (requiring the need for a three seasonal baseline data), ancillary or induced development, resettlement & rehabilitation and is located at close proximity to ecologically sensitive areas. For example, breakwater projects, port and harbour projects initiated for the sake of industries, projects involving resettlement and rehabilitation issues, projects located in critical habitats etc require an extensive or comprehensive EIA. The characteristics of the impacts of these projects can be determined only with a detailed study.

Types of EIA

a. Project specific EIA: Some projects cause a limited number of adverse impacts and do not result in ancillary activities or induced developments. For example, a container terminal, which handles only containers, may not have associated developments

b. Regional EIA: Projects resulting in development of an entire region in terms of ancillary industries and/or induced developments require a regional EIA. It involves assessment of the cumulative environmental impacts of a number of projects proposed in that region. For example, a port and harbour project might trigger off the growth of industries and consequently rapid industrialisation and urbanisation of the region.

c. Sectoral EIA: When a long-term development plan of a particular sector (for example, port sector) is proposed, environmental impacts need to be evaluated in a broader framework.

d. Risk Analysis: Is the process of identifying the probability of occurrence of an accident and its consequence, when ports handle hazardous cargo or involve risky operations.

In general a project specific rapid EIA with or without risk analysis is conducted for any project requiring an EIA. Regional/sectoral /comprehensive EIA is initiated by the IAA if it considers the project to have a significant environmental impact.

1.5 Participants in an EIA

EIA Study

A team of cross-functional professionals shall conduct EIA. The team leader shall be capable of addressing issues with a broad overview and shall collate the findings of the EIA team. The team shall consist of professionals with experience in

- Environmental sciences/process designs
- Coastal engineering (Marine structures, foundations, dredging etc.)
- Chemical/ Mechanical engineering (Hazardous material handling/operations)
- Oceanography
- Water resources
- Marine biology
- Socio/Environmental/Natural Resource – economics
- Sociology

EIA Process

The participants of the EIA process and their function are given in Table 1.1.

Table 1.1 Participants in an EIA

Participants	Description & Function
Project proponent	Government or private organisation or whoever proposes project development.
Environmental consultant	The person(s), agency or company responsible for conducting the EIA
Public-Citizens and media	Special interest groups such as the NGO's, environmental agencies, labour unions form the public participation group who have a role in identifying specific environmental concerns
Reviewer	Agency responsible for reviewing the environmental impact summary report such as the Impact Assessment Agency
Other agencies of Government	National and State Government agencies that will directly or indirectly have an interest or responsibility in the EIA process.
Expert advisors	They may be Government or private experts with special knowledge of the either the project activity or the EIA process.
Decison-maker	Designated official/ agency

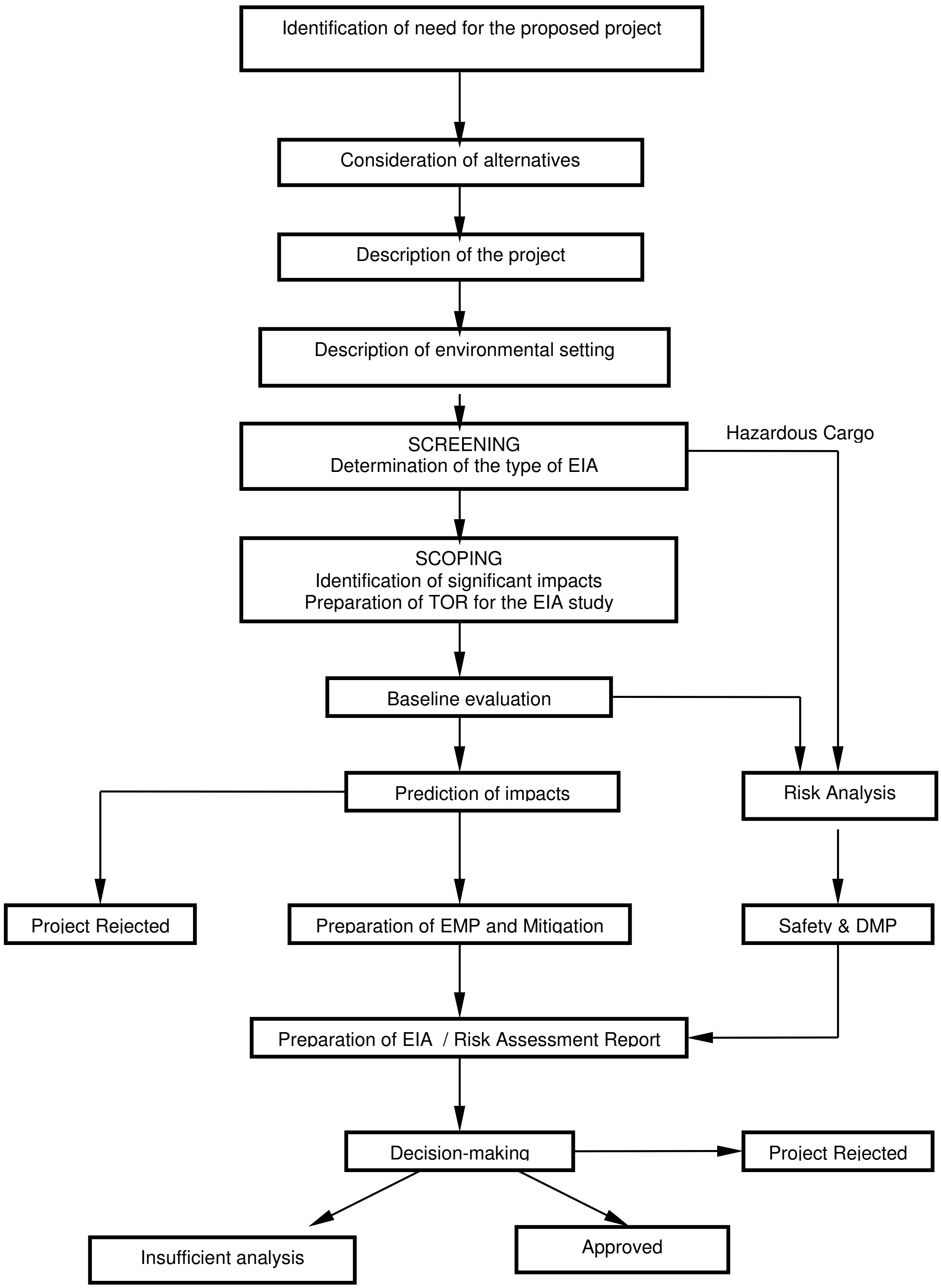

Fig. 2.1 Basic Components of EIA Study

Environmental Clearance

Port and harbour projects fall under Schedule-1 of the MoEF EIA notification, 1994 and hence require an EIA. These projects are also categorised as site specific under the notification, and hence also require site clearance by the MoEF. Therefore, the EIA Notification provides for two-stage clearance for site-specific projects. Site clearance is given in the first stage and the final environmental clearance in the second stage. Ports and harbours require waterfront and foreshore facilities and fall in the Coastal Regulation Zone (CRZ) and therefore require environmental clearance from the Ministry of Environment & Forests under the CRZ notification, 1991. In the case of projects within the existing port limits except areas classified as CRZ-I, the power to grant clearance under the Coastal Regulation Zone Notification has been delegated to the Ministry of Surface Transport (MoST).

Public hearing has been made mandatory for all the cases where the environmental clearance is required. It is, however, not needed for site clearance or permission to conduct surveys.

Figure 2.1 explains the stepwise process involved in environmental clearance of the projects.

1.6 Documents required for Clearance

Project proponents applying for environmental clearance of projects are required to submit twenty sets of the following documents to the concerned State Pollution Control Board.

- An executive summary containing the salient features of the project both in English as well as local language
- Form XIII prescribed under Water (Prevention and Control of Pollution) Rules, 1975 where discharge of sewage, trade effluents, treatment of water in any form, is required
- Form I prescribed under Air (Prevention and Control of Pollution) Union Territory Rules, 1983 where discharge of emissions are involved in any process, operation or industry
- Any other information or document, which is necessary in the opinion of the Board for their final disposal of the application.

Project proponents are required to furnish the following information to the Union Ministry of Environment and Forests for environmental appraisal

- EIA/EMP report (20 copies);
- Risk Analysis report (20 copies): however, such reports if normally not required for a particular category of project, project proponents can state so accordingly, but the IAA's decision in this regard will be final;
- NOC from the State Pollution Control Board;
- Commitment regarding availability of water and electricity from the competent authority;
- Summary of Project report/feasibility report (one copy);
- Filled in questionnaire (as prescribed by the IAA from time to time) for environmental appraisal of the project;
- Comprehensive rehabilitation plan, if more than 1000 people are likely to be displaced, otherwise a summary plan would be adequate.
- Comments of the State Department of environment regarding CRZ classification of the area and that the proposal conform to the approved CZMP of the area;
- NOC from the Chief Directorate of Explosives in case it involves storage/handling of hazardous substances;
- Demarcation of HTL/LTL by one of the authorized agencies;
- Comments of the Chief Wildlife Warden if in the proximity of marine parks, breeding and nesting grounds etc;
- Location map showing various activities with reference to the high tide line

1.7 Environmental Regulations relevant to Port and Harbour Projects

The Ministry of Environment and Forests (MoEF) is the nodal agency in the administrative structure of the Central Government and is the primary agency for regulating environmental protection in the country. The Central and the State Pollution Control Boards are the administrative bodies for exercising promotional and regulatory functions under the Water, Air and Environmental Acts. Notifications/standards that are applicable to a port and harbour project have been listed herein.

a. Environmental Protection Act 1986

- EIA Notification (1994 as amended on 27th Jan 2000) http://envfor.nic.in/
- Coastal Regulation Zone Notification, (1991, as amended upto 4th Aug 2000) http://envfor.nic.in/
- The Water, (Prevention and Control of Pollution) Act, 1974 as amended upto 1988 http://envfor.nic.in/
- Hazardous Wastes (Management & Handling) Rules (1989) http://envfor.nic.in/
- Manufacture, storage & import of hazardous chemicals Rules (1989) http://envfor.nic.in/

b. Others

- The Air (Prevention and Control of Pollution) Act, 1981 as amended by amendment Act 1989 (http://envfor.nic.in/)
- Forest (Conservation) Act, 1980
- Indian Ports Act 1908

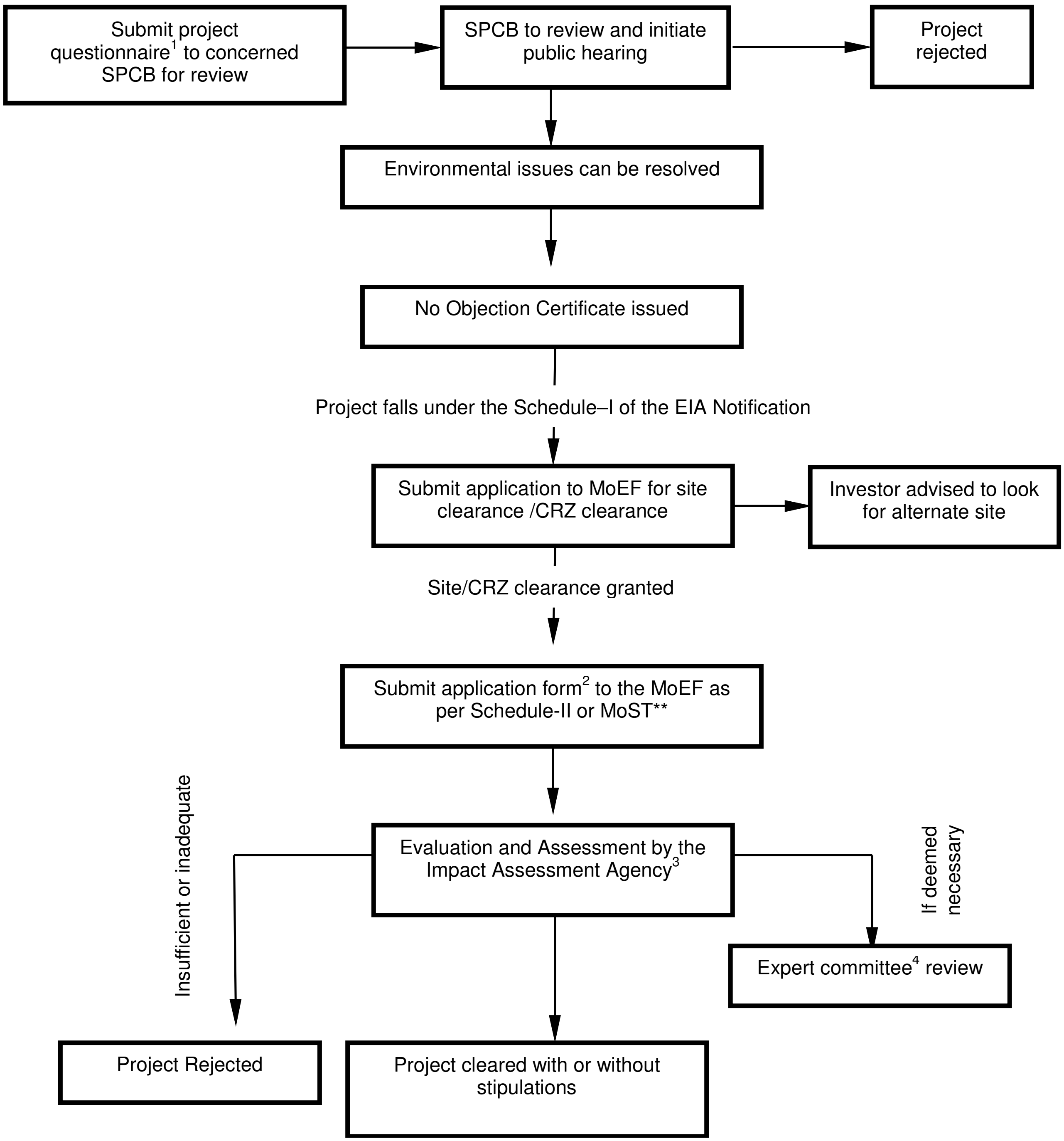

Fig. 2.1 Procedure for obtaining environmental clearance

List of documents to be submitted to the SPCB is as per Schedule-IV of the EIA notification

List of documents consist of EIA report/EMP and details of public hearing as specified in Schedule-IV

Impact Assessment Agency is the Union Ministry of Environment and Forests

Expert committee composition is according to the Schedule-III of the EIA notification

1.8 International Treaties

Shipping is an international activity and hence national specifications and regulation relating to loading and safety at sea are largely based on international agreements and conventions. International regulations relevant to port and harbours are given herein. India is a signatory to these International agreements/conventions.

a. Shipping

- International Maritime Dangerous Goods Code (IMDG-code) http://hazmat.dot.gov.imdg.htm

  The IMDG code relates to methods of safe transport of dangerous cargoes and related activities. It sets out procedures for documentation, storage, segregation, packing, marking and labelling of dangerous goods.

- International Convention for the Prevention of Pollution from ships (MARPOL) http://www.imo.org/imo/convent/pollute.htm

  The main objectives of this convention are to prevent the pollution of the marine environment by the operational discharges of oil and other harmful substances and the minimisation of the accidental discharges of such substances

- United Nations Convention on the Law of the Sea (UNCLOS), 1982. http://www.tufts.edu/departments/fletcher/multi/texts/BH825.txt

  The main objective is the obligation to prevent pollution damage by addressing particular sources of pollution, including those from land based activities, seabed activities, dumping, vessels and from or through the atmosphere.

b. Others

- Ramsar Convention on Wetlands: http://www.ramsar.org/

The Convention requires states to designate at least one wetland site on the basis of ecology, botany, zoology, limnology or hydrology and requires the conservation of all wetlands by establishing nature reserves. There is also a requirement that any loss of a wetland should be compensated for by creation of new habitat.

For details, the reader is advised to refer to "Wetlands, biodiversity and Ramsar convention – The role of convention on wetland in the conservation and wise use of bio-diversity", edited by A.J.Hails, Ramsar convention Bureau, MoEF, 1996(1997).

2.0 PORTS AND HARBOURS

2.1 Need for the project

Necessity for a port and harbour project, including expansion of existing port arises due to one or more of the following

- Location of industries requiring the raw product, which can be imported.
- Location of mines/industries at close proximity to enable export the goods
- Port of entry for passengers
- Strategic importance
- Fisheries

2.2 Consideration of alternatives

Project alternatives

There are number of port and harbour types. A choice has to be made considering the various types of port and harbour facilities. Alternatively, an entirely different project, which is more suitable to be located at that particular site, could also be proposed. Different port and harbour alternatives are given herein

- Natural harbours normally offer sheltered locations for berthing of ships, the construction of which may not result in any change to the shoreline and estuarine ports
- Artificial harbours are constructed in open sea where breakwaters are constructed to provide tranquil conditions for ship operations. Breakwater constructions could result in major shoreline changes as well as alter the hydraulic characteristics resulting in major impacts like accretion and erosion.
- Use of single point mooring system which does not involve any jetty or dock construction, but only consists of a catenary platform, from where tankers can unload liquid cargo into submarine pipelines, which take the cargo across to the tank farm located onshore.
- Construction of open jetties, offshore, where the cargo is offloaded onto conveyors or pipelines and carried to the shore using trestles. Open jetties do not involve extensive dredging and do not change coastal hydraulics. Climatic

and hydraulic characteristics will dictate the window of operation at an open jetty.

Location Alternatives

Siting of a Port and Harbour is characterised by a number of technical and economic criteria like easy access, physical and topographical features, hydrographic, meteorological and hydrological factors. The following environmental and ecological criteria must be taken into account before siting is done.

- The location shall be away from sensitive and critical habitats on land and coastal waters (mangroves, coral reefs, breeding and nesting grounds, sand dunes, fishing zones, marine parks, migratory routes of birds and mammals etc)
- There shall be minimal displacement of local population, diversion of forest and agricultural lands
- There shall be minimum depletion of available resources due to direct and induced development
- There shall be minimal disturbance and losses to existing socio-economic activities
- Location in brackish water regions shall be carefully planned.

Environmental setting is required to identify the environmental components at the site that are likely to be affected by the project activities. This enables to determine the significance of impacts and identify the recipients. The description shall contain the current uses of the area and the future developments. It shall include

- Presence/proximity to ecologically sensitive areas, critical habitats, wetlands, endangered species, etc
- Designated water usage at the project site vis-à-vis its availability from different sources
- Existing solid and liquid waste disposal sites/treatment facilities
- Designated landuse in and around the project site including anticipated future developments
- Proximity to residential, industrial, commercial and institutional areas

- Occupation and means of livelihood of the population near the project site

A questionnaire provided in Annexure-A enables detailed description of environmental setting at the project site

Technology Alternatives

- Alternative process designs to minimise resource consumption and waste generation
- Incorporation of environmentally sound alternatives in the project design
- Environmental Management Plans

2.3 Project Description

Project description involves description of the project activities and infrastructure requirements. Annexure A gives a questionnaire for describing the project setting. For a typical port and harbour project, the harbour infrastructure requirements are breakwaters; tug boats, lighthouse, fire fighting equipments, facilities to combat oil slick (oil skimmers, booms), buoys and marine police. Dock requirements are dictated by the vessel types, cargo type and storage and handling requirements. General considerations for the overall layout of the facility depend on berth length, number of vessels, loading/unloading points, apron width, short-term storage on the pier or wharf, cargo-handling equipment requirements, exposure to sea conditions, deck elevation and traffic movements.

Port requirements can be classified as landside and waterside requirements. Figure 3.1 gives the facilities involved in a Port and Harbour project.

A broad list of activities (though not exhaustive) involved in a port and harbour construction and operation are given in Table 3.1. All these activities involve a number of tasks or sub-activities.

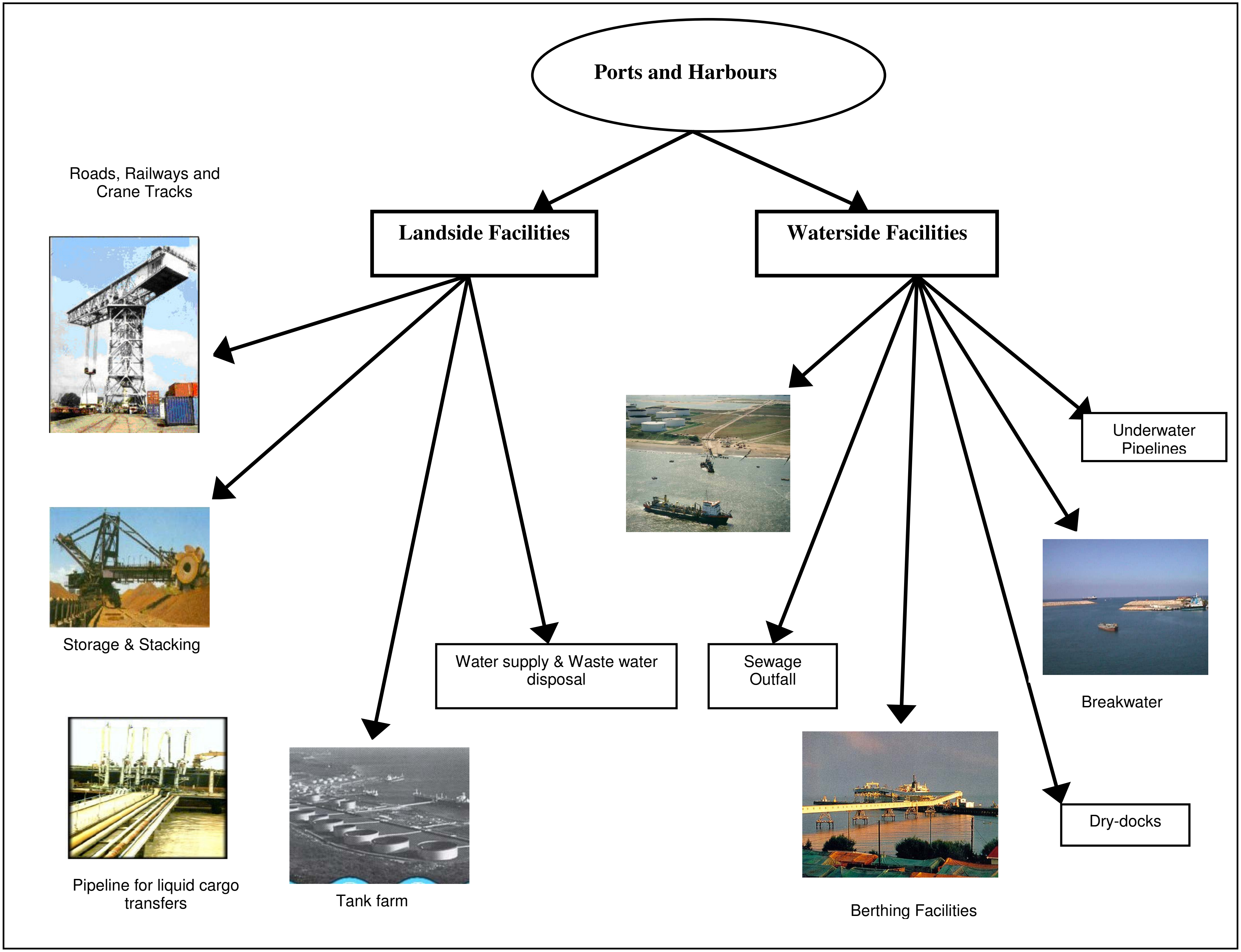
Ports and Harbours
Landside Facilities
Waterside Facilities
Roads, Railways and Crane Tracks
Storage & Stacking
Pipeline for liquid cargo transfers
Tank farm
Water supply & Waste water disposal
Sewage Outfall
Underwater Pipelines
Breakwater
Berthing Facilities
Dry-docks

Table 2.1 Activities typical to ports and harbours

Phase	Landside Activity	Waterside activity
▪ Construction	▪ Site clearing/deforestation ▪ Resettlement ▪ Rehabilitation ▪ Soil excavation / Quarrying ▪ Transportation of raw materials* ▪ Construction/ Precasting / Fabrication/Welding Laying of roads/railways/crane tracks ▪ Land reclamation/ disposal of dredged material on-shore ▪ Labour camps for all activities	▪ Capital dredging ▪ Disposal of dredged material into sea ▪ Berth/wharf/jetty/trestle Construction (Piling operations/ Construction of gravity foundation/ diaphragm walls) ▪ Breakwater Construction * ▪ Single Point Mooring (SPM) ▪ Trenching the seabed for underwater pipeline /intake/ outfalls / underwater blasting
▪ Operation	▪ Afforestation ▪ Vehicular traffic (roads & railways) ▪ Storage of dry cargo ▪ Loading and unloading of dry cargo ▪ Loading and unloading of liquid cargo ▪ Storage of wet cargo/ Tankfarm operation ▪ Pipeline operation ▪ Disposal of dredged material on land / Land reclamation ▪ Waste management and effluent discharge	▪ Maintenance dredging ▪ Disposal of dredged material into sea ▪ Maintenance of Breakwater/water-front structures ▪ Brine discharge from desalination plants ▪ Cooling water discharge from power plants ▪ Ship operations (bunkering, ballasting/deballasting, discharges) ▪ Fishing Activities

Phase	Landside Activity	Waterside activity
	▪ **Maintenance Infrastructure** ▪ **Desalination plants** ▪ **Captive power plants** ▪ **Induced development**	

* Raw materials like gravel /boulders/sand for construction shall be obtained only from approved quarry sites

Construction Period

The construction of any port and harbour involves a time period of 4-6 years or even more due to the complexity of structures and foundations involved and the hostile marine environment where these tasks have to be carried.

3.0 CONCEPT OF SCOPING

3.1 Scoping

Scoping is a priority-setting activity in the EIA process, which identifies environmental parameters that are likely to be adversely affected by the proposed project activities and focuses the assessment on important issues. It typically follows screening.

Scoping is synonymous to identifying the significant impacts and needs to be done systematically based on the activities that are involved in a port and harbour project

Timing of scoping

Scoping ideally begins early in the EIA. However, the process of evaluating the importance of issues should be reviewed throughout the EIA process. It is recommended that scoping be undertaken prior to hiring a consultant for EIA study. It is also essential that scoping be performed during the pre-feasibility stage of the project, in parallel with the technical and economic pre-feasibility studies, so that environmental concerns are incorporated in the project at the planning stage itself.

Advantages of Scoping

- It enables integrated project planning

- It helps to identify key issues and environmental concerns in the early project planning stage
- It helps in confining the study to an essential set of significant environmental parameters thereby allowing judicious allocation of time and money for assessing relevant environmental issues.
- It reduces the likelihood of a deficient EIA

Participants in a scoping process

Scoping can be done by the environmental consultant while developing the proposal for the proponent, or while designing the EIA study. The project proponent can also do scoping.
The proponent may

- Do the scoping in-house based on prior experience and in the process he will prepare the Terms of Reference for the environmental consultant
- Appoint an environmental consultant to develop a Terms of Reference for the EIA
- Request potential EIA consultants for scoping the proposals while providing background information of the project during the tender process. The EIA consultant may conduct scoping in the preparation of the proposal such that it is cost effective and technically complete.

The proponent/environmental consultant may consult,

- The relevant administrative authority for the statutory and procedural requirements, such as MOEF, SPCB, CPCB etc
- The educational, research and government agencies, for their specific knowledge of impacts from similar projects and specific issues within their jurisdiction. This may include specific legislation, standards, data collections, methodologies, local knowledge and experience
- Local inhabitants for details of the site, the surrounding environment, means of livelihood, available resources, local knowledge and experience

Scoping must be presented in sufficient detail to permit the decision-maker to understand the procedure for priority setting, particularly for the environmental parameters that are likely to be studied in greater detail. In addition, the decision-maker may also do, examine/evaluate scoping before assessing the EIA report so as to confine his assessment to key issues of project only.

Siting

Environmental impacts of projects are influenced by the project location and therefore the environmental acceptability of the project site is of primary concern in any development. It is essential that the project proponent assess the site for its environmental suitability thereby saving time, efforts, investment and risk.

3.2 Steps in a scoping process

1. Identify the activities of the proposed project and the location
2. Identify key environmental issues of concern that are likely to be triggered by the project
   - Identification of insignificant impacts must be justified by quoting precedence from similar projects/activities where the same activity has not resulted in adverse environmental impacts.
3. Identify available information sources
4. Identify baseline data requirement
   - It is recommended to carry out a detailed primary data collection program only if the secondary data does not provide adequate information required for impact analysis
5. Compile information on environmental setting at the site (Annexure A)
6. Consider scenarios for impact analysis
7. Prepare a Terms of Reference for the EIA study

3.3 Scenarios to be considered for assessing environmental impact

Table 3.1 Scoping Scenarios

Scenario	Type	Description	Inference
A	Without project in future	To assess the impact of all environmentally cleared future developments and associated demographic changes at the proposed project site without the proposed project in the future.	The scenarios A & B will help assess the additional environmental impact of the proposed project in future without mitigation measures incorporated in it The scenario B & C will help assess the additional environmental impact due to the proposed project & the role of EMP/ RMP in mitigating the impacts and risks associated with the project

Scenario	Type	Description	Inference
B	Project without EMP/ RMP	To assess the likely impact of the proposed project without the incorporation of an environmental management plan and/ or a risk management plan	
C	Project with EMP / RMP	To assess the likely environmental impact of the proposed project with an environmental management plan and/ or risk management plan incorporated into it.	

EMP - Environmental Management Plan **RMP - Risk Management**

3.4 Characteristics of Impacts

Impacts of proposed activity affect the environment depending upon how, when, where and by how much they occur. Impacts are characterised by

- Nature (positive, negative, direct, indirect, cumulative, synergistic)
  - An increased employment opportunity is a direct- positive impact.
  - Loss of wetlands, destruction of eco-systems, coastal erosion or change in the shoreline, impact on water quality and its availability, relocation of households, increased air emissions are some direct-negative impacts, which occur around the same time as the action that causes them.
  - Human health problems, impacts on marine organisms due to water quality deterioration or dredging are indirect-negative impacts, which occur later in time or in a place other than where the original impacts occurred.
  - Impacts from various activities and subprojects can be additive and result in cumulative impacts
  - Impacts from various activities and subprojects can interact with other sources and create new or larger impacts than those originally occurring resulting in synergistic impacts
- Magnitude

- Estimation of the size of impact; eg. Small quantities of release of toxic substances can cause large scale impacts on human and aquatic life

- Extent/location (area/volume covered, distribution)
  - Spatial distribution of toxic/hazardous substance release (risk contours), extent of area affected due to overpressures from explosions, emissions from DG sets, dredging activities, breakwater construction etc.

- Timing (during construction, operation, decommissioning, immediate, delayed, rate of change)

- Duration (long-term, short-term, intermittent, continuous)
  - Noise arising from equipments during construction are typical short term impacts
  - Inundation of land, accretion, erosion etc are typical long-term impacts
  - Blasting operations may be intermittent while noise due to pile driving operations may be continuous.
  - Discharge of wastewater may be continuous, while spills during transfer operations may be short-term.

- Reversibility/irreversibility
  - Restoration of the environmental quality to pre-existing stage is defined as reversible
  - Air pollution due to transportation of raw material occurs only during construction stage and hence reversible, whereas construction of breakwaters causes an irreversible change to the coastline.

- Likelihood (risk, uncertainty)
  - Some impacts can be predicted to occur more likely, whereas others are less certain. Examples are, release of cargo, oil spills etc., during transfer operations.

- Significance (Refer Section 6.8 for details)
  - Assessment of the acceptability of the impact in terms of existing criteria/ standards.

3.5 Methods to identify impacts

A number of methodologies have been developed to improve the effectiveness and efficiency of identification of impacts. A good methodology should also be simple to understand and disseminate the information to the public. Common methods are as follows.

- Ad hoc procedures: It generally consists of assessments by a team of experts and based on a combination of experience and intuition. This method indicates broad areas of the general impacts and their nature

- Checklists: Consist of a list of environmental parameters that are affected by the proposed development. This method is generally adopted by regulatory agencies since it insures that the major impacts have been adequately covered

- Matrices: Identifies interaction between the various project activities and the environmental parameters. The project activities are listed on one axis and the environmental parameter on the other axis. This is an improvement from the checklist as the impact on a parameter (e.g. water quality) may be due to more than one activity of the project. This method can be quantitative as well as qualitative as a value can be assigned to the interaction. There are over a hundred methods of matrix method of analysis. One such popular and widely accepted method is the matrix method developed by Leopold et al. (1971)

- Networks: Begin with project activities and then form a network of cause-effect network. Thus, for an action, a series of impacts will be seen.

- Overlay techniques generally consist of several thematic maps, each of which depicts components of the environmental inventory. By placing sets of these in an organised and scientific manner, it is possible to visualise the impact on the environmental parameters. This has now become substantially easier with the computer based "Geographical Information Systems (GIS)".

4.0 BASELINE STUDIES

Baseline studies help establish site characteristics such as those,

1. environmentally critical, worthy of conservation
2. environmentally sensitive, requiring substantial management plans
3. environmentally tolerant requiring routine control measures and good housekeeping practices
4. environmentally degraded area due to existing development requiring remediation.

The baseline studies may be designed based on the results of the scoping process and should address two major issues

- Sampling parameters and attributes (Sec 5.2.1)

- Sampling plan - locations and frequency (Sec 5.2.2)

4.1 Data types

Primary data

The data collected at first-hand, by undertaking field visits/surveys, collecting samples and conducting analyses are referred to as primary data. Standard procedures are to be used for analysis and quality control. Quality assurance reports are recommended to support the results.

Secondary data

Secondary data are those already collected by others for various purposes. These are available in departments or institutions, which undertake studies routinely for various purposes, including monitoring the quality of the environment, scientific and research activities. Secondary data can also be obtained from published reports.

4.2 Environmental Attributes

Environmental attributes are defined as variables that represent characteristics of the environment, and changes in these attributes provide indicators of changes in the environment. Table 5-1 gives some of the environmental parameters and attributes.

Table 4.1 Environmental Attributes

Parameter	Attribute
▪ Air	▪ Diffusion factor – atmospheric (wind speed & direction, temperature, temperature gradient, humidity, rainfall, frequency of inversion, stability) & topographic (hills, valleys, buildings) factors and climatology ▪ Quality factors – Particulates, Sulphur oxides, Hydrocarbons, Oxides of Nitrogen, Carbon monoxide
▪ Noise	▪ Attenuation factors- atmospheric & topographic factors ▪ Noise levels
▪ Marine environment	▪ Diffusion factor –hydrodynamics (tides and tidal ranges, waves, current velocity) ▪ Marine soil characteristics ▪ Water quality factors - physical (pH, salinity, temperature, oil & grease, TSS, turbidity), chemical (DO/BOD, nutrients, heavy metals/toxic compounds), biological (faecal coliforms,) ▪ Sediment quality (Benthos, toxicity, SOD, phytoplankton, zooplankton)
▪ Land	▪ Soil characteristics, hydrology, land-use patterns, waste management practice, topography including geomorphology, coastal stability, archaeological monuments etc.
▪ Ecology	▪ Natural vegetation including forest, endangered species, marine organisms including fisheries, ecologically sensitive species (eg. mangroves, sea grass, corals etc.)
▪ Socio-Economics	▪ Regional economic stability, population statistics, per-capita consumption, standard of living, resettlement and rehabilitation issues, marine resources like fisheries etc.
▪ Resources	▪ Fuel resources, non-fuel resources, aesthetics, water supply etc.

Typical baseline parameters for Port and Harbour projects

Air quality attributes

- Atmospheric diffusion factors (wind speed & direction, temperature, humidity, rainfall, stability, mixing depth) & topographic diffusion factors (hills, valleys, buildings) are essential for any air quality study since they determine the transport and dispersion of air pollutants in the atmosphere.

Table 4.2 Air quality attributes

Air quality attribute	Activities that require assessment
SPM, RPM	Site clearing, soil excavation, construction activities, transportation of raw material, captive power generation, dry cargo handling, port based industry etc.
CO, NO_x & SO_2	Vehicular traffic, emissions from construction equipment, ship operations, & captive power generation
Hydrocarbons	Handling of petrochemicals, captive power generation, diesel operated construction equipment and vehicular traffic
Hazardous toxicants	Spillage or leakage of hazardous cargo. ▪ The type of toxicants to be measured is characterised by the cargo proposed to be handled

Noise quality attributes

- Noise attenuating factors such as atmospheric factors (humidity, pressure, wind speed & direction) and topographic factors (hills & valleys) and vegetation are essential to assess a noise quality impact

Activities that require assessment for impacts on noise quality are site clearing, soil excavation, quarrying, dredging, underwater blasting, use of power tools for construction, captive power plants and piling operations.

Water quality attributes

- Oceanographic diffusion factors such as tides, currents and waves and physical parameters like bathymetry are essential for any water quality study since they determine the transport and dispersion of pollutants in water. Past record on tidal information can be obtained from the Indian tide tables, published by the Survey of India. Bathymetry of the region can be obtained from the Naval Hydrographic Office Charts (NHO Charts)

Table 4.3 Water quality attribute

Water quality attribute		Activities that require assessment
Physical	pH, salinity, temperature, TSS, turbidity, oil & grease	pH, salinity, temperature etc. need to be measured for waste discharge from labour camps, dredging, dumping, breakwater construction, discharge of brine from desalination plants Oil and grease need to be measured for petrochemical and petroleum handling operations, ship operations & pipeline transfer operations involving oil.
	Turbidity & TSS	Site clearing, quarrying, soil excavation, construction activities, waste discharge from labour camps, dredging, dumping, breakwater construction, ship operations, trenching for pipelines
Chemical	DO/ BOD, Nutrients	Waste discharge from labour camps and port buildings, dredging, dumping of dredged materials into sea, trenching and underwater blasting, ship operations, breakwater construction
	Heavy metals & toxic compounds	Dredging, dumping of dredged materials into sea, trenching and underwater blasting, cargo storage and handling operations, pipeline operations etc. ▪ However assessment of heavy metals is also characterised by the industrial discharges & geological features in the region
Biological	Faecal coliforms	Waste discharges from labour camps , port buildings and ships
	Phytoplankton, zooplankton, benthic organisms	Dredging, dumping of dredged materials into sea, trenching, underwater blasting, ship operations, breakwater construction, accidental spillage of cargo, discharge of brine from desalination plants etc.
	Species diversity	Introduction of non-indegenious species during deballasting, thermal discharges, brine discharges
Groundwater quality	TSS/ salinity, organic chemicals and heavy metals	Cargo handling/ storage operations, dump sites, seepage

Sediment

Sediment transport and sediment quality form the sediment parameters. For the assessment of impact of project on sediment it is essential to collect data on

- Soil characteristics (clay, sand, silt) and sediment transport phenomena or littoral drift which influences erosion and sedimentation
- Sediment quality (sediment oxygen demand, toxicity, carbon and phosphorus, sediment organisms) which affects the water quality and ecology

Sediment sampling locations are to be situated based on dredging, dumping, trenching locations, outfalls etc. Sediment/hydrography surveys must also address the possibility of marine archaeological sites.

Land attribute

The extent of assessment of the landuse shall be concentrated within a 10 Km radius around the project area. The extent of landuse within a 25Km radius is required when the project is situated near an ecologically sensitive area.

Assessment of aesthetics and landscape is required for site clearing, quarrying, land reclamation, breakwater construction, dry cargo handling and storage, conveyor system etc.

Table 4.4 Land attribute

Land attribute	Activities that require assessment
Land-use patterns & Geomorphological features	Site clearing, quarrying, labour camps, land reclamation, & induced development (major industries in the area)
Topography	Site clearing, quarrying, activities generating noise, hazardous cargo handling operations, and pipeline operations
Soil characteristics	Site clearing, quarrying, storage of cargo, and pipeline operations
Groundwater hydrology	Water supply for construction activities, water supply for labour camps, land reclamation, and storage of dry and wet cargo.

Ecology.

- Natural vegetation, endangered species, marine organisms including benthic and ecologically sensitive species, breeding and spawning grounds, sanctuaries and protected areas help define the environmental setting at the site. These attributes are critical in assessing the suitability of the project at a selected site.

- While collecting baseline information on the flora and fauna of the area, species which are endemic to the area shall be obtained from the Red Book of Botanical Survey of India (BSI) and Zoological Survey of India (ZSI)

Socio-economic attributes

Table 4.5 Socio-economic attributes

Socioeconomic Attributes	Activities that require assessment
Regional economic stability	Existing infrastructure Cargo handling operations that result in employment and induced development
Population statistics	Quarrying operations, hazardous cargo handling operations to study population
Per-capita consumption of valuable attributes	Labour camps, requirements during operational phase of the project, induced development etc
Standard of living	Beneficial aspects of the project in terms of increased employment opportunities, water supply and sanitation, power supply, medical facilities, educational institutions, recreational facilities,
Resettlement and rehabilitation	Land acquisition

Resources

- Water, fuel & non-fuel resources are assessed for labour camps, construction activities, operational power requirement and induced development
- Raw material requirement and resources for land reclamation, breakwater construction etc needs to be assessed. Location of authorised quarry sites may be identified.

Guidance to baseline data collection

- Water sampling stations shall be selected based on the basis of hydrodynamics and location of port/harbour, alignment of berths and ancillary activities, effluent discharge points, sewage outfalls, dredging/dumping sites, etc, and shall be based on the environmental setting of the project site.

- Water quality samples may be collected during high and low tides (for understanding tidal variability and collected over a tidal cycle). Data shall be collected for one season for rapid EIA and three seasons for comprehensive EIA excepting during monsoon.

- Hydro-geological report is required where the project requires withdrawal of large quantity of ground water or storage of water

- Ambient air quality and meteorological data should be collected for one season for rapid EIA and 3 seasons for comprehensive EIA as per the guidelines published by the CPCB in June 1998.

- Sampling stations shall be representative to indicate average conditions. For air and noise quality measurement, criteria specified by CPCB may be followed.

- Air sampling stations shall be selected based on emission discharge locations such as near DG sets, captive power plants, industrial emissions, peak hour/heavy traffic locations, and at sensitive receptor locations, wind direction.

- In respect of meteorological data, a weather station may be required during the period of data collection, while the past data can be obtained from the Indian Meteorological Department

- Noise quality stations shall be selected based on noise emitting equipment/sources such as DG sets, peak hour / heavy traffic locations etc and at noise sensitive receptors. In general noise quality shall be measured at air quality sampling locations

- Biological sampling shall
    - concentrate on benthic fauna for locations that are already developed
    - be conducted in fishing, breeding and polluted zones
    - include analyses at various trophic levels and
    - aim to identify endangered species/critical habitats
    - consist of intertidal sampling for studying mangroves (flora & fauna)

- Bio-diversity/wildlife study may be required in case of projects having impact on flora and/or fauna over a large area

- Rehabilitation and resettlement is essential in the EIA report of any project that is likely to displace people from their homestead and/or farmlands

- The questionnaire for environmental setting covers an exhaustive list of parameters essential for baseline assessment.

4.3 Validation of Data

Validation is a process of checking the correctness of data. When primary data is collected, it can be checked by

- standard procedures for repeatability, variance, confidence limits, expected error based on sample size and comparison with secondary data.

- satellite imageries / GIS

Any deviation in data observed could be correlated with the environmental changes that have occurred in the time interval that has elapsed between secondary and primary data collection.

5.0 PREDICTION OF IMPACTS

Estimation of impacts is called prediction. It gives an estimate of magnitude and spatial distribution of impact. Predictions can be quantitative or qualitative. Quantitative methods give an estimate of the impact using mathematical expressions/computer models and experimental/physical models. Qualitative methods are based on professional judgement and are supported by examples of similar occurrences/events in other locations/projects or cited in literature.

Predictions must incorporate the precautionary principle to account for scientific uncertainty, in representations of natural processes, especially when the risk of serious or irreversible environmental damage is high.

5.1 Scenarios for prediction

The scenarios typically employed in predicting an impact are

Most probable case scenario

Characterised by the combination of discharges/emissions and hydrodynamic/atmospheric interactions that produce the most frequently encountered impact. Examples are discharges/routine spillage during cargo transfers, ship/vehicular discharges during normal climatological conditions

Worst case scenario

Characterised by the combination of discharges/emissions and hydrodynamic/atmospheric interactions that produce maximum adverse impact. Examples are accidental releases from tanks/vessels / pipelines, DG set emissions with stable to strongly stable atmosphere.

5.2 Marine Water Environment

The typical significant water environment impacts in a port and harbour project are those of sediment transport and water quality. These are influenced by the oceanographic parameters like waves, tides, currents and bathymetry. The sediment transport issues are related to the physical alterations of the coastline such as a presence of breakwater, seawall or reclamation, the water quality issues are related to the pollutants generated from dredging activities, oil spills, wastewater discharges and runoff from land areas.

Sediment Transport

Waves arriving at an angle to a shoreline generate longshore currents parallel to the shore in the nearshore zone. The current flows in this zone have the highest velocities and turbulence, transporting sand in suspension along the bottom surface. Long-shore currents for a stretch of coastline have certain capacity to carry sediment, depending on the long-shore current velocity, wave climate and sediment characteristics. When coastal structures obstruct this along-shore transport, it causes deposition behind the obstruction. As a result, the sediment in down drift side of the obstruction is considerably reduced. To fulfil the requirement of the sediment carrying capacity, the upstream shoreline supplies sediment, resulting in erosion.

The impact of coastal structures on the shoreline can be simulated using physical models or mathematical models. Mathematical models require the long-shore current component, which is typically generated from wave radiation models. The long-shore sediment transport is calculated using the continuity equation for sediment volumes. The primary inputs for the computation are the wave climate, cross-shore profile, sediment properties and the coastline orientation.

Water quality

When a pollutant is discharged into a water body, the water quality in the surrounding area is a function of the currents, mixing, water chemistry and biological processes of the natural water body.

The simplest method available for predicting concentrations is for a continuous discharge into a receiving water body under steady state conditions. The currents in the water body will transport the pollutant downstream; spreading the waste by molecular and turbulent diffusion processes and for some pollutants, transforms the pollutant by chemical and biological processes. The typical water quality model is one that simulates the advection and dispersion of the pollutant, with the use of specific modules for simulating the fate of the various pollutants. These models are often linked to hydrodynamic models that provide the current magnitude and direction for the advective term.

The concentration of some pollutants such as pathogenic bacteria and BOD may be modelled by simple ‘first-order’ decay equations, where the mass of the pollutant decreases with time. Dredge spoils may also be simulated using the first-order equations when the grain size is fairly uniform.

Behaviour of trace metals and organic chemicals are more complex to predict, requiring sediment concentrations in water to estimate the partitioning of the pollutant in its dissolved and particulate phases. Dissolved Oxygen is an important water quality and ecosystem health indicator. DO models include many complex ecosystem components such as nutrient uptake, algal photosynthesis, primary productivity, benthic processes, etc.

Oil spill models use the advection-dispersion model base and include processes such as volatilisation, settling of tars and wind dispersion. Temperature models for thermal discharges have modules to define the heat exchange with the atmosphere, which is a function of evaporation, solar radiation and convective losses.

5.3 Air Environment

In a port and harbour project, the typical air quality problems arise due to emissions from DG sets, ships, transportation of raw materials, vehicular traffic, leakage during cargo handling and pipeline transfer operations, dry cargo storage in open yards and transfer in conveyors, site clearing, soil excavation, quarrying, construction activities, evaporation of oil spilled on water etc.

The simplest method available for predicting concentrations is the steady state Gaussian equation, designed for conditions where a continuous stream of pollutant is released into a steady wind in an open atmosphere. In nature, the pollutant plume will rise and bend over, get transported by the wind, and concentrations will decrease away from the source. The plume spread will be influenced by molecular diffusion, turbulent eddies of the average wind flow, thermal gradients, random shifting of winds and mechanical mixing of the air moving over the land. The dispersion of an air pollutant released into the atmosphere depends on the following factors

- Properties of pollutant (stable, unstable)
  - SO_2, CO and SPM are stable pollutants, as they do not participate in chemical processes in the atmosphere.
  - NO_x and certain hydrocarbons are unstable pollutants which actively participate in chemical reactions thereby forming secondary pollutants
- Release rate & type (puff, plume)
  - An accidental release of chemical from a pipeline or hose is an example of puff release (instantaneous)
  - Emissions from power plants, vehicles are continuous and an example of plume release
- Meteorology (Atmospheric stability)
  - Atmospheric stability is defined by wind speed and vertical temperature gradient and influences mixing of pollutant
  - Wind speed influences the horizontal diffusion/dispersion of an air pollutant while wind direction determines the region and receptor of impact.

- Temperature gradient affects vertical mixing of pollutants

- Local terrain conditions (hills, valleys, buildings)
  - The local terrain conditions influence the mechanical mixing of the pollutants.

- Height of release above the ground
  - Emissions from a DG set may occur at different heights based on stack height, while releases from pipeline occur at ground level. Releases from a lower height will have greater ground level pollutant concentrations than releases from a greater height

- Release geometry (point, line, area source)
  - Emissions from ships, DG sets, pinhole leakage from pipeline are point sources
  - Emissions from vehicular traffic during peak hours are line sources
  - Particulate emissions from soil excavation, site clearing, quarrying, dry cargo storage/transfers are area sources. Even evaporation from oil spills on water form an area source.

5.4 Noise Environment

In a port and harbour project, the typical noise problems arise from DG sets, ships, transportation of raw materials, vehicular traffic, site clearing, soil excavation, quarrying, dredging, pile driving, and construction activities.

Sound or noise is a disturbance, which propagates away from the source through an elastic medium, namely air, water or solids, until it reaches a receiver. Models to predict noise, estimate the noise level (dB) at the receiver’s location and is a function of the characteristics of the sound source (power, intensity and frequency spectra), the properties of the transmission medium and the presence of objects or barriers.

For simple cases, such as a point source, the sound energy is radiated over spherical surfaces, away from the source, and the presence of objects in the path of sound propagation will result in a decrease in the sound pressure level. For a source located on the ground, the sound will propagate in a hemispherical pattern. Wave divergence causes the sound pressure level to decrease with increasing distance.

The prediction of noise should address the type of source, type of environmental conditions at the site and the receptors.

- Type of source:
  - Impulsive or sudden: e.g. Blasting for quarrying/soil excavation

- Intermittent-unsteady: e.g. Vehicular traffic
- Continuous- steady noise: e.g. pile driving, dredging, DG sets

- Types of environment or attenuating factors: Atmospheric conditions like humidity, wind direction, wind speed, trees, vegetation, barriers such as walls form the attenuating factor. For example site clearing can remove trees/vegetation and hence reduce attenuation. Green belt development can result in greater attenuation.

- Type of receptors: Insensitive, sensitive zones. For example hospitals, bird sanctuaries, aquatic species are sensitive noise receptors while industrial, commercial areas are insensitive.

5.5 Biological Environment

Ship operations, dredging, pile driving, breakwater construction, underwater blasting, pipeline trenching, disposal of wastes from labour camps, brine discharge from desalination plants, oil spills, hazardous cargo spills are some of the activities of a port that have an impact on the aquatic biology.

The most common method of prediction is the qualitative approach by an expert. Prediction is based on baseline ecology, knowledge of the plant & animal life and their habitat requirements. By utilising the changes predicted for air, noise, water and land environment, an estimate of the ability of the biological community to tolerate the change can be assessed. This is best performed when the data on the biological environment is available for different trophic levels. Tools to assist the expert in the prediction of impacts are:

- Statistical estimates of bio-diversity such as the Shannon-Weiver Diversity Index or species richness indices from the rarefaction method or Jack-Knife estimates. These statistical estimates should be compared with other values for similar environments only. The more recent trends in this direction are the species – abundance – biomass comparison curves.

- Biomass and energy pyramids are aids to define the food chains and the health of the ecosystem. The baseline structure will help in the assessment of the impact of the abiotic environment on the ecosystem.

- Nutrient cycles that can help define potential impacts such as eutrophication, contribution to green house gases.

- Ecological models have also been developed for specialised ecosystem. If an EIA consultant uses these models, appropriateness to the tropical coastal ecosystem of India must be ensured.

Assessment criteria shall consist of species and structural diversity, incidence of rare or threatened species of animals and plants, natural characteristics and irreplaceability of habitats, representative quality etc.

5.6 Land Environment

A port and harbour project usually involves acquisition of significant areas of land and also attracts industries leading to rapid growth of the region. In this perspective the most significant elements of land have been broadly classified into the following

- ***Soil Erosion***: Site clearing, soil excavation, quarrying, and construction wastes lead to soil erosion. Methods like Universal Soil Loss Equation (USLE) are useful to make estimations of soil erosion

- ***Soil Permeability:*** Land disposal of effluents and solid waste/ hazardous wastes may lead to ground leaching. The permeability characteristic is essential to design the lining of the soil for disposal of wastes

- ***Land-use patterns***: Induced development, land reclamation, resettlement etc lead to changes in landuse patterns in and around the project site. Evaluation or interpretation of whether a proposed use of certain parcels of land conforms or conflicts with the existing or proposed landuse plans needs to be done in order to assess landuse compatibility.

- ***Hydrology***: Groundwater may be a source of water for labour camps and construction activities. Alternative sources for water must be identified to protect against depletion of resource & saltwater intrusion. Land-use pattern may significantly increase the surface runoff and reduce the groundwater recharge. Leaching of pollutants into the groundwater can also be of serious concern.

5.7 Socio-Economic Environment

Acquisitions of land, resettlement/rehabilitation, loss of commercial fishing grounds, restriction on fishing activities, infrastructure requirements, induced development etc.are activities that affect the socio-economic environment. Predicting socio-economic impacts can best be done by means of scientifically planned surveys with questionnaires to the public. This survey can help quantifying many of the likely responses of the community to the project.

It is possible to make estimates on the change to the socio-economic environment with a detailed description of the project. The starting point for these estimates is human population & economic models. Population forecasts can involve simple forecasts of historical trends to complex cohort analysis. Econometric models relate the population & economic characteristics of the study areas with interrelationships of the change of economics & population. Table 6.1 gives a list of social and economic impacts that require prediction (as applicable to the project)

Table 5.1 Prediction for Socio-economic Impacts

Social impacts	Economic impacts
▪ **Resettlement of coastal population and loss of livelihood** ▪ **Increased risk of accidents to adjacent neighbourhood** ▪ **Increase in traffic flow and congestion at and around the project location** ▪ **Disruption in area due to construction activities** ▪ **Increase in population /transient population in the area** ▪ **Health and life style impairment because of noise effects** ▪ **Increased housing requirements**	▪ **Loss of fishing grounds** ▪ **New jobs created from the project** ▪ **General growth in commercial and industrial activity in the area** ▪ **Potential loss of taxable property due to acquisition of private lands** ▪ **Increased cost for public services such as police and fire protection** ▪ **Change in adjacent property values** ▪ **Increased energy consumption of port facilities** ▪ **Increase in local sales tax revenues and other tourist oriented revenues**

Impact on human health and materials

Any development can have associated health impacts that can result directly from changes to the biophysical environment (such as exposure to toxic pollutants) or indirectly as the result of other changes caused by the project (eg lowered socio-economic status).

The health impact could also be due to the risk of accidents and disasters. Potential health-related effects of development can be predicted, mitigated and managed. Health impacts are in general, secondary effects of air, noise and water pollution and listed in Table 6.2.

Table 5.2 Health Impacts

Parameter Affected	Cause (Primary attribute)	Effect	Type of Impact
Human health **Vegetation** **Materials** **Risk to humans**	Air attributes **Particulate matter** **Sulphur oxides** **Hydrocarbons** **Nitrogen oxides** **Lead** **Carbon monoxide** **Photo-chemical oxidants**	▪ **Increased mortality & morbidity in exposed population** ▪ **Aggravates bronchitis, respiratory diseases, emphysema, cardio-vascular diseases, eye irritation** ▪ **Chronic plant injury, excessive leaf dropping, reduced productivity in plants & trees** ▪ **Soils clothes & structures** ▪ **Deterioration, corrosion of steel & other metal structures** ▪ **Visibility problems, increased accidents**	**Long-term**
Human Health **Material**	Noise attributes **Physiological effects** **Psychological effects**	▪ **Increased tension and fatigue** ▪ **Increased pulse and respiration rates** ▪ **Dizziness and loss of balance** ▪ **Anger, irritation and nervousness** ▪ **Partial hearing loss**	**Long-term**

	Communicating effects	▪ **Sleep loss** ▪ **Degradation/effect on structures** ▪ **Detrimental effects on worker performance**	
Health **Aquatic life** **Aesthetics** **Socio-economics**	<u>Water attributes</u> **Water quantity** **Suspended solids** **BOD** **DO** **Oil** **Dissolved solids** **Nutrients** **Faecal coliform**	▪ **Coating of free oil on algae and plankton causing destruction** ▪ **Interference with re-aeration and photosynthesis** ▪ **Water soluble fractions of oil likely to cause direct toxic action** ▪ **Destruction of benthic organisms** ▪ **Direct deleterious effect on fish due to coating on gills and blanketing bottom organisms by suspended solids** ▪ **Interference with fish spawning areas and loss of fish production** ▪ **Reduced recreational and economic benefits**	**Long term**

5.8 Significance of impacts

Determination of significance of impacts is to check whether the impacts are acceptable, require mitigation or unacceptable to the community. Significance of impact is determined by the consideration of the impact characteristic and the importance (value) attached to them.

Impact characteristic x Impact importance → Significance

The predicted impacts need to superimposed on the existing background concentrations and compared with standards. There may, however, be no appropriate technical standard for a social or a visual impact and resources that require sustainability. Significance in such cases must be derived from community preferences and can be discovered through public involvement or other special methods. (E.g. Delphi techniques).

The key basis for assessing impact significance are: level of public concern over health and safety, scientific and professional judgement, disturbance/destruction of valued ecological systems and degree of negative impact on social values and quality of life.

Significance can be determined based on ecological importance, social importance and environmental standards.

6.0 RISK ASSESSMENT

The density of traffic movements, nature of cargo handled, configuration of channels, composition of channel beds etc influence risk in a port and harbour facility. The risk of grounding increases as ships approach relatively shallow waters and restricted channels of port areas. Also, there is a risk of collision with port installations in the final approach.

Risk analysis is a tool to determine the consequence of operational failures (e.g. failure of pipeline carrying hazardous liquid) in a project. It is therefore undertaken to enable port authorities determine the action that needs to be taken to improve safety of navigation and deal with the probable effects of an incident in the area.

6.1 Methodology

Risk is typically defined as the product of the frequency of hazard and its consequence.

Risk = Frequency x Consequence

Risks can be divided into two groups, viz., daily risk from routine operations and major risk connected to disastrous accidental events. Daily risks resulting from routine operations of a similar nature that make it possible to predict for the future based on past experience. Major risk is determined by few severe accidents at large time intervals and cannot be predicted by past experience since each severe accident is unique.

Basic steps involved in assessment of risk

Typical incident and consequence in ports are

- An instantaneous release or release over a period of time of the entire quantity of liquid cargo of largest class of vessel using the port
- The dispersion range of the gas cloud under various climatic conditions and the effects of immediate or delayed ignition
- Probability factor of a non-ignited gas cloud approaching populated areas under various climatic conditions

The following steps are required for such risk assessments

1. Study of characteristics of hazardous substances (flammable, toxic, reactive, radioactive, corrosive, explosive, combustible, poisonous, material compatibility)
2. Identify failure scenarios (worst case scenario, most credible loss scenario)

- The most credible loss scenario (MCLS) is the most likely failure scenario, which is inherent to port activities. Failures will occur with a certain probability despite following certain safety procedures and regulations. The common cases of MCLS in a Port and Harbour facility are flange joint failure, pipeline leakage, unloading arm failure, tank rupture, safety valve failure, tank overflow and conveyor belt damage.

- The worst-case scenario (WCS) involves release of maximum quantity of material, under worst weather conditions. The cases of WCS are snapping of flexible hoses, pipeline rupture, catastrophic failure of barge/vessel/tank, ship collisions and cascading effects in storage tanks etc.

3. Estimate probability or frequency of failure (historical records and application of fault tree or event tree techniques)

- Fault tree is a methodology that represents backward logic since it starts with the effect and seeks the causes. Here, the final fault or failure (e.g. the release of hazardous chemical) is assumed, and all the causes that lead to the failure are identified. Frequencies for all the causes are assigned based on experience and historical occurrences. From this the frequency of occurrence of the final fault/failure is obtained.

- Event tree is a methodology that identifies all component failures or causes that would lead to a set of final faults/failures. It represents forward logic and begins with initial event and presents all possible outcomes of the event. Frequency of occurrence of the final fault/failure is obtained by assigning appropriate frequencies to component failures.

- Frequency tables from literature

4. Perform consequence analysis

- Estimate rate & duration of release

- Obtain dispersion parameters such as wind speed, wind direction, atmospheric stability, wave, current velocity and tide.

- Identify material properties such as specific gravity, molecular weight, vapour pressure, flash point, lower & upper flammability limits, stoichiometric concentration, heat of combustion, latent heat of vapourisation, & burning rate

- Quantify impact using models/mathematical calculations. There are various equations and models for dispersion calculations for
  - Liquid spill on water or land
  - Evaporation of the spill to the atmosphere or seepage into soil
  - Pool fire burning & radiation intensity
  - Vapour cloud dispersion/ dense gas dispersion
  - Vapour cloud explosion & overpressure

5. Estimate impact of release on people, property or environment (overpressure, toxic dosage). Risk measure can be made in terms of

- Risk indices
- Individual risk measure
- Societal risk estimate

Quantitative risk analysis provides a numerical measure of the risk any facility poses to the public. The bases for the quantification of risk are the outputs obtained from the assessment of risk viz.,

- Hazard distances and directions
- Concentrations as functions of time and location
- Concentration isopleths map
- Hazard zone map (contours for various damage distances shall be plotted on the map)

7.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

An EMP is an implementation plan to mitigate and offset the adverse environmental impacts of the project and to protect and where possible, enhance the environment. Based on the potential impacts identified, it sets out in detail, the process of implementing mitigation and compensatory measures, the timing of these measures and indicative costs. EMP should be viewed as a legal commitment on the part of the proponent to minimise environmental impacts.

Ports that successfully integrate full consideration of environmental resources, including mitigation of unavoidable adverse impacts, into the planning and construction of port development projects stand to benefit from:

- Reduced uncertainty with respect to approval of projects
- Reduced permit delays and associated costs
- Increased public support for port development projects
- Reduced operational and insurance costs.

In many instances, it has been found that successful implementation of EMP has resulted in reduction in project costs in the long run. This is because the EMP contains

- Proposals for optimum usage of available resources
- Plans to address minor faults at the initial stage (spills, leakage etc. can be minimised using components like safety valves, pressure relief valves)
- Disaster management plans to respond to accidents.
- Countermeasures and recovery plans for spills

Since communities rely on the marine resources for their livelihood, it becomes absolutely necessary to maintain a clean and usable waterfront. Environmental management is essential for sustainable use of the coastal ecosystem to preserve its rich diversity.

7.1 Environmental Management Process

The environmental management process consists of

- Defining an environmental policy
- Developing plans for environmental management
- Implementation of the EMP
- Monitoring the EMP and incorporating corrective action
- Review of the policy, EMP and improvement

Environmental auditing and life cycle assessments may also be incorporated as an integral component of the EMP.

Environmental Policy

In principle any port should define its environmental policy and ensure commitment to its environmental system. The policy shall be displayed at prominent points in the port so that the people visiting the area are made aware of the do’s and don’ts involved in the operation and maintenance.

Environmental policy (An example)

- **To develop projects, in a manner that provides for sustainable use of the marine ecosystem and design infrastructure in such a way as to minimise their environmental impacts.**
- **To minimise significant adverse environmental impacts through the preparation and implementation of comprehensive environmental management plans**
- **To develop indicators of environmental performance by the authority concerned, and include statistics on these indicators in annual reports to government.**
- **To run maintenance operations in ways that, adhere to environmental regulations, prevent pollution and reduce waste, recover and recycle materials wherever possible.**

- Significant environmental impacts that have been identified
- Regulatory requirements
- Proposed environmental policy

Implementation

The following steps are involved in EMP implementation

Step 1: Develop an organisational structure for EMP implementation

Step 2: Assign responsibilities for implementation

Step 3: Define timing of the implementation

Step 4: Define monitoring responsibilities

Monitoring

Environmental monitoring is essential and should be undertaken during the construction and operation phases (Post project monitoring & evaluation) of the project.

The responsibility of implementation shall lie with the construction contractor during the construction phase and the project proponent during the operations phase, while the overall responsibility of monitoring shall always lie with the project proponent. A department/section/cell with trained personnel shall be set up and shall be responsible for the environmental management and monitoring.

External monitoring/auditing is required to be done by the local Pollution Control board or a recognised appointee (by the MoEF) of the project proponent.

7.2 Costs of EMP

Wherever responsibility of EMP action items lies with construction contractors, the cost could be part of the construction contract rates and prices. The cost of EMP shall be a part of the project cost. The funds to be allocated for the various EMP costs are:

- **Personnel**: Training, periodic health check-up, protective devices like masks, helmets, earplugs etc
- **Rehabilitation:** Compensation for resettlement, afforestation, habitat restoration, compensation as a result of accidents
- **Air Pollution Control**: Maintenance and pollution check for emission levels from exhausts, shields for restricting material being flown, dust control measures
- **Water Management:** Water procurement for construction, workforce etc, construction of dykes, berms etc.
- **Waste Management:** Collection and treatment of run-off from ore storage units and spills, construction of sludge tanks, slop pits, associated piping and treatment, construction of tanks for wastes and treatment, incinerators for waste disposal
- **Sediment/Erosion control**: Sand deposition for erosion mitigation, sedimentation control (by dredging or pumping)
- **Safety measures:** Components like safety valves, pressure relief valves, equipment for liquid cargo handling like skimming equipment, fire-fighting systems with hydrants, sprinkler systems, foam generation systems, emergency power supplies during accidents
- **Environmental Quality Planning/maintenance:** Monitoring agencies (Involvement of third party monitoring), hiring experts

7.3 Disaster Management Plan (DMP)

In the case of accidental spillage of hazardous substances, immediate reporting and response are necessary to contain and limit damage. The DMP shall include all types of accidents and it should be geared to meet the worst-case scenario.

Emergency Response Procedure

An emergency response should be developed with the following criteria

- Investigate available resources (including local, regional, national and international groups, and the scale of spillage at which they should be contacted). There shall be a protocol for responding to emergencies. A list of local resources for emergency response, address, telephone numbers shall be made available at strategic locations.

- Emergency services available on site and in local area (site response team, fire department etc.)

- Investigate the location and deployment of available equipment (hydrants, fire extinguishers, absorbent materials, etc)

- Identify suitable means for disposal of contaminated debris

- Define special equipment and product requirements and provide for their acquisition, deployment and maintenance

- Provide for training of personnel

- Establish the authority and responsibilities of individuals in the event of a spill or other occurrence

- Individual employee actions required (especially if employee safety is threatened)

- Emergency personnel and/or management actions required

- Establish a policy for response, including the legal framework for damage assessment, compensation and clean-up costs

Contingency plan

Following is the list of information required for responding to spills and should be clearly displayed at strategic locations.

- Name, CAS number (world's largest and comprehensive database of chemical information) of substance released or markings on tank, car, truck or vessel

- Physical state of released substance (solid, liquid, vapour)

- Source of release (i.e., tank, truck, barge, stationary installations)

- Approximate volume of release and/or total volume of source

- Media into which release may occur and anticipated movement of spill

- Local terrain/accessibility, topography, porosity of ground surface

- Distance to drinking water supplies, population centres and public areas such as schools, churches, public buildings, busy intersections, shopping centres, recreational facilities, sewers and watercourses, other hazardous substances, food and feed processing facilities

- Weather conditions currently at site or forecast over next 24 hours, wind speed and direction, air/ground/water temperature as applicable, precipitation.

8.0 WRITING AN EIA REPORT

8.1 Introduction

The final step in the EIA process is the preparation of an Environmental Impact Statement (EIS) or an EIA report, which summarises all the s

Studies carried out for the environmental impact assessment. EIS shall contain a summary, which should stress major conclusions, areas of controversy (issues raised by the public) and issues to be resolved (including the choice among alternatives). In order to stress and highlight these points, it is desirable to cover these topics, as distinct sub-sections.

Decision-makers, planners and scientists read an EIS. To cater to these diverse groups, the EIS must be written in simple language. In all likelihood the summary will be read by all, especially decision-makers and planners, while the technical content will be scrutinised by stakeholders with specific interests. It is therefore imperative that the summary be written carefully and thoughtfully. The summary must clearly state the advantages and disadvantages of the project with a statement on the recommendations. Ambiguous statements that use phrases such as "may occur" etc must be avoided as much as possible.

8.2 Contents of an EIS

Brief description of the project

- Need for the project
- Project activities

Description of the existing environment

- Natural Setting, Resource availability, Sensitive areas
- Social Setting

Consideration of alternatives

- Project alternative
- Site alternative
- No Project alternative

Identification of impacts

- Methodology of impact identification
- Impacts during the construction phase
- Impacts during the operation phase
- Impacts without the project in future
- Characterisation of impacts

Baseline study

- Baseline parameters
- Sampling criteria
- Methodology of analysis
- Validation

Prediction of impacts

- Area/receptors subject to potential impacts
- Summary of prediction/calculations
- Significance of impacts
- Without project
- With project with/without EMP

Risks due to the project

- Area/receptors subject to risks
- Frequency of risk
- Consequence analysis

Mitigation, protection and enhancement measures

- Environmental Management Plan
- Monitoring
- Disaster Management Plan (DMP)
- Safety measures & emergency procedures

Summary and conclusions

- Summary of impacts and comparison with baseline and regulatory standards.
- Summary of project with environmental management plan
- Conclusions shall contain answers to questions like
- Will the implementation of the project have significant adverse effect on the quality of the environment?
- Is the project environmentally friendly/controversial?

8.3 Considerations in the preparation of EIS

- EIS shall be concise and written in simple language, and shall contain appropriate illustrations/flowcharts to enable the reviewer and public understand the document. Examples are
  - Illustrations/maps providing details about the location, landuse, and ecologically sensitive areas.
  - Illustrations/drawings of the layout and proposed facilities.
  - Process flow diagrams, management hierarchy, cause-effect relationship between project activities and impacts etc
- An EIS shall be analytic rather than subjective
- Impacts shall be discussed in proportion to its significance
- EIS shall assess the environmental impact of the proposed action and not justify decisions that have been already taken.

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List of Abbreviations

BOD	Biochemical Oxygen Demand
CAS	Chemical Abstract Services
CPCB	Central Pollution Control Board
CRZ	Coastal Regulation Zone
dB	Decibels
DG	Diesel Generator
DMP	Disaster Management Plan
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
GIS	Geographical Information System
IAA	Impact Assessment Agency
IMDG	International Maritime Dangerous Goods
MARPOL	Marine Pollution
MCLS	Most Credible Loss Scenario
MOEF	Ministry of Environment and Forests
MOST	Ministry of Surface Transport
NAAQS	National Ambient Air Quality Standards
NGO	Non Governmental Organisation
RMP	Risk Management Plan

SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
TDS	Total Dissolved Solids
TOR	Terms of Reference
TSS	Total Suspended Solids
UNEP	United Nations Environmental Program
USLE	Universal Soil Loss Equation
WCS	Worst Case Scenario

Guidelines

for

Wastewater disposal through marine outfalls

for

The Department of Ocean Development

Under the

Integrated Coastal and Marine Area Management Program

Prepared by

National Institute of Ocean Technology
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Introduction

9.0 WASTEWATER DISPOSAL

Most of the largest population centres in the world are sited in coastal areas and more than half of the world's population currently lives within 60 km from the coastline. It is anticipated that by the year 2020, the coastal inhabitants will constitute 75% of the global population. The projected coastal population growth shall be accompanied by an increase in sewage and subsequent increase in health problems if wastewater discharges are not controlled. (World Bank, 1996)

Increased industrialization and rapid urbanization of the coastal cities has stressed marine resources, with polluted discharges from industries, domestic sources and urban runoff. While municipal sewage contains pathogens and nutrients, industrial effluents and urban runoff may contain trace metals, organics and chemicals.

Discharge of wastewater into the oceans with minimal treatment is the preferred option worldwide as dilution is considered to be an alternative to treatment. Yet, coastal areas are the most productive and thus wastewater discharge in coastal waters must consider long term secondary impacts of untreated effluent discharge or if effluents are discharged after primary treatment. .

Controlled disposal of wastewater is an essential component of water quality management in order to ensure guaranteed quality for the general public as well as for trade, fishing communities and industry..

9.1 Need for marine outfalls

The primary need for disposal of wastewaters in deep waters through marine outfalls rises out of growing environmental concerns associated with the discharge of partially treated/ untreated sewage into natural streams, rivers and estuaries. Subsequent pollution of these water bodies has a significant negative impact on the health, environment and aesthetics of the society. Ocean disposal is therefore the most preferred option as its objective is to transfer wastewater from a region of high impact to a region of localized low impact. Wastewater disposal through marine outfalls is beneficial and provides a net positive impact to the region because of

Improved water quality at coastal locations
Improved physiochemical quality of water due to

- Reduced BOD and nutrient loading

- Elimination of colour and odour

Enhanced aesthetics
Reduced ecological impact

These benefits would therefore result in

Increased property values
Improved safety & health conditions
Improved surface & groundwater quality
Creation of business opportunities like tourism

However, environmental concerns at the outfall location need to be addressed in the marine outfall project design, construction and operation phases.

9.2 Marine outfalls

Principle

A marine outfall is a pipe that conveys wastewater/liquid effluent from a treatment plant to the receiving (marine) waters, possibly located several kilometers offshore in deep waters.

Wastewater consists of municipal sewage and/or industrial trade effluents like cooling water from power generation plants, brine from desalination plants, effluent from manufacturing processes etc and is usually subject to treatment so as to conform to the national standards for discharge before its final disposal into the coastal waters.

The treated wastewater is pumped (against the hydraulic pressures of tidal and wave motion in the marine environment) to an outfall system. A diffuser section is provided at the end of the outfall and is the final location of wastewater disposal. The diffuser section is provided with one or more number of ports and is a mechanism for providing rapid mixing of the effluent during its discharge into the sea.

Dilution mechanism

Mechanisms that govern the dilution characteristics of the marine outfall are considered in three phases

(a) Initial dilution phase (near field)

This occurs in the first few minutes as the wastewater leaves the outfall diffuser and rises in the water column. Initial dilution is caused by

- Jet mixing due to momentum of wastewater as it leaves the diffuser port

- Buoyancy effect resulting from density differences between the wastewater and the ambient sea water (temperature and salinity differences) which causes the wastewater to rise upward in the water column as an expanding plume thus mixing with sea water

- Current effect causing the lateral entrainment of sea water into the wastewater plume

The wastewater plume may rise to the water surface or may be trapped below the surface depending on the density stratification of the water column. The initial dilution is a function of the water depth at the point of disposal; diffuser length; number, orientation and spacing of ports; port diameter; exit velocity and density differences between wastewater and ambient seawater.

(b) Transport and dispersion of the sewage field (far field)

The hydrodynamics such as water depths, ocean currents, turbulence etc., govern the molecular diffusion, advection and dispersion of the sewage plumes after the initial dilution.

(c) Kinetic reactions that take place in the sea (water quality)

Reactions on wastewater are influenced by water quality parameters such as salinity, temperature, pH, presence of toxic substances, nutrients etc. For example, salinity and temperature influence the bacterial (E-coli) die-off rates, which is regarded as an important indicator of fecal pollution in the marine environment.

9.3 Considerations in marine outfall design

The primary considerations of wastewater disposal through marine outfalls are:

- Characteristics of wastewater (quantity & quality)

- Applicable discharge standards for industrial wastewater and receiving water quality standards upon disposal;

- Siting of the treatment facilities, landfall and discharge points for outfalls and pipeline routing;

- Significance of climatic and oceanographic factors and their seasonal variations

- Requirement of minimal levels of treatment before discharge;

- Location and size of outfall structure

- Projected population growth (short and long term)

- Impact on existing and future water uses and marine ecology;

The basic objective in design is to reduce adverse effects at one location, thus resulting in a net benefit to that region. Some of the adverse impacts during the construction and operation phases of a marine outfall are listed in the following section.

Adverse impacts

Construction phase

Minor temporary impacts are:

Particulate emissions from site clearing, transportation of raw materials and other construction activities;
Noise generation from site clearing, transportation of raw materials, underwater blasting and tunneling at the project site; and
Soil and beach erosion due to site clearing and removal of beach vegetation.
Water pollution due to increased suspended solids, turbidity, nutrient release from sediments from trenching of seabed.

Major temporary impacts are:

Loss of valuable flora and fauna (benthic organisms, fishing and spawning grounds) due to trenching on seabed for pipeline
Impact on sediment transport due to trenching, pipeline laying and backfilling
Impact due to tunneling/dredging and disposal of excavated dump.

Operational phase

Water quality impact on adjacent water uses due to wastewater disposal causing temporary or even permanent displacement of users
Impacts from discharge of wastewaters in offshore locations (domestic and industrial) are

- Bacterial contamination due to disposal of partially treated wastewaters
- DO decrease in the coastal waters and its impact on fishes
- Increased BOD, COD, suspended solids and nutrients near the outfall location
- Increase in heavy metals, non-biodegradable organic matter and persistent chemicals
- Increased temperature of cooling water discharges, salinity from brine discharges from desalination plants

Magnitude and Extent of impacts

The degree or magnitude of impact during construction will mainly depend on

- Type of outfall (pipeline or tunnel)

- Size of pipelines/ tunnel
- Installation techniques and type of equipment
- Soil properties
- Type of environment

The extent of impact is determined by the area/region of impact distribution. A localized impact shall be observed during trenching or tunneling due to:

- Sediment resuspension causing an increased turbidity;
- Nutrients in the sediments causing increased productivity and DO uptake;
- Release of heavy metals (if any in the sediments);
- Noise generated from the equipments driving sensitive marine organisms away from site of construction activity;
- Benthic impacts.

All these impacts are however short term and confined to the project location.

9.4 Alternative theory

Currently, in large coastal cities of India, land price is high and secondary treatment is expensive. Hence municipal wastewater discharge through deepwater marine outfalls are being recommended. Deepwater outfalls aim to avoid the need for secondary treatment by significant dilution of sewage, discharge at a remote location where aesthetic requirements are marginal assimilating the sewage with minimal side effects.

In such cases wastewater after preliminary treatment (screening and grit removal) or primary treatment (primary clarification) are conveyed through the pipeline or tunnel and disposed off at a deepwater location at about 4-5 km from offshore. The combined effect of the diffusers, the depth and mixing with the cold seawater is designed to ensure that the sewage seldom surfaces, but remains submerged in deep waters.

> The concept of deepwater marine outfalls is that "when the sewage is discharged into deeper water, and at a lower level, it will at once be mixed with a larger quantity of salt water, and be thus to a greater extent diluted and disseminated, being more exposed to the action of the tide, instead of being discharged upon the foreshore, where it festers in the sun and air, and hence becomes offensive, or spread over the surface of the water with almost equally bad effect" [Sydney City and Suburban Sewage and Health Board, Sixth Progress Report, 1875, p5].

The principal problem associated with partially treated municipal sewage (bypassing secondary treatment) is the faecal coliforms, BOD and the total suspended solids. Dilutions in deep waters reduces BOD mass and suspended solids concentration in a matter of a few minutes or hours after disposal.

Bacteria and viruses could die in the hostile sea environment or reduced by sedimentation, adsorption, normal biological mortality and sunlight, but the primary concern is the time taken for them to die. While 90% of fecal coliforms die-off in 1-7 hours, viruses can live for months in the seawater and build up over time. The presence of such organisms in the coastal waters is detrimental to the health of bathers, swimmers and recreational and other users of coastal waters.

A single sewage particle contains a large number of microorganisms because of the tendency for particles to attract bacteria and viruses on their surfaces and hence dilution mechanism is inadequate and inappropriate to deal with such organisms that cause water borne diseases.

World over the concept of deepwater outfalls for partially treated municipal sewage is being questioned due to problems associated with such disease causing organisms. Hence in future, large metropolitan areas along coastlines have to re-evaluate the current approach to treatment before marine disposal of wastewater.

9.5 Need for guidelines

Pollution of marine coastal waters with sewage, effluents and wastes from the hinterland and ships is an important problem associated with industrial development, growth of coastal towns and navigational activities in ports and harbors.

In India, though it is mandatory for various types of industries to obtain environmental clearance by conducting EIAs, a wastewater disposal facility does not independently require an EIA. Wastewater collection, treatment and disposal form a part of every municipality and industry. Environmental clearance for the industry takes care of this issue. However, specific guidelines for wastewater disposal and optimal location of wastewater disposal facility (such as marine outfalls) do not exist for either industry or municipalities.

Since the coastal zones are ecologically fragile and commercially valuable and as coastal waters are put to various types of beneficial uses such as bathing, contact sports, fishing, swimming, harbors, navigation, etc it is essential that adequate steps be taken for sustainable use the of coastal resources with minimum pollution. It is essential to ensure that a wastewater disposal through marine outfalls is sustainable in a long term and from this perspective there is a requirement for a guideline that helps developers and environmental consultants understand the importance of optimally locating the discharges so that the coastal environment is sustainable.

9.6 Guidelines for wastewater disposal through marine outfalls

The guideline for wastewater disposal through marine outfalls shall address the following issues

1. Environmental legislations applicable to locating an outfall facility in the coastal zone, discharge standards of treated wastewater and coastal water quality criteria for different uses

6. Optimisation of the location of the outfall and design - Analysis of alternatives
   - Alternative location i.e. selection of the pipeline route ‘
   - Alternative technology i.e. alternative wastewater treatment and disposal option
7. Marine outfall facilities construction and operational activities
8. Environmental impacts of marine outfall
9. Baseline assessment
10. Prediction of environmental impacts during construction and operation stages
11. Monitoring the performance of a marine outfall.

The primary criterion for an outfall location (depth of pipeline and length of pipeline from shore) is the ecological characteristics of the site and the "designated use classification" of the coastal waters, which shall be determined based on the water quality in the receiving waters after dispersion of the effluent. The effluent characteristics (rate, quality parameters such as temperature, BOD, suspended solids, salinity, fecal coliforms etc), the hydrodynamics (currents, waves and tides) and bathymetry govern the dispersion mechanism in the receiving waters.

Environmental Legislations

10.0 INTRODUCTION

The section gives a broad outline of the existing national environmental legislations relevant to wastewater disposal through marine outfalls. It includes legislations that govern the location of wastewater disposal facilities and standards for discharge of effluents into the marine coastal areas. However, the reader needs to refer to the latest acts/rules and standards.

Wastewater disposal can adversely affect water uses in the coastal areas and therefore the environmental quality objectives for outfalls call for protection of

- Marine life;
- Recreational waters;
- Aesthetic quality of water by avoiding slicks and floating matters; and
- Water quality for industrial and other uses

10.1 Environmental legislations

Environmental Impact Assessment Notification, 27th January 1994, (as amended upto 21st of November 2001) by the Ministry of Environment and Forests (MoEF)

"Various types of industries" are categorized under the Schedule I of the EIA notification and require an EIA. Item (5) of Schedule II of the EIA notification is relevant to wastewater disposal.

Schedule-I consists of twenty-nine different activities falling under nine sectors for which Environmental Impact Assessment (EIA) is statutory. These twenty-nine activities are broadly categorized under the following sectors.

- Various types of industries
- Mining Projects
- Thermal power plants
- River valley projects

- Ports, harbours and airports
- Communication projects
- Atomic energy projects
- Transport projects (rail, road and highway)
- Tourism projects (including hotels, beach resorts etc.)

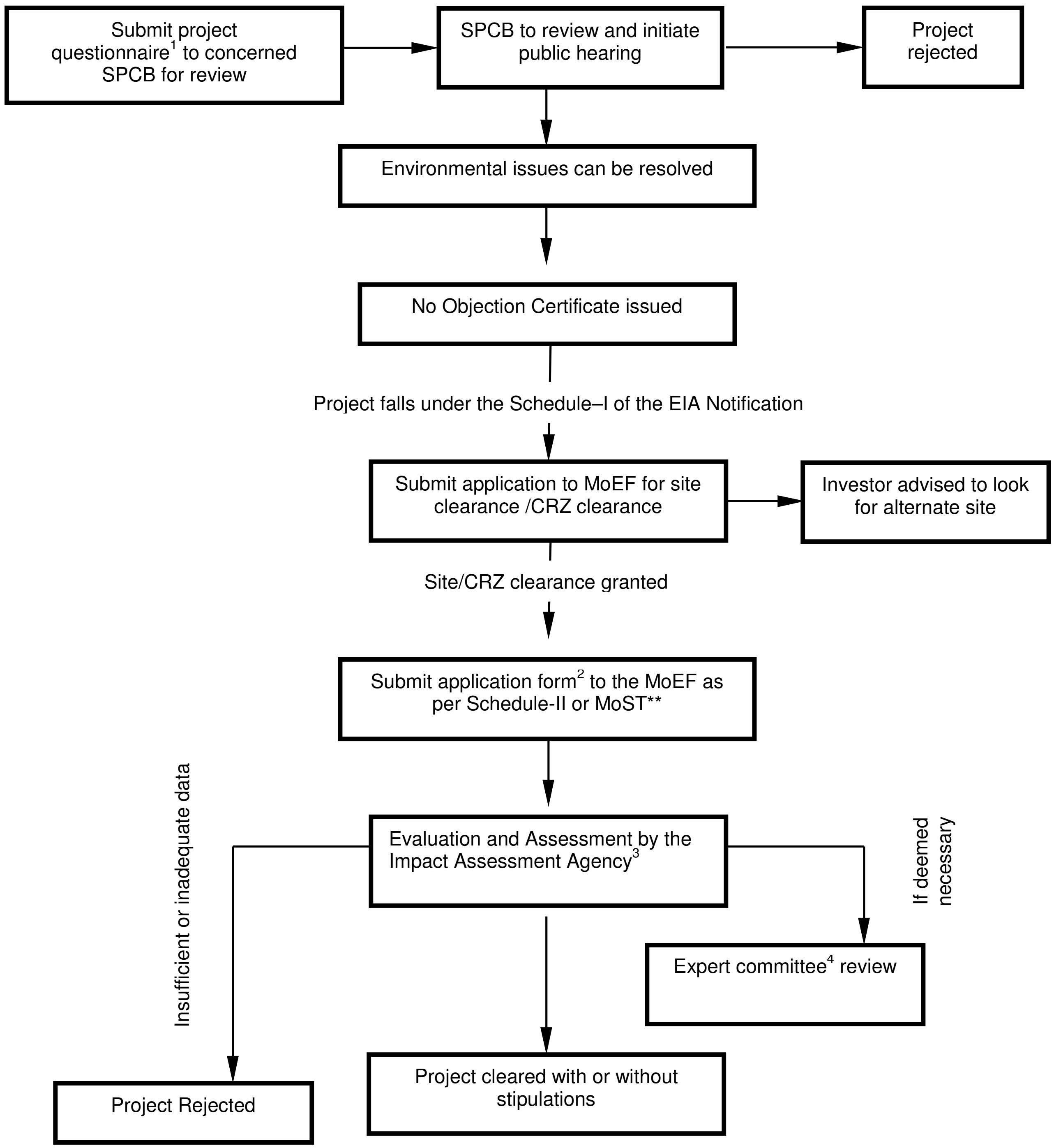


Fig. 2.1 Procedure for obtaining environmental clearance

List of documents to be submitted to the SPCB is as per Schedule-IV of the EIA notification

List of documents consist of EIA report/EMP and details of public hearing as specified in Schedule-IV

Impact Assessment Agency is the Union Ministry of Environment and Forests

Expert committee composition is according to the Schedule-III of the EIA notification

** Expansion and modernization of existing ports and harbours in areas within the existing port limits shall require environmental clearance from the

Coastal Regulation Zone Notification, 19th February 1991 (as amended upto 3rd of October 2001) by the Ministry of Environment and Forests (MoEF)

The Government of India in the MOEF notification dated 19th February 1991 declares coastal stretches as Coastal Regulation Zones (CRZ). According to the notification, coastal stretches of sea, bays, estuaries, creeks, rivers and backwaters, which are influenced by tidal action upto 500 metres from the High Tide Line (HTL) and land between the Low Tide Line (LTL) and the HTL are declared as Coastal Regulation Zone. Restrictions are imposed on the setting up and expansion of industries, operations and processes in the CRZ. (http://envfor.nic.in/) Projects in the coastal zone of value greater than Rs. 5 crores require EIA clearance

Activities in the coastal zone are regulated under the CRZ Notification as permissible and prohibited activities. Permissible activities require environmental clearance from the MoEF. Wastewater disposal facilities and activities that lie within the CRZ are regulated as given below

i. Permissible activities

- Facilities for discharging treated effluents into the water course, provided approval has been obtained under the Water (Prevention & Control of Pollution) Act, 1974
- Facilities for carrying treated effluents and wastewater discharges into the sea
- Facilities for intake and outfall for wastewater/cooling water

ii. Prohibited activities

- Setting up and expansion of units/mechanisms for disposal of wastes and effluents
- Discharge of untreated wastes and effluents from industries, cities, towns or human settlements
- Construction in ecologically sensitive areas

Compliance with CZMP for the region

The Coastal States and Union Territory Administrations shall prepare the Coastal Zone Management Plan (CZMP), which identifies and classifies the CRZ areas within their respective territories in accordance with the "Coastal Area Classification and Development Regulations" (Annexure I) of the CRZ notification and obtain approval from the Central Government in the MoEF. Any development and activities within the CRZ shall therefore comply with the CZMP for the region.

The Water (Prevention and Control of Pollution) Act, 1974

This act demands approval for new outlets and new discharges (section 25). As per the act ‘No person shall, without the previous consent of the State Board

- Establish or take any steps to establish any industry, operation or process, or any treatment and disposal system or an extension or addition thereto, which is likely to discharge sewage or trade effluent into a stream or well or sewer or on land; or
- Bring into use any new or altered outlets for the discharge of sewage; or
- Begin to make any new discharge of sewage; ‘

“Stream” includes river, water course (whether flowing or for the time being dry), inland water (whether natural or artificial), subterranean waters, sea or tidal waters

“Trade effluent" includes any liquid, gaseous or solid substance, which is discharged from any premises, used for carrying on any ["Industry, operation or process, or treatment and disposal system"] other than domestic sewage.

10.2 Water quality standards

Standards for receiving waters

In a coastal segment marine water is subject to several types of uses. Water quality standards have been specified to determine its suitability for a particular purpose. Among the various types of uses there is one use that demands highest level of water quality/ purity and that is termed as “designated best use” in that stretch of the coastal segment. Based on this, the primary water quality standards have been specified for the following five designated best uses.

Table 2.1 Water Quality standards

Class	Designated best use
SW-I	Salt pans, shell fishing, mariculture and ecologically sensitive areas
SW-II	Bathing, contact water sports, and commercial fishing
SW-III	Industrial cooling, recreation (non-contact) and aesthetics
SW-IV	Harbour waters
SW-V	Navigation and controlled waste disposal

Indian standard (IS-7967-1976) "Criteria for controlling pollution of marine coastal areas"

This standard lays down the criteria for controlling pollution of marine coastal areas caused by the discharge of sewage, effluents and wastes from hinterland and from ships.

Discharge limits and standards for industries

The treated industrial effluent shall conform to

- The Indian Standards (if any for that particular industry) before disposal; and
- The tolerance limits for water quality after receiving discharges as per the Indian Standard IS – 7967-latest edition "Criteria for controlling pollution of marine coastal areas"
- The domestic/ municipal wastewater after treatment shall conform to the IS – 7967-latest edition.

EPA Standards for wastewater

The USEPA regulates the discharge and treatment of wastewater under the Clean Water Act. The National Pollutant Discharge Elimination System (NPDES) issues permits to all wastewater dischargers and treatment facilities. These permits establish specific discharge limits, monitoring and reporting requirements and may also require these facilities to undertake special measures to protect the environment from harmful pollutants.

For detailed information on laws/regulations, water quality standards, implementation criteria and technological background, water quality criteria with respect to aquatic life, human health, biological, nutrient and microbial requirements, the reader is referred to the EPA WebPages at http://www.epa.gov/waterscience/standards/laws.htm

Outfall design

11.0 INTRODUCTION

This chapter discusses selection of route for pipeline based on environmental engineering and siting criteria and the various components of the marine outfalls. The environmental concerns need to be integrated in the early stages of the project engineering design.

11.1 Design of outfall

The design of any waste disposal facility is based on evaluation of the limits to acceptable change in each environmental parameter, including health related risks, which can be obtained through estimation of impacts or prediction. For marine outfalls, these limits correspond to meeting receiving water quality standards, principally for bathing areas, shellfish and fishing grounds, areas of sensitive aquatic flora and fauna etc.

- **The first step in designing an outfall is basic configuration of the port diffuser for the effluent discharge, i.e., number of ports, diameter, spacing, height from the bottom, orientation of the ports etc. using model studies. The objective of design shall be to maximize the mixing in the near field.**
- **The next step is to identify the outfall locations based on criteria such as (i) Minimization of construction and maintenance costs and (ii) Water quality standards required for "designated best uses".**

11.2 Components/facilities of a marine outfall

Pumping station/headwork

The pumping station provides necessary pumping head or force for transporting wastewater against the hydraulic pressures generated through tidal and wave motion in the marine environment

The outfall system

The outfall is essentially the conveyance system that transfers the effluent from the headwork to the disposal point, which is about a few thousand meters or more from the shore in deep waters (say 5-100 meters). The ideal profile is that with a drop shaft to below low tide level that continues down a seaward slope until it breaks through the seabed at the start of the diffuser section (Fig. 3.2).

The diffuser section

The diffuser section is a mechanism for providing rapid mixing of wastewater during its discharge into the sea. It is provided with a large number of ports and the diffuser design is such that it provides an even flow distribution at peak discharge so that all the ports achieve similar initial dilution and adequate secondary dispersion to achieve the receiving water quality standards; minimizes the head loss; and provides adequate flushing of the sediment, slime and grease.

11.3 Optimization of outfall location

Appropriate locations for outfall shall be identified based on results of both Hydrodynamic and Advection-Dispersion modeling studies. Several alternatives with various outfall locations (distance from shore) and water depths need to be assessed. Simulations shall comprise different outfall locations, with outlet direction along the ambient current flow and away from the shore. The outlet direction away from the shore needs to be checked to determine environmental benefits. Fig. 3.1 shows the steps in the optimization of outfall location.

Outfalls are required to be sited based on considerations such as (i) distance, level of treatment and method of discharge to meet receiving water quality standards throughout the site and (ii) cost effectiveness of the location

Outfall location design

Choice of the outfall location can be made based on pollutant concentration excesses at various distances from the shore for several alternative locations considering water quality criteria. Velocity changes in the vicinity of the outfall also need to be assessed to avoid erosion or mobilization of sediments. The outfall shall be beyond the surf zone, catering to peak wave conditions

Diffuser design

The considerations for selecting a diffuser configuration include temperature increase, well-mixed conditions in the near field and stratification. Several combinations of diffuser configurations such as, (i) diffuser block located at different water depths, (ii) varying the number of ports, (iii) spacing, and (iv) outlet directions, shall be modeled before selecting a particular diffuser configuration.

Optimization of the diffuser design shall ensure mechanical and structural stability, construction ease and material availability, while ensuring well-mixed conditions of the effluent plume.

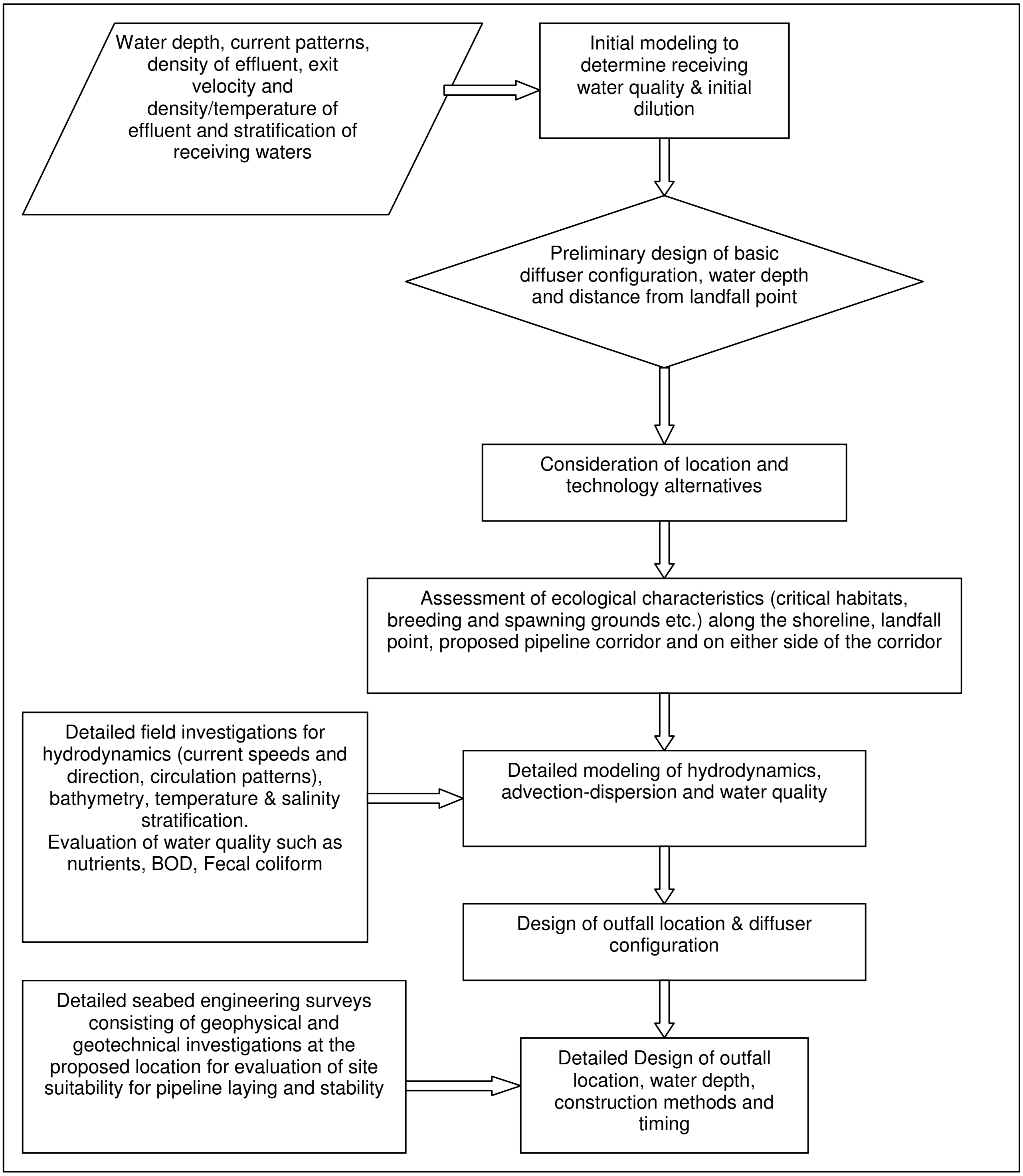


Fig 11.1 Steps in outfall design

11.4 Assessment of receiving water quality

Effluent discharged from outfalls undergoes rapid initial dilution, typically within a few hundred meters of the outfall, before reaching either a level of neutral buoyancy or the ocean surface. It undergoes a number of physical, chemical and biological processes in the water column before being transported out of the region or settling down into the sediments or being accumulated by biota.

Mixing and dilution of the effluent occur due to turbulence that causes entrainment and diffusion. The source of this turbulence changes with distance from the discharge point. Near the diffuser, the primary source of turbulence is shear, induced by the discharge momentum and buoyancy. Local currents and local boundaries may modify this "self induced" turbulence. This region is often called near field or initial mixing region. Farther from the diffuser, this self-induced turbulence decays, and mixing becomes primarily due to turbulence naturally present in the ocean. This region is called far field [Roberts et al].

A prerequisite for estimating the changes to the water environment is the understanding of the movement of the water mass as defined by the waves and tides, otherwise called wave and tidal hydrodynamics and current circulation patterns. Behavior of plumes from ocean outfalls can be predicted using numerical models and assessment needs to be made of the three different stages, viz., initial dilution (near field modeling), transport (advection and dispersion modeling) and decay (fate) of pollutants (water quality modeling).

Near-field modeling

When wastewater is ejected from the outfall diffusers, the plume rises/slumps through the water column depending on its buoyancy relative to the surrounding ocean waters and the momentum of the jet. As the plume mixes in the water column, it is diluted by entrainment of the ambient ocean water resulting in gradual increase in plume density. Eventually, a trap level is reached, either at the surface or at a point in the water column where the plume attains neutral buoyancy.

Behavior of effluent in the immediate vicinity of the outfall is a function of outfall geometry (number, size, orientation and spacing of diffuser ports), water depth, current patterns, buoyancy of effluent, exit momentum and density/temperature stratification of receiving waters, all of which need to optimized in the near field modeling studies.

The first step in the modeling process is to maximize the dilution by attaining well-mixed conditions for the given ambient discharge conditions. This can be achieved by designing/providing the basic diffuser configuration necessary to meet well-mixed conditions. The considerations for selecting a diffuser configuration include temperature/pollutant increase, well-mixed conditions in the near field and stratification.

Near field models are used to predict, where the plume will eventually reach a trap level, the thickness of the plume, and the dilution achieved at the end of the near field zone. There are simple models [like USEPA's CORMIX] available for modeling wastewater discharges from diffuser block.

- CORMIX can be used for preliminary design of the diffuser. (Number of ports, diameter, spacing, height from the bottom and orientation). The diffuser design shall aim to optimize complete mixing with the ambient waters.

- CORMIX models the discharge of wastewater from outfalls, providing an estimate of initial jet mixing and the plume configuration in the immediate vicinity of the outfall

Also semi-empirical equations formulated based on experiments conducted with T-shaped risers (ports perpendicular to the diffuser axis in both directions), negligible port spacing and jet momentum flux are available for obtaining initial dilution at the end of the near field [Roberts et al 1989]

Considerations in diffuser design

The standard hydraulic design criteria for diffusers comprise uniform effluent distribution along the diffuser, minimum velocity in the diffuser pipe between 0.61and 0.91 m/s at peak flow to prevent deposition within pipe, port densimetric Froude numbers greater than 1 to prevent saline intrusion and total area of ports downstream of a diffuser pipe section not greater than 1/2 to 2/3 of the area of that section [Grace 1978]. However beyond these internal hydraulics designs, following are some important considerations that shall be ensured.

- **The diffuser location and orientation shall be such as they do not block normal ambient sediment transport;**
- **The diffuser's internal condition shall be readily and quickly assessed through accessible inspection ports or inspection risers;**
- **Ports shall be easily capped as needed, during periods of low flow early in the outfall's life.**

11.5 Consideration of alternatives

Preliminary studies are required to identify possible routes/sites for the outfall. The selection of route/site is based on technical, economical and environmental considerations.

Location Alternatives

The objective of route selection is to determine the best route to the desired water depth. Coastal topography, shoreline configuration, landfall location etc are some of the factors that dictate selection of a route.

Nautical charts, oceanographic maps, SONAR charts and sounding as well as bottom samples are sources of information, which are useful for preliminary evaluation of a route. It is essential that a detailed route survey be conducted along the route evaluated from preliminary survey, as many features, which are too small to show up on maps, are required while detailing the route.

While generally, route selection is based on technical and economic criteria, assessment of potential impacts on biological, physical and cultural environments during construction and operations shall be made for alternative routes. Following are some of the factors that shall be checked and screened during site selection and route evaluation.

c. Ecology and culture

- Existence of critical habitats, breeding and spawning grounds, migration routes, aquatic vegetation, endangered species etc., along the route or in close proximity to the proposed site.
- Routes through existing marine parks, coral reefs, dive sites, swimming beaches, other recreational beaches, archaeological, historical and cultural interests

d. Oceanography and climate

- Site vulnerable to cyclones and hurricanes
- Sites with strong wave action and bottom currents

e. Bathymetry

- Routes with uneven and steeply sloping sea floors that may give rise to integrity and stability problems for pipelines along them.
- Obstacles like rocks etc.

f. Sediment transport

- Geomorphologic processes at the site such as progradation (advance of shoreline resulting from near shore deposition of sediments brought into the sea by rivers), accretion (sediment accumulation due to inflow of sediment from external sources) and erosion (removal of material from shoreline due to wave action).

g. Siesmicity

- Sites at close proximity to active geological faults having increased risk of disruption due to earthquakes.

h. Geotechnics

- Areas with shoreline and seafloor instability.
- Soil (especially rocks) poses problems for trenching and burial of pipelines.

Technology Alternatives

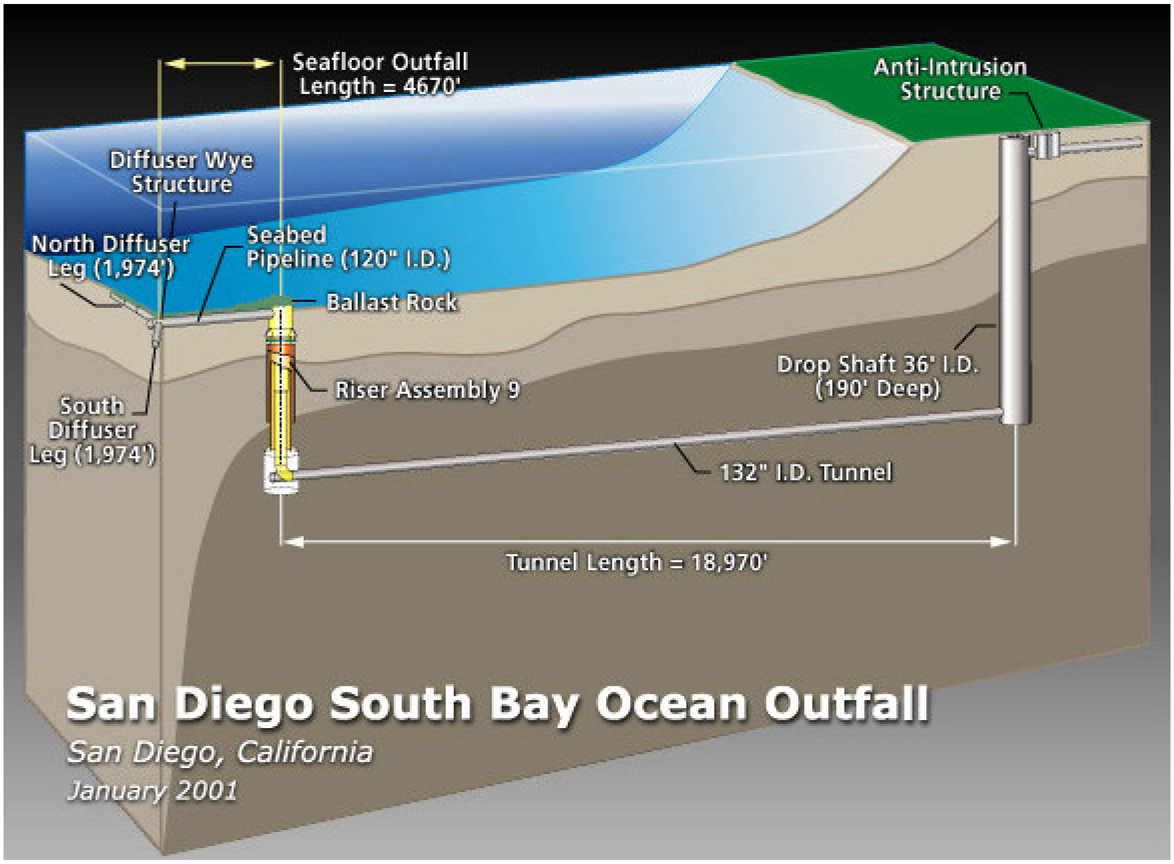
Marine outfalls are piped structures designed to convey wastewater into the coastal environment. Essential components of an outfall are the headwork for providing necessary pumping head for the transport of wastewater and the diffuser section for providing rapid mixing of wastewater after its discharge into the sea.

Alternative outfall designs

The prime structure in an ocean outfall system is the longitudinal section of the outfall itself and immediately follows the headwork. The outfall is either laid in a trench (pipeline) in the seabed or tunneled (tunnel outfall) through the subsea strata. The major emphasis of a marine outfall design is on the outfall profile, as it influences the hydraulic performance of the system.

- For a piped outfall, generally, trestles and sheet pile trenches are constructed through the surf zone, and from thereon the pipelines are laid on the surface or in a trench. Riprap is provided on both sides to prevent lateral displacement and to prevent uplift and damage from ship anchors. Pipelines are sometimes installed by pre-assembling them in long lengths on a beach or in a protected harbour, then floating them to the site and lowering by combinations of ballasting and support from surface pontoons.

- A tunnelled outfall (Fig. 3.2) is laid in a tunnel under the sea floor. There is an initial drop shaft and a final riser assembly. The advantages of tunnelled outfalls is that it eliminates the use of construction trestles and reduces the impact within the surf zone, minimises impacts on local salt marshes, reduces potential for liquefaction and seismic impacts and requires reduced energy during operations.



(Source http://www.parsons.com/about/press_rm/potm/01-2001/)

Fig 11.2 Example of a tunnelled outfall

Selection of appropriate pipeline material

Selection of the most appropriate type of material is essential in designing submarine pipelines. The pipe material needs to be evaluated for the following.

- Durability and immunity in the extreme corrosive environment.
- Joint strength and tightness.
- Flexibility to bend without causing structural failure to enable span across low areas in sites where the seabed is uneven and flexibility of construction
- Toughness to withstand accidental impacts of boats, anchors etc and resistance to abrasion.
- Strength to sustain high operating pressures, externally as well as internally.

11.6 Far field modeling

Beyond the point of initial dilution, further dilution occurs from turbulent mixing by current circulations, eddies and shear induced by water movement, as the effluent is transported away from the near field-mixing zone by ambient ocean currents. This region is called the far field-mixing zone. The rate of mixing in the far field is however slower than in the near field.

Hydrodynamic modeling

Behavior of effluent in the far field mixing zone is a function of current velocities, direction and circulation patterns, bathymetry, tidal ranges i.e., hydrodynamics, the understanding of which is a prerequisite for estimating the changes to the water environment. The complexity of the system can be studied using hydrodynamic models, which simulate ocean currents in the region.

Computer based mathematical models are based on differential equations that were developed from the understanding of processes observed from natural or physical modeling exercises. Mathematical models help in reviewing various options and layouts and obtain optimized solutions. Various solutions exist within the mathematical models and the choice can be based on the complexity of the project and environment. The predictions of hydrodynamic models need to be calibrated and validated from field measurements. A hydrodynamic model predicting velocities and direction is a necessary input to advection-dispersion models.

Advection and dispersion modeling

Additional dilution of the wastewater occurs due to lateral dispersion of the effluent during horizontal travel. In a coastal environment, advection is governed by the current speeds and direction while dispersion is characterized by molecular diffusion and turbulence. A typical water quality model is one that simulates the advection and dispersion of the pollutant.

While advection of effluent can also be computed directly from current meter records there are several computer models for advection and dispersion modeling. One the model is the Brooks' model, for computing the centerline plume dilution due to dispersion, assuming spatially uniform currents in stratified waters.

An advection-dispersion model simulates the spreading of a dissolved or suspended substance in an aquatic environment under the influence of the fluid transport and associated natural dispersion processes. The substance may be a pollutant, which may be treated conservatively or first order decay: salt, heat and dissolved/suspended contaminants.

Water quality modeling

Significant water quality/marine environmental issues associated with marine outfalls are:

- **Pathogens in plumes;**

- **Toxic persistent organic and inorganic pollutants;**
- **Presence of oil and grease;**
- **Minor changes in abundance of certain bottom dwelling organisms and swimming fish near outfalls;**
- **Accumulation of sewage particles and associated contaminants in offshore sediments.**
- **Nutrient enrichment.**

When wastewater is discharged to the open ocean through properly designed outfalls and diffuser systems, environmental issues such as BOD, suspended solids, salinity and nutrients have lesser significance, relative to discharge in inland channels and creeks.

Decay of the waste field i.e., the water quality in the surrounding area is a function of the currents, mixing, water chemistry, biological processes of the natural water body and decay rates of pollutants themselves. Today, simple planning type models to sophisticated computer based water quality models simulate these processes. It is necessary to recognize the significance of decay rate of a pollutant in relation to flushing characteristics of receiving waters. For example, while decay rate of fecal coliform is high and 90% decay occurs within a few hours of discharge, decay rate of organic chemicals (with long half-lives) are slow and persist in the system.

The concentration of some pollutants such as pathogenic bacteria or all non-conservative substances may be modeled by simple 'first-order' decay equations, where the mass of the pollutant decreases with time. Effective dilution factors can be computed from simple expression where, subject to spatially uniform current assumptions, travel time can be computed from as function of outfall length and current velocity.

Parameters such as trace metals and organic chemicals are more complex, requiring sediment concentrations in water to estimate the partitioning of the pollutant in its dissolved and particulate phases.

Dissolved Oxygen is an important water quality and ecosystem health indicator and is always indicated in water quality standards. The origin of DO modeling began with the Streeter-Phelps equation that modelled DO as a function of Biochemical Oxygen Demand (BOD) and re-aeration of oxygen from the atmosphere. Today, DO models include many complex ecosystem components such as nutrient uptake, algal photosynthesis, primary productivity, benthic processes, etc.

The water quality (WQ) module of typical 2-D and 3-D models simulate resulting concentrations of bacteria threatening bathing water quality, oxygen depletion due to the release of BOD, excess concentrations of nutrients (ammonia and phosphate) and chemical substances. The processes, which influence these concentrations, are functions of the environmental conditions eg light intensity, water temperature and salinity.

11.7 Risk analysis

Risks to outfalls may occur from seabed instability around pipelines due to natural hazards such as hurricanes and cyclones and from liquefaction of the seabed soils. Other hazards like slope failures near the shoreline and possible seafloor slides are also issues of concern. Design of marine pipelines from stability point of view is important due to the environmental issues associated with the failures of these pipelines.

Liquefaction may result in long spans of pipelines becoming unsupported. Shocks, vibrations, wave actions (cyclic loads) may possibly cause liquefaction of the sediments around pipelines. Parameters such as grain size analysis, permeability characteristics and liquid limit enables prediction of liquefaction potential of sediments.

Laying of pipelines on seafloor may result in local increase in the speed of current and hence of scour. The vertical and horizontal instabilities can occur around pipelines as a result of scour. Calculation of stability of a bottom-laid pipeline is therefore essential in pipeline design.

Slope failures near shorelines may also affect the structural stability of pipelines and is therefore an important issue of concern.

11.8 Outfall Description

A marine outfall project description shall include existing infrastructure and additional requirements It shall also clearly state the various assumptions made in the design and justification for decisions made on aspects such as treatment levels, outfall location and water depths, type of outfall etc. Description shall address the following details

- Need and justification for the project.
- Reasons for the choice of the main components (pumping station, treatment plants etc.) and description of main features of the project such as length of outfall, type, diameter and material of outfall, depth below sea level, distance from shore, process description such as risers, diffusers etc., service life of outfall, capacity to handle average dry weather flows and peak flows etc.
- Description of effluent characteristics and discharge conditions.
- Identification of construction (pipeline installation/tunnelling methods etc) and operation processes (tidal reversal/seawater intrusion and accumulation of sewage gas).

- Anticipated timing of the project and schedule of construction activities.

A detailed description of the wastewater disposal project or a wastewater disposal plan within a project is essential for determination of impacts of the project.

Identification of project activities

Table 3.1 gives a list of activities that are typical of a wastewater disposal project. Activities have been identified for the construction and operational phases of the project. Construction may involve a time-period of several years due to dynamic marine environment where the tasks have to be carried out and is a function of the length and type of the outfall.

Table 11.1 Activities

Phase	Landside	Waterside
Construction	• **Site clearing, Soil excavation/Quarrying** • **Transportation of raw materials** • **Construction (including headwork) & Precasting / Fabrication & welding** • **Labour force for all activities**	• **Tunnelling under the seabed for tunnel outfall and disposal of excavated muck (OR)** • **Trenching of sea bed for piped outfalls** • **Laying of pipes on the seabed** • **Backfilling on laid pipelines**
Operation	• **Treated wastewater conveyance** • **Captive power generation**	• **Wastewater disposal**

Identification of likely impacts of a marine outfall project

12.0 PRELIMINARY EVALUATION OF IMPACT CHARACTERISTICS (SCOPING)

While a marine outfall improves the environmental quality of the nearshore areas and the land environment substantially by transferring pollutants to a region of low impact, they have certain adverse impacts associated during the construction and operation stages. These impacts need to be identified through an EIA study and management options devised to mitigate the effects. .

Scoping is an exercise to focus the study on significant issues. The objective of scoping is to conduct an EIA study efficiently and effectively. This is done by judiciously allocating time and resources to baseline assessment and prediction of impacts thereby focusing the study on issues of concern.

Scoping involves identification of the most obvious impacts and exclusion of impacts that are considered insignificant, from the knowledge of baseline environment and proposed development.

- Significance determination is based on receptor locations and sensitivity such as presence of critical habitats, fishing grounds, desalination plants etc., in the project vicinity

12.1 Environmental setting

Following are the most important questions related to the existence of critical habitats in the proposed project site.

1. Is there a national park, sanctuary or reserved forest in the area?
2. Are there any coral reefs in the area?
3. Are there mangroves/seagrass beds in the area?
4. Are there significant areas of breeding/spawning grounds in the vicinity?
5. Does the area form a part of migratory route or nesting grounds for aquatic and avi-fauna?
6. Are there endangered species in the area?

12.2 Project setting

Scoping is usually based on a preliminary site survey, which involves visual inspection of the project site and its surroundings for the existing infrastructure/conditions and shall address issues such as

1. Air pollutant sources, Air quality (good, medium, poor)
2. Background noise levels (high, medium, low)
3. Water bodies and sources of water supply
4. General water quality (good, medium, bad)
5. Wastewater/effluent discharge sources, disposal methods/location of disposal
6. General aesthetics (good, medium, poor)
7. Landuse (rural, urban, residential, industrial, commercial, agriculture etc)
8. Landscape and terrain (slope, hilly, plain)
9. History of natural hazards (cyclones, floods, earthquakes, landslides etc)
10. Nature of soil (clayey, silty, sandy)
11. Flora and fauna (terrestrial, aquatic & endemic species)

12.3 Identification of likely impacts

Identification of the likely impacts of a project is essential to determine the issues of environmental concern and aid in the selection of appropriate route and outfall location. An overview of parameters likely to be affected due to the activities of a wastewater disposal project is given in Table 4.1

Table 12.1 Overview of likely impacts

Activities	Environmental Parameters affected						
	Air	Noise	Land	Water*	Sediment	Ecology	Socio-Economics
Site clearing/land development / Soil excavation	✓	✓	✓	✓		✓	✓
Transportation of raw materials	✓	✓					
Construction activities	✓	✓		✓			✓
Labour force			✓	✓			✓
Tunneling the seabed and disposal of muck**		✓	✓	✓	✓	✓	
Pipeline laying on the seabed		✓		✓	✓	✓	
Wastewater discharge from outfalls				✓	✓	✓	

*Water environment consists of marine & fresh water resources; **Land or water and ecology shall be impacted depending on the location where dredge disposal occurs; ground vibration due to blasting shall be assessed.

Table 4.2 gives details of the parameters likely to be affected by each of the activity, impact characteristics and their level of significance, from which a scoping exercise is performed to identify issues of environmental concern.

Extent of environmental impact

Siting and/or development of projects result in environmental impacts, which are not confined to the project location and its environs alone, but shall extend spatially over zones such as (a) Beach and shoreline (b) Coastal waters (c) Estuaries, backwaters and lagoons and (d) Offshore waters

Table 12.2 Preliminary Evaluation of Impact Characteristics for a Marine Outfall Project - Scoping

Activity	Impacts			Impact Characteristic	Significance Level
	Parameter	**Sub-attribute**	**Cause**	**Duration/ Nature / Reversibility**	
Construction phase					
Site clearing	Air quality	Suspended Particulate Matter (SPM)	Wind erosion of dislodged fine soil particles due to earth moving/removal of vegetative cover etc	Negative Short-term Reversible	High when wind speeds are high with removal of vegetativecover / trees; Low in the proximity of barriers like buildings / trees and / or when wind speeds are insufficient to cause wind erosion
	Noise	Noise levels	Use of earth moving equipment, power tools, diesel engines etc.	Negative Short-term Reversible	Low when there are no noise sensitive receptors, when workers are provided with ear plugs or when adequate vegetative cover exists/retained
	Water quality	Turbidity levels	Soil loss by runoff into water body in the vicinity	Negative Short term Reversible	Low when vegetative cover is not removed and/or when gravel washings are less due to scanty rainfall.
	Land	Soil	Soil erosion due to removal of vegetative cover and root structures that formerly protected the soil and/or change in the gradient of existing slopes	Negative Short term Irreversible	Low when minimum vegetative cover is removed and / or when natural slopes are not altered
		Landuse	Loss of cultivable lands/ /fishing grounds and/or loss of livelihood	Negative Longterm Irreversible	High when there is loss of livelihood / production / conflicting landuse pattern; Low when alternate means of livelihood is provided or with adequate compensation
	Terrestrial ecology	Flora & fauna	Removal of vegetation	Negative Long term Irreversible	Low when minimum vegetative cover is removed / when vegetative cover is commercially unimportant or when fauna is absent; High when fauna are endangered species

Activity	Impacts			Impact Characteristic	Significance Level
	Parameter	Sub-attribute	Cause	Duration/ Nature / Reversibility	
Site clearing (contd)	Socio economics	Economic stability	Ressetlement, removal of vegetation and/or change or loss of livelihood	Negative Long term Irreversible	High when there is loss of commercially valuable area/ resettlement of population and changes in livelihood
Transportation of raw materials	Air	SPM, NOx, HC, CO	Vehicular emissions & generation of dust due to handling and transport of fine & coarse gravel in uncovered trucks	Short term Negative Reversible	Low with low cost EMP such as use of tarpaulin sheets for covering trucks or water sprays for dust suppression and regular emission checks; High when transported through unpaved/poorly maintained roads
	Noise	Noise levels	Vehicular noise	Short term Negative Reversible	High when heavy trucks ply through noise sensitive areas especially at night Low when there are no noise sensitive receptors
Construction activities	Air	SPM, NOx, SO_2, HC and CO	Fugitive dust generation due to concrete mixing, cement handling, & gaseous emissions from welding, asphalt heating, mixing, and laying, operation of construction machinery	Short term Negative Reversible	Low, with low cost EMP such as sprinkling water and wearing masks and when regular emission checks are done for the construction machinery, and/or when construction area is protected by barriers
	Noise	Noise levels	Use of construction equipment and power tools	Short term Negative Reversible	Medium when there are noise sensitive receptors in the vicinity; Low, with low cost EMP like providing workers with ear plugs or when there are no noise sensitive receptors in the vicinity
Construction activities (contd)	Water	Water Quantity Turbidity	Water consumption for construction Turbid runoff from construction site washings	Short term Negative Reversible	Low, if groundwater is not tapped and when runoff is minimized by construction of small bunds

Activity	Impacts			Impact Characteristic	Significance Level
	Parameter	Sub-attribute	Cause	Duration/ Nature / Reversibility	
Labour force	Water	Water Quantity DO, BOD, TSS, Nutrients, Fecal Coliform	Water consumption for domestic usage Disposal of untreated waste	Short term Negative Reversible	Low, if workers are local as the usage pattern is maintained or when water resource is not a constraint Low, with basic treatment units such as soak pits, septic tanks etc
	Land	Landuse pattern and aesthetics	Generation of solid wastes, haphazard growth of temporary buildings / dwellings/hutments	Short term Negative Reversible	Low, when proper collection and disposal of solid wastes is practised Low when the proponent provides adequate shelter, basic resources and sanitation for the workers or when temporary construction is regulated
	Socio-Economics	Employment	Increased employment opportunities	Short term Positive Reversible	Low, if the employment is temporary and only during the construction phase
Pipeline laying on the seabed	Noise	Noise levels	Use of dredging equipment and power tools	Short term Negative Reversible	Low if the soil at the dredging location is soft and of clayey nature with no noise sensitive marine species at close proximity Medium for a rocky profile
	Water	TSS, Nutrients, Toxicity	Sediment resuspension Release of toxic substances and nutrients from the sediments	Short term Negative Reversible	Medium for turbidity when the material is clay and low for toxicity when sediment toxiciy is minimal
Pipeline laying on the seabed (contd)	Ecology	Micro and Macrobenthos	Disturbance of bottom sediments and removal or destruction of spawning grounds	Short term Negative Reversible	Low, when commercially valuable species/ breeding/spawning grounds are not present
Disposal of dredged material along the coast or land reclamation	Ecology	Benthos	Trapping of benthos	Long term Negative Irreversible	Low if the area is a barren and devoid of ecologically sensitive species/commericially valuable species

Activity	Impacts				Impact Characteristic	Significance Level
	Parameter	Sub-attribute	Cause		Duration/ Nature / Reversibility	
	Sediment transport	Shoreline changes	Change in hydrodynamics due to material dumping		Long term Negative Irreversible	Low if dumping site is not close to the water front
Disposal of tunneled material at sea	Water	TSS Turbidity Nutrients Toxicity	Dumping of dredged material		Short term Negative Reversible	Low when the dredged material conforms to the sediment properties at the disposal site. High when dredged material is toxic or in the presence of fishing / breeding / spawning grounds
Operations phase						
Power plants	Air	CO, NOx, SPM, SO_2 and HC	Emissions from DG sets	Operation phase	Long term Negative Irreversible	Low when the DG sets are used only for emergency purposes and when frequent emission checks are made and when there are no sensitive receptors in the downwind direction
	Noise	Noise levels	Noise generation from DG sets	Operation phase	Long term Negative Irreversible	Low when the DG sets are used only for emergency purposes and when there are no sensitive receptors in the downwind direction
Wastewater discharges (municipal) from outfalls	Water	TSS, DO, BOD, Nutrients & Fecal coliforms	Discharge of treated or untreated sewage into the water body	Operation phase	Long term Negative Irreversible	Low when the wastewater is treated before discharge
Wastewater discharges (municipal) from outfalls (contd)	Ecology	Marine flora and fauna	Discharge of wastes	Operation phase	Negative	Low when the wastewater is treated before discharge

Activity	**Impacts**				**Impact Characteristic**	**Significance Level**
	Parameter	**Sub-attribute**	**Cause**		**Duration/ Nature / Reversibility**	
Effluent discharge from desalination plants	Water quality	Salinity, DO	Discharge of brine	Operation phase	Long term Negative Reversible	Low when the brine is sufficiently diluted with fresh water
	Ecology	Marine organisms	Discharge of water with higher salinity	Operation phase	Long term Negative Reversible	Low when there are no ecologically sensitive species at and near the location of disposal
Cooling water discharge from the power plants	Water quality	Temperature	Discharge of effluent which has higher temperature than that of the water body	Operation phase	Long term Negative Irreversible	Low when the cooling water is sufficiently diluted and when there are no ecologically sensitive species at and near the location of disposal
	Ecology	Marine organisms	Discharge of effluent which has higher temperature than what the organisms are acclimated to	Operation phase	Long term Negative Irreversible	Low when there are no ecologically sensitive species at and near the location of disposal

Baseline study

13.0 INTRODUCTION

For route-planning and site-specific detailed engineering design, it is essential to have the existing (baseline) status of the project location. The study of baseline status and the site-specific data is useful in determining the

- environmental design considerations for the project and
- environmental parameters that are likely to be impacted by the project.

13.1 Engineering design considerations

The following sections describe site-specific data required for detailed engineering design and for incorporating environmentally appropriate considerations at the planning stage.

Route survey

Several routes are generally considered for a proposed pipeline route based on desk study. Survey of the alternative routes is essential to assess the viability of the best option. Appropriate site-specific measurements may be required in addition to details in maritime charts, to ascertain the local current patterns and seabed contours at suitable intervals.

Route survey shall be carried out with the following objectives:

- To establish vertical route profiles, contour plan and seabed features, particularly nearshore rock outcrops;
- To obtain accurate bathymetry, locate all obstructions and identify other seabed features which may affect the laying, trenching and stability of the pipeline;
- To define geology of the sub-seabed by geophysical surveys;
- To define the geotechnical properties of the seabed soils by in-situ testing and sampling.

Seabed engineering surveys

Hydrodynamics

Site-specific measurements shall consist of current speeds, directions; wave heights, vertical currents along the pipeline route, circulation patterns etc.

Geophysical investigation

Geophysical surveys for pipeline installations are normally carried out with the purpose of determining

- Bathymetry, topography, wrecks and obstacles on the surficial soils by acoustic methods such as echo sounder, side-scan sonar and/or magnetometers

- Sub seabed geological information comprising structure, geometry and configuration of approximately the first hundred metres of subsoil for tunnelled pipelines, using seismic reflection methods (seismic prospecting).

Marine geotechnical investigation

Comprehensive soil investigations shall include in-situ tests, grain-size distribution, plasticity and strength parameters. Results of geotechnical investigation shall include recommendations on slope stability, suitability of soil from trench excavation, recommended soil-pipeline friction factors, liquefaction potential, possibilities of scour around pipelines, stability / mobility of sediments, comments regarding lay barge anchoring etc.

13.2 Environmental Parameters

Air, water and sediment quality, noise levels, ecological characteristics and socio-economic conditions are some of the quantifiable parameters that define environmental setting in and around the project location. Baseline studies characterize the existing condition before the proposed project and needs to be designed to represent site-specific conditions. . Baseline monitoring must be representative of the typical conditions at site and can include both average and peak (such as spring and neap) conditions. However, care should be taken to avoid sampling during an unusual event that is not representative of baseline, such as sampling air quality close to a transient source, sampling noise levels near piling operation sites or water quality near dredging sites etc.

Air Environment

For assessing ambient air quality status, the parameters measured are:

- Existing air quality at the site i.e. the background concentrations of suspended particulate matter (SPM), SO_2, NO_x, etc;

- Wind direction to determine the receptor;
- Wind speed which influences the horizontal mixing of pollutants;
- Wind speed, temperature gradients and rainfall that determine the atmospheric stability (inversion, mixing heights etc) which further affects the vertical mixing of pollutants;
- Topography (hills, buildings, trees etc) which influences the mechanical mixing of pollutants; and
- Land use to determine receptors

Table 5.1 gives details of air quality data collection. Sampling stations for air quality shall be selected based on emission discharge locations such as near DG sets, captive power plants, industrial emissions, peak hour/heavy traffic locations, and at recipient locations.

Table 13.1 Air quality data collection

Component	Parameter	Sampling criteria		Source
		Specification	Frequency	
Meteorology	Wind direction	Distribution with height	1 year daily data	IMD
	Wind speed	Distribution with height	1 year daily data	IMD
	Temperature gradient	Distribution with height	1 year daily data	IMD
	Atmospheric stability	Distribution with height	1 year daily data	IMD
	Rainfall	Distribution	1 year daily data	IMD
Air quality	Suspended particulate matter (SPM), SO_2, NOx,	24-hr average for one season other than monsoon	Twice a week for 3 months	Primary data
Topography	Hills, buildings, trees and other mechanical obstructions	Layout map of the area	Present data	Secondary data/ visual observation

Baseline studies for air quality assessment shall include study of bacterial contamination through aerosols and odour problems due to location of head works.

Noise

To determine the impact on noise levels due to a project, baseline data collection shall consist of

- Existing noise levels at the site i.e. the background concentrations
- Noise attenuating factors such as hills, trees, barriers, humidity etc

- Land use map to locate the noise sensitive receptors such as schools, hospitals, residential areas, concert halls, etc.

Table 5.2 gives details of data collection for noise levels. Noise levels shall be measured at the project site and at noise sensitive receptor locations.

Table 13.2 Noise level data collection

Components	Specification	Frequency & Period
Noise levels	Intermittent/ Impulsive/ Continuous	1 sample each during day and night
Noise attenuating factors	Trees, hills, valleys, buildings	Latest information
Noise sensitive receptors	Types of receptors, location and distances	Latest information

Land

The extent of assessment of the landuse shall be concentrated within a 10 Km radius around the project area. The extent of landuse within a 25 Km radius is required when the project is proposed near an ecologically sensitive area. Baseline parameters shall also address the land environment specific to the project site. Assessment of the local landform type and its constituent materials enables evaluation of potential hazards of the proposed activity on the local physical environment. Project activities affect the availability or suitability of land for certain uses i.e., the land-use patterns.

Land environment comprises aesthetics, land use pattern, soil, slope, drainage characteristics, topography, etc. To determine the impact on land the following baseline parameters are essential

- Existing aesthetics, land use pattern
- Terrestrial ecology (trees, vegetation etc)
- Soil, slope and drainage characteristics that affect runoff and groundwater infiltration
- Topography such as hills, valleys & landscape

Table 5.3 gives details of specifications and data source for assessment of baseline land environment.

Table 13.3 Land environment data collection

Component	*Specification*	*Data source*
Landuse	Residential, industrial, commericial, agricultural, etc	State Metropolitan Development Authority, Town planning department, Panchayath etc
Soil, slope and drainage characteristics	Soil types, gradient, hydrology	Survey of India (SOI) Toposheets, State Soil Conservation Departments
Topography	Hills, valleys, terrain	Survey of India (SOI) Toposheets, State Revenue Department; Visual inspection from site visits
Terrestrial ecology	Flora and fauna	Biological Survey of India, Zoological Survey of India, State Metropolitan Development Authority; Site-specific data in and around project location

Water and sediment quality

Water environment consists of oceanographic, water quality (physical, chemical) parameters and biological characteristics. Oceanographic parameters are tide, wave height, current speed and direction etc. Water quality parameters are turbidity, temperature, suspended solids, salinity, pH, DO, BOD, nutrients etc. Biological characteristics are categorized as pathogenic (fecal coliforms) and ecological like benthos, phytoplankton, zooplankton, fish etc. Transport mechanism of pollutants is influenced by advection - diffusion factors due to tides, waves, and currents.

For assessing the impact on water environment the following baseline information is essential

- Existing water quality at the project location (sea, creek) i.e. the background concentrations
- Oceanographic parameters such as tides, waves, current speed and direction and bathymetry that influence mixing and diffusion of water quality parameters

Tables 5.4 and 5.5 give sampling specifications, frequency for site-specific water quality and sediment quality data collection. Sampling stations shall be selected based on the effluent discharge points, sewage outfalls, dredging/dumping sites etc, and shall be based on the environmental setting of the project site. Sampling shall not be conducted during cyclones or during dredging operations, i.e., sampling shall represent average conditions.

Table 13.4 Water Environment

Component	Parameter	Sampling criteria	
		Specification	**Frequency & Period**
Oceanography			
Hydrodynamics	Tides, waves & currents (speed & direction)	1 to 3 season sample excepting monsoon	15 days / season
Bathymetry	Water depths		Once
Water quality			
Physical parameters	pH, salinity, temperature (thermal stratification) TSS, TDS, Oil and grease	1 to 3 season sample excepting monsoon	1 sample each during high and low tides
Chemical parameters	DO, BOD & Nutrients, Cadmium, Lead, Mercury TOC, Pesticides*, Silicate, Heavy metals*, Organochlorine* and phosphorous compounds*	1 to 3 season sample excepting monsoon	1 sample each during high and low tides
Biological Characteristics			
Biological characteristics	Phytoplankton, Zooplankton, Fishery potential, Bacteriology work, Intertidal fauna (Bioassay test, primary productivity, species diversity, species abundance)	1 to 3 season sample excepting monsoon	1 sample each during high and low tides

*** Optional items – depends on type of discharges in the location**

Table 13.5 Sediment quality data

Component	Parameter	Sampling criteria	
		Specification	Frequency & Period
Physical quality	pH, Sediment granulometry	1 to 3 season sample excepting monsoon	1 sample / season
Chemical quality	Nutrients, organic carbon, heavy metal* / pesticide analysis*, detergents	1 to 3 season sample excepting monsoon	1 sample / season
Biological quality	Macrobenthos, Microbenthos, Meiobenthos	1 to 3 season sample excepting monsoon	1 sample / season

*** Optional items – depends on type of industrial discharges in the location**

13.3 Ecology

Natural vegetation, endangered species, marine organisms and ecologically sensitive species help define the ecological setting at site. These attributes are critical in assessing the suitability of the project at the selected site.

All areas of ecology are very difficult to quantify. However, qualitative analysis of the characteristics can be done on the basis of knowledge and experience in a broad range of analogous systems. Quantifiable methods such as biodiversity and/or species richness indices, biomass energy pyramids, nutrient cycles for biology provide sufficient information on ecological status of a location.

Measurement of ecological characteristics shall

- Be conducted in fishing, breeding and polluted zones
- Include analyses at various trophic levels and
- Identify endangered species/critical habitats

13.4 Socio-economics

Wastewater disposal projects are likely to have impacts on socio-economics of a region during construction stages. However, the operation of outfalls shall have a net beneficial impacts to the socio-economics of the region. Receptors / beneficiaries of impacts may be local population, fishing communities and beach users.

Assessments of baseline socio-economic conditions comprise, study of demography, health status, living conditions etc. To assess impact on socio-economic environment, it is essential to collect the following data

- Livelihood of the population, fishing practice, location of fishing grounds etc.
- Details on level of education of the population surrounding the project site, likely receptors of impact;

- Standard of living at the site i.e. the infrastructure available to local population such as water supply, sanitation, electricity, transportation, education, medical treatment etc;
- Health status of the population especially those suffering from infectious diseases.
- Commercially valuable species and materials at the project site

Resources

- Water, power, fuel & non-fuel resources are assessed for labour camps, construction activities, operational requirement etc.

13.5 Typical baseline requirement

Table 5.6 gives typical baseline parameters required for various activities of a wastewater disposal project. The extent of baseline study is a function of the nature of activities and the environmental status at the project location.

Table 13.6 Activity-specific baseline Parameters

Activity	Environmental Parameters						
	Air	Noise	Land	Water	Sediment	Ecology	Socio-Economics
Site clearing/ Land development/	SPM	Noise Levels	Landuse, layout of buildings	TSS in water bodies in the vicinity		Terrestrial flora & fauna	Rehabilitation issues, Livelihood¸ health status
Transportation of raw materials	SPM, NOx, SO2	Noise Levels					
Construction activities	SPM	Noise levels		TSS, Water source & availability			
Labour camps			Aesthetics, solid waste disposal location	pH, Temp, salinity, TSS, DO, BOD, Nutrients, Fecal coliforms, Water source &availability			Number of people likely to be employed
Tunnelling the seabed and disposal of muck1		Noise levels, Noise sensitive receptors	Extent of land, Landuse, soil type	DO, TSS, Nutrients	Benthos, nutrients	Plankton	Identification of commercially valuable marine species
Pipeline laying on the seabed		Noise levels, Noise sensitive receptors		TSS, nutrients	Macro-benthos, Micro-benthos, nutrients	Plankton, breeding grounds	Identification of commercially valuable marine species

Activity	Environmental Parameters						
	Air	Noise	Land	Water	Sediment	Ecology	Socio-Economics
Wastewater discharge from outfalls				pH, Temp, salinity, TSS, DO, BOD, Nutrients, Cadmium, Lead, Mercury TOC, Pesticides3, Silicate, Heavy metals3 Organocholrine3 and phosphorous compounds3	MPD, nutrients, organic carbon, heavy metal3 / pesticide analysis3 , detergents	Plankton, breeding grounds, Fishery potential, Bacteriology, Intertidal fauna	Identification of commercially valuable marine species
Emissions from DG sets	SPM, NOx, SO_2, HC^2, CO^2	Noise levels					
Cooling waster discharge from power plants				Temp, DO	Macro & Micro-benthos,	Plankton, breeding grounds, Fishery potential, Bacteriology; Intertidal fauna	Identification of commercially valuable marine species

1 Land or water, sediment and ecology parameters required only when such disposal is involved.

2 Optional Parameters- shall be measured when such emissions are expected depending on fuel used

3 Optional items – depends on type of discharges in the location

Prediction of impacts

14.0 PREDICTION

Goal of prediction is to establish/forecast the difference in environmental quality due to a new development

Predictions consist of estimating impacts of all the activities of the proposed project and overlaying the baseline on it, from which change in each environmental parameter due to the project can be evaluated, which essentially gives a measure of "how much can be changed" whilst still maintaining the present environmental conditions. Comparison with national standards for air, noise and water quality can be made from these estimates and change from new development determined.

Predictions can be quantitative and/or qualitative. Quantitative methods give an estimate of the impact using mathematical expressions/computer models and experimental/physical models. Simple quantitative methods are typically analytical with broad assumptions requiring hand calculations, while the complex models are computer based and address many of the complexities of the natural environment. Qualitative methods are based on professional judgment/examples of similar occurrences/events in other locations/projects or cited in literature.

Results of prediction can be illustrated with contours or plots showing critical concentrations, in conjunction with receptor locations to determine the significance of impacts.

Scenarios for prediction

Prediction must be done for climatologically critical conditions, i.e., when stress on the environment is the greatest. The critical conditions must be clearly indicated in the EIA report. An example for air pollution is the period of inversion, when the pollutants do not disperse easily. For a water quality, the critical scenario may be the hottest period of the year. The choice of an appropriate scenario for the study depends on the climatological history of the area and requires a database of long-term measurements. The scenarios typically employed in predicting an impact are:

- Most probable case scenario
- Worst case scenario

Most probable case scenario:

This is characterized by the combination of discharges/emissions and hydrodynamic/atmospheric interactions that produces the frequently encountered impact.

Worst case scenario

This is characterized by the combination of discharges/emissions and hydrodynamic/atmospheric interactions that produce maximum adverse impact.

14.1 Assessment of ground vibrations due to underground blasting

A tunneled outfall may require blasting of the sub seabed rock layer. Blasting results in vibration, which may cause damage of structures adjacent to the site. Though vibration related problems are difficult and complex to identify, it is essential to consider the combined effect of factors such as characteristics of vibration sources and site, propagation of surface and body waves in the ground and response of structures. There are techniques to predict air and ground vibration levels theoretically, to assist in the control of blasting operations, thereby reducing the level of operating risk concerning blast vibration. In coastal and marine areas, it is appropriate to identify and consider the response of foreshore and offshore structures while planning blasting operations. Prediction of safe inhabitant building distance can be made from peak particle velocity (PPV) of ground motion which shall also take into consideration the soil conditions, structural type and ground motion frequency contents.

14.2 Assessment of air quality impacts

The air pollutants emitted into the atmosphere will be diluted and dispersed depending on local meteorological and geographical conditions. A continuous stream of pollutants when released into the atmosphere will rise, bend and then travel in the direction of the wind, which enables dilution and carries the pollutants away from the source. This plume of pollutants will also spread out or disperse in both horizontal and vertical directions from its centerline.

The simplest method available for predicting concentrations is the steady state Gaussian equation, designed for conditions where a continuous stream of pollutant is released into a steady wind in an open atmosphere. In nature, the pollutant plume will rise and bend over, get transported by the wind, and concentrations will decrease away from the source. The plume spread will be influenced by molecular diffusion, turbulent eddies of the average wind flow, thermal gradients, random shifting of winds and mechanical mixing of the air moving over the land. The dispersion of an air pollutant released into the atmosphere depends on the following factors

- Properties of pollutant (stable, unstable)
    - SO_2, CO and SPM are stable pollutants, as they do not participate in chemical processes in the atmosphere.
    - NO_x and certain hydrocarbons are unstable pollutants which actively participate in chemical reactions thereby forming secondary pollutants
- Release rate & type (puff, plume)

  - An accidental release of chemical from a pipeline or hose is an example of puff release (instantaneous)
  - Emissions from power plants, stream of vehicles are continuous and an example of plume release

- Meteorology (Atmospheric stability)
  - Atmospheric stability is defined by wind speed and vertical temperature gradient which influence mixing of pollutant
  - Wind speed influences the horizontal diffusion/dispersion of an air pollutant while wind direction determines the region and receptor of impact.
  - Temperature gradient affects vertical mixing of pollutants

- Local terrain conditions (hills, valleys, buildings)
  - The local terrain conditions influence the mechanical mixing of the pollutants.

- Height of release above the ground
  - Emissions from a DG set may occur at different heights based on stack height, while releases from pipeline occur at ground level. Releases from a lower height will have greater ground level pollutant concentrations than releases from a greater height

- Release geometry (point, line, area source)
  - Emissions from DG sets are point sources
  - Emissions from vehicular traffic during peak hours are line sources

Modeling of pollutant dispersion needs to take into consideration, the thermal stratification existing in the atmosphere, particularly in the ground layer. Differential heating/cooling of the different layers result in density stratifications, the most critical of which is the 'thermal inversion' which block vertical diffusion/dispersion across them (vertically). The inversion occurring close to the ground surface almost each night to pre-dawn periods, caused by the back radiation from heated earth-surface and building structures are termed 'ground-based inversion' and significantly affect pollutant-dispersions and consequent environmental impacts. By blocking vertical dispersion of pollutants, inversions limit the height of atmosphere within which mixing is allowed to take place i.e., 'mixing heights' of the atmosphere.

The understanding and characterization of these inversions is absolutely essential to any meaningful modeling of pollutant dispersions. Thermal stratification and consequent mixing heights can be taken into account by using 'stability classes'. IS: 8829-1978 gives the methodology for determination of stability classes.

The activities of the coastal tourism project that cause an air quality impact are

1. Site clearing / Soil excavation
2. Transportation of raw materials
3. Construction activities
4. DG sets / Captive Power Plant emissions

Items 1 to 3 primarily relate to generation of fugitive dust during operations. These are construction phase activities and will cease to contribute pollutants after construction is complete. Vehicular emissions from traffic during construction and operational phases can be modeled using Guassian line models. Emissions from DG sets/ captive power plants are point sources and released at their stack heights, which can be appropriately modeled by Guassian point models.

Guassian models, which determine the spatial distribution of pollutant concentrations, are based on the Guassian equation, which applies to a single steady state continuous point source. The basic inputs for this model in predicting the concentration are

- Emission rate of pollutant
- Vertical and horizontal dispersion coefficients which are a function of the downwind distance
- Wind velocity in the downwind direction
- Vertical distance above ground
- Lateral distance from the centreline of the plume
- Length of the line source (in case of line source emissions)

Meteorological data needed for pollutant dispersion modeling shall include:

a. **Average wind direction: to define co-ordinates**
b. **Average wind speed: to provide velocity**
c. **Atmospheric stability: to determine the vertical and horizontal dispersion coefficients**
d. **Ambient temperature: to calculate the effective height of (stack) emission above ground level**
e. **Atmospheric temperature lapse rate: to determine stability classes**

14.3 Assessment of noise level impacts

Sound or noise is a disturbance, which propagates away from the source through an elastic medium, namely air, water or solids and reaches a receiver. The noise level (dB) at the receiver's location is a function of the characteristics of the sound source (power, intensity and frequency spectra), the properties of transmission medium and the presence of objects or barriers.

For simple cases, such as point source, the sound energy is radiated over spherical surfaces away from the source. The presence of objects in the path of sound propagation results in reduction in the sound pressure level. For a source located on the ground, the sound will propagate in a hemispherical pattern.

The prediction of noise should address the type of source, type of environmental conditions at the site and the receptors

Type of noise source

Noise sources may be classified as impulsive or sudden; intermittent-unsteady; continuous-steady noise. Table 6.2 gives the types of noise sources for coastal tourism project activities.

Table 14.1 Noise pollution source characteristics

Activity	Source type
Site clearing / Soil excavation	Conitinuous-Steady
Transportation of raw materials	Intermittent-unsteady
Construction activities	Continuous – unsteady
Blasting operations	Intermittent-unsteady
DG sets/Captive Power Plant emissions	Conitinuous-Steady

Types of environment or attenuating factors

The type of environment determines the degree of noise attenuation, where the greater the attenuation, the lesser the impact on the receptor. Examples of attenuating factors are:

- Atmospheric conditions like humidity, wind direction, wind speed etc; and
- Barriers such as walls, vegetation etc.

Type of receptors

Receptors could be insensitive or sensitive. For example inmates of hospitals or bird sanctuaries, aquatic species etc., are sensitive noise receptors while industrial, commercial areas are relatively insensitive. Limits of acceptable noise levels for each category of receptor or areas/zones are specified in the National Ambient Air Quality Standards in respect of noise (Section 2.1).

14.4 Ecological Environment

The ecosystem comprises of both the abiotic (non-living) and the biotic (living) assemblages. Coastal zones are considered to be the most productive ecosystems on earth. In rural areas or industrially undeveloped areas, the primary economic activities such as agriculture, forestry and fisheries are based upon the living natural resources or the biological environment.

The most common method of prediction is the qualitative approach by a qualified expert. An expert bases the prediction on the basis of baseline ecology, knowledge of the plant & animal life, their habitat requirements, and utilises the changes predicted for air, noise, water and land environment to estimate the ability of the biological community to tolerate the change. This prediction is best performed when the data on the biological environment is available for different tropic levels.

Tools to assist the expert in the prediction of impacts are,

iii. **Statistical estimates of bio-diversity such as the Shannon-Weavers Diversity Index or species richness indices from the rarefaction method or Jack-Knife estimates. These statistical estimates should be compared with other values for similar environments only.**

iv. **Biomass and energy pyramids that are aids to define the food chains and the health of the ecosystem. The baseline structure helps in the assessment of the impact of the abiotic environment on the ecosystem.**

v. **Nutrient cycles that can help define potential impacts such as Eutrophication, contribution to green house gases.**

Mathematical models have also been developed for ecological energetic or the study of the flow of energy within an ecosystem and ecological modeling for specialized ecosystem. However, while using these methods, determination must be made to ensure appropriateness to the tropical coastal ecosystem of India

14.5 Land Environment

Though a wastewater disposal project, may not involve acquiring significant areas of land, clearing the site, soil excavation and activities such as disposal of muck from tunnels, may affect land directly. In this perspective the most significant elements of land that require prediction have been broadly classified into

- Soil Erosion

- Salt water intrusion

Erosion is the process through which soil particles are dislodged and transported to other locations by actions of water and/or wind. Removal of vegetative cover exposes the soil to erosive forces of water and wind. Soil erosion will lead to an unproductive land, change the drainage pattern of the area, increase the sediment load reaching the neighboring water bodies, and the resulting landscape will be aesthetically unappealing. Methods like Universal Soil Loss Equation (USLE) are useful to make estimations of soil erosion.

Groundwater may be a source of water for labor camps and construction activities. If the rate of withdrawal exceeds the rate of groundwater recharge, the yield of the aquifer (or the available water resource) will decrease and subsequently salt-water intrusion may be observed. Alternative sources for water must be identified to protect against depletion of freshwater resource &/or saltwater intrusion.

If land reclamation is proposed, it is necessary to determine the composition of the fill material and the topsoil at the reclamation site to evaluate the impacts on flora, fauna and groundwater due to contrast in the soil types and leaching characteristics.

14.6 Socio-economic Environment

Socio-economic impacts can be assessed by means of scientifically planned surveys like obtaining public response through questionnaires. Public hearings also help in cost-benefit analysis of the project and its location.

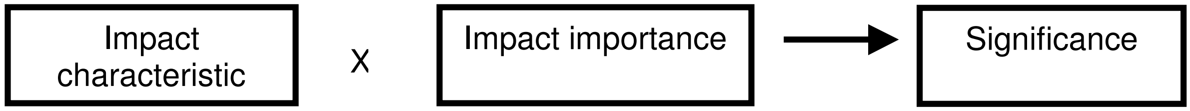
It is possible to make estimates on the change to the socio-economic environment with a detailed description of the project. The starting point for these estimates is human population and economic models.

Associated health impacts that can result directly from changes to the biophysical environment may result in increased exposure to toxic pollutants by fish in the region, increased health related risks (such as high incidences of skin irritation, abdominal rashes, tuberculosis and respiratory problems) amongst the local population. Following are some of the salient issues, which need to be assessed before the commencement of the project.

- Resettlement of coastal population
- Increased risk of accidents possibly from blasting or leakages in sewer systems.
- Disruption in area due to construction activities
- Health impairment
- Reduced value for fish-catch in the region

14.7 Significance of impacts

Determination of significance of impacts is to check whether the impacts are acceptable, require mitigation or unacceptable to the community. Significance of impact is determined by the consideration of the impact characteristic and the importance (value) attached to them.



The predicted impacts need to superimposed on the existing background concentrations and compared with standards. There may however be no appropriate technical standard for a social or a visual impact and resources that require sustainability. Significance in such cases must be derived from community preferences and can be discovered through public involvement or other special methods. (E.g. Delphi techniques).

The key basis for assessing impact significance are: level of public concern over health and safety, scientific and professional judgment, disturbance/destruction of valued ecological systems and degree of negative impact on social values and quality of life.

Significance can be determined based on ecological importance, social importance and environmental standards.

Monitoring performance of outfall

15.0 INTRODUCTION

Monitoring functioning of outfalls is imperative for environmental management of the region in order to ensure that the outfall is performing its duty of transferring impacts to a region of localized negligible receptors. Operational performance monitoring provides information for (i) management of commercial fisheries and tourist resources in the region and (ii) evaluation of compliance to designated standards. Performance monitoring needs to be carried out for structural stability, hydraulic performance, public health and ecology.

15.1 Monitoring plans/procedures

Monitoring requirements are defined by the (i) receiving water quality requirements and (ii) findings of baseline survey (data interpretations, trends, fishing grounds. Selection of appropriate water quality parameters, sampling station locations, oceanographic parameters (diurnal fluctuations in tidal movements, current speeds and directions) forms the crux of a well-designed monitoring program. Monitoring needs to be carried out in critical seasons that reflect the highest stress on water quality. Important considerations in monitoring program are the optimum number of sampling stations and replication of biological samples. Careful selection of methods and their calibration within the particular environment to be monitored are essential for a successful data collection program.

15.2 Pipeline monitoring

Records of information such as “As Built” drawings of pipelines, route maps, vertical and horizontal alignment of pipelines etc. shall be maintained for operation purpose. Other records shall include

- Procedure containing
  - Description of system components;
  - Details of operating manuals and personnel;
- Documentation of operations procedures for start-up and shut down of pipelines;

Marine outfall pipelines shall be manually inspected atleast once in a year essentially when they extend beneath navigational (shipping) channels, trawling areas (fishing gears) or over shallow surf zones. An established methodology may be followed for inspection maintaining routine schedule and log sheets.

Site and project specific procedures shall be planned taking into consideration, factors such as pipeline material, water depths, effluent characteristics, sensitivity of the environment etc. Diffusers shall be frequently monitored and inspected to ensure proper functioning. Regular flushing of the pipeline can ensure removal of any grease or grit accumulation. Inspection shall be carried out to check loss of diffuser risers, anchor blocks etc., which may cause lateral displacement of the pipeline.

15.3 Hydraulic performance

Seasonal and/or annual monitoring of discharge of wastewater, average concentrations of selected dissolved and suspended constituents needs to be monitored. Extreme conditions from spills or overflows during wet weather also need to be monitored.

15.4 Ecological requirements

Effluent characteristics

The treated wastewater characteristics shall be monitored to comply with discharge standards, from which treatment efficiency and better source control can be monitored.

Water and sediment quality

In order to assess impacts of outfalls on beach and coastal water quality, monitoring shall be undertaken for the following:

- Pathogens, nutrients and suspended solids in water column;
- Contaminants and sediment characteristics;
- Pathogens and grease on beaches

Ecology

Monitoring needs to measure the impacts of wastewater on the marine ecosystems particularly fish and benthos and utilization of marine resources with reference to seafood contamination (chemical contamination in fish, oysters etc.).

Changes in diversity, species richness, community structure and decrease/increase in abundance of biological communities in the receptor locations of outfalls and any significant changes in chlorophyll-a levels needs to be assessed through surveys. Alternatively, indicator organisms that are capable of providing a measure of the environmental sensitivity of the site may be identified during baseline surveys and monitored subsequently.

15.5 Public Health

Survey of health related issues in the local fishing population and beach users (especially swimmers) are some social concerns that require monitoring.

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Guidelines for

Environmental Impact Assessment

of

Coastal Tourism Projects

for

The Department of Ocean Development

Under the

Integrated Coastal and Marine Area Management Program

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Introduction

1.0 COASTAL TOURISM IN INDIA

The Indian Peninsula, including the two emerald archipelagos of Lakshadweep and Andaman, bounded by the Arabian Sea, the Bay of Bengal and the Indian Ocean has a long coastline of over 7500 km, with spectacular golden beaches, pristine natural beauty, lush green tropical forests, and unique fauna and flora. This provides immense scope for development of coastal tourism, basically marketing the “sand, sea and sun” (3S) phenomenon.

There is also high population density in the coastal belt of India with most of the major cities and metros situated on the coast. The coastal cities are well connected domestically and internationally through highways, railways, harbours and airports. This infrastructure provides access to domestic and international travellers, laying the foundation for increased coastal tourism.

The tourism sector is one of the fastest growing sectors in the country’s economy. Although tourism activity consists of both domestic and international tourism, tourism development strategy places primary emphasis upon international tourists, as international tourism provides foreign exchange earnings to the destination country while domestic tourism leads largely to a redistribution of national income.

1.1 Typical Coastal Tourism Industry

The origin, transit and destination regions constitute the basic tourism system. Components of this system have complex inter-relationship between and among several sectors (transportation, commerce, water supply etc.), service providers (travel agents, tour operators, hotels, merchandisers) and stakeholders (tourists, local population). The distribution of each of these categories of the tourism sector varies from origin to transit to destination as shown in Fig. 1.1.

While the primary attraction of the coastal tourism industry is the pristine natural environment, present-day coastal tourism includes large-scale constructed facilities such as theme/amusement parks, resorts, marinas, fishing piers and recreational boating harbours. Typical attributes of tourism sites are provided in the following sections.

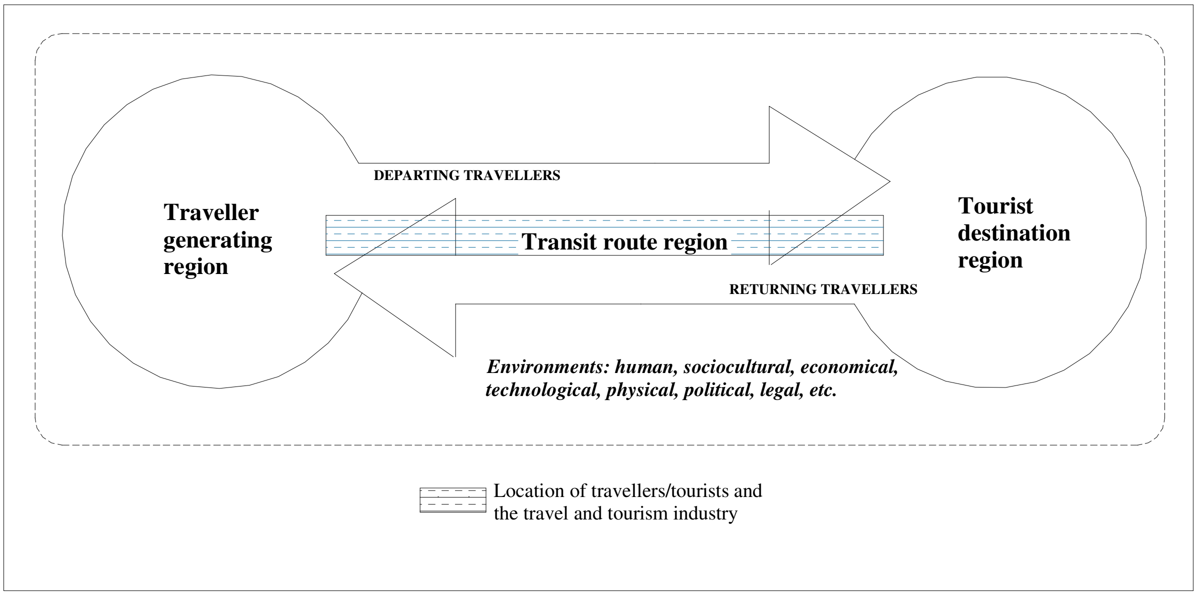
2.0 Tourist Attractions

Tourist attractions can be based on:

- Natural sites (beaches, coral reefs, mangrove forests, lakes, rivers, waterfalls etc);

- Natural events (tides, bird migrations etc.);
- Cultural / heritage sites (historical monuments, ancient temples, ethnic neighbourhood etc);
- Cultural events (festivals, fairs); and
- Constructed sites/Recreational events (resorts, theme/amusement parks, golf courses, ski hills, stadium, sports etc.).

A clean environment is the primary resource for the tourism industry, without which the tourism site will lose its value.



[Source: Fig. 2.1 A basic whole tourism system (Source:Leiper 1995) -'Tourism Management' by David Weaver & Martin Oppermann)]

Fig. 1.1 TOURISM SECTOR COMPONENTS

3.0 Accessibility

Accessibility can be classified as spatial and seasonal. Spatial accessibility to tourist destination is a key criterion for siting of a tourist facility. Accessibility can be provided by construction of roads, airstrips, piers, landing jetties etc.

4.0 Infrastructure

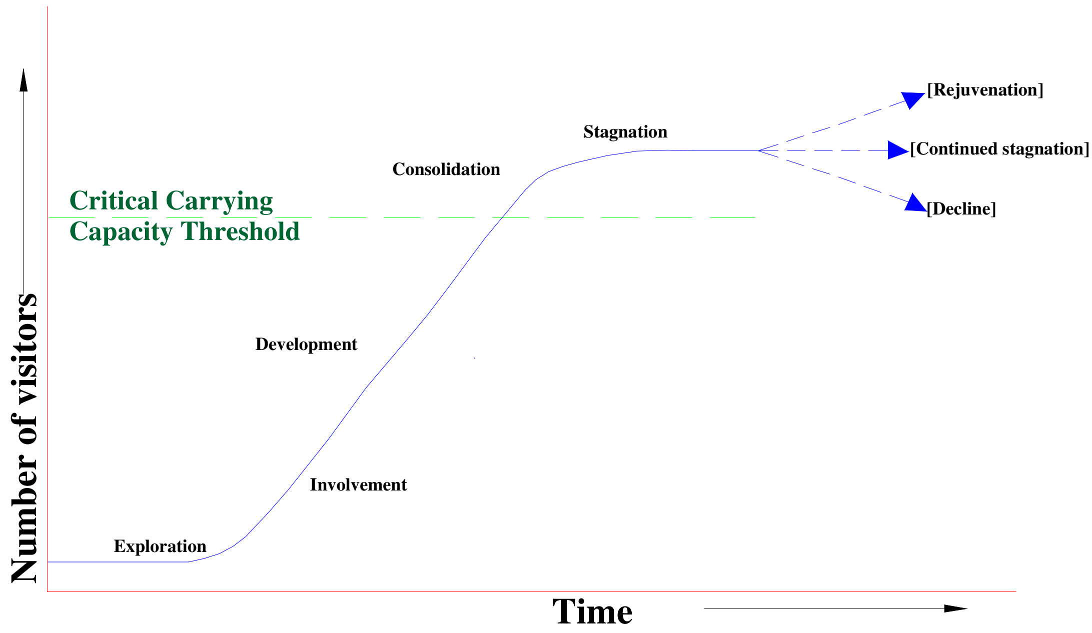
Land is the primary requirement for tourism industry while other infrastructure requirements include transportation, water and sanitation, power, accommodation, food and beverages.

4.1 Tourism industry life-cycle

Tourist spots along coasts develop and gain popularity within a very short period of time, resulting in concentrated activity in a complex, spatially constrained and vulnerable environment. *Each destination can sustain a specific level of acceptance of tourist development and use, beyond which further development can result in environmental and social deterioration or a decline in the quality of the experience gained by visitors. In other words, the carrying capacity of a destination is determined (i) by its ability to absorb tourist development before negative impacts are felt by the host community; and (ii) by the level of tourist development beyond which tourist flows will decline because the destination area ceases to satisfy and attract them. [Alexis Saveriades – Tourism Management 21 (2000) 147-156]*

One of the most discussed models for destination development is the Butler's life cycle model as a device to assist tourism project proponents as well as decision-makers to assess the various phases of the industry's life cycle in conjunction with carrying capacity threshold. Fig. 1.2 illustrates the life cycle of tourism development in a high demand location on the environment.

- ***Exploratio****n* is the initial stage, characterised by very few tourists with little or no adverse impact
- ***Involvemen****t* is the stage, where the local community responds to opportunities created by tourism by offering specialised services, associated with a gradual increase in tourists.
- ***Development*** is the stage when growth is accelerated within a relatively short period of time.
- ***Consolidation*** phase is the stage when tourism totally dominates the destination and local carrying capacities are exceeded with decrease in growth rate.
- ***Stagnation*** is the stage where the tourism industry stagnates due to deterioration of the destination.
- ***Declination*** is the likely scenario if appropriate measures are not taken to restore the destination or reduce the stress on the environment.
- ***Rejuvenation*** is possible if appropriate measures are taken to restore the destination or increase the carrying capacity, resulting in renewed development.



[Source: Fig. 10.1 Butler sequence -'Tourism Management' by David Weaver & Martin Oppermann]

Fig. 1.2 TOURISM INDUSTRY LIFE CYCLE

4.2 Techno-economic feasibility study for tourism development

Techno-economic feasibility study helps identify tourism investment options before committing time and money, by evaluating alternative proposals (which may be alternative projects or alternative processes for a single project). It is imperative that promoters plan tourism development in consultation with local or regional authorities, in order to ensure compatibility with regional plans, environment and ecology.

The end product of a complete feasibility study shall be a sustainable tourism product with a clearly identified market and form. Unlike other industries, tourism industry's main resource is the natural environment. In a popular tourist site, there could be a spurt of several tourism projects (Fig. 1.2), using the same resource, i.e., the environment. In the absence of self-regulatory mechanisms by tourism promoters, quality of the natural environment shall continuously deteriorate. This deterioration of environmental quality beyond the carrying capacity threshold could lead to collapse of the tourism market or impact the profile of tourists visiting a location, thereby altering the economics of a project. Promoters should bear in mind that environmental protection is cheaper than environmental rehabilitation for sustainability of the tourism market.

For long-term sustainability of tourism industry, it is critical to consider environmentally sound designs and approaches right at the techno-economic feasibility stage. A number of alternatives shall be considered at the planning stage, including the "no project" alternative and each of them shall be subject to a qualitative environmental review, so as to identify the environmentally preferable alternative, which addresses the sustainability of the industry.

Key data (Table 1.1) required for the proposed development are collected during the techno-economic feasibility stage. The data in most cases can be obtained from local planning agencies, revenue departments' research and educational institutions etc. It must be recognised that the techno-economic feasibility and the environmental impact assessment have common goals and thus common data requirements.

Since tourism activities are site-specific, the general tendency is to confine the study to the site/premises, where environmental management can be attained through proper housekeeping practices. However, incremental loads on existing traffic network, water supply, sewer system etc. from project needs, extend impacts over the region, necessitating integrated planning of the tourism project within a regional development perspective.

Table 1.1 Data required for feasibility study

Economic	Technical	Environmental
1. Market potential 2. Growth potential and likely returns 3. Existing competition 4. Proposed type of products and services 5. Costs of economic, social, political and environmental risks, 6. Costs of environmental management and compliance requirements 7. Time delays and corresponding costs in obtaining approvals, finance and construction	1. Accessibility, public roads 2. Site suitability for construction (such as in sand dunes) 3. Slope, soil type, drainage patterns, water table 4. Availability of infrastructure (sewerage, water and power supply) 5. Risks from natural hazards (inundation and unstable cliffs, slopes etc.) 6. Seasons, climate, precipitation etc. 7. Topography, coastal features 8. Hydrodynamic information (data on waves, tides, currents etc.) 9. Aesthetics and landscape	10. Standard of living of the community at the site 11. Ecological sensitivity of the site such as location of coral reefs, mangroves, endangered species etc. 12. Existence of indigenous tribes etc. 13. Baseline environmental quality

5.0 Summary of feasibility studies

The feasibility stage is like a preliminary assessment to identify technical, environmental, social and economic issues pertinent to the proposed development that might influence its siting, design, construction and management to make the project economically workable and environmentally appropriate.

The feasibility studies shall address queries like

What is the planned recuperation period of the invested capital?

A short period of recuperation means that there may be little or no incentive to manage the industry and the environment in the long term.

What is the extent of short-term and long-term environmental effects including secondary effects of tourism development?

Some impacts may be short-term and easily mitigable, while long-term impacts could be permanent. Tourism development may stimulate significant secondary environmental impacts. For example, tourism development may promote large-scale tourism and in turn put pressure on the existing transportation network, landuse, water and power resources etc., i.e., carrying capacity of the region. (Fig. 1.2)

What is the extent of cumulative effects of the proposal?

During the feasibility study it is necessary to focus on combined effects of a series of activities occurring over a longer period of time, compared to the project specific action. Some impacts may not be significant when considered at project specific level, but may assume significance when considering the cumulative effect of a series of activities.

What is the degree to which the current project proposal may establish precedent for future proposals or shut out future proposals?

Project proposals may form a precedent to other future developments or may represent a decision in shutting out future proposals due to its environmental significance, thus focussing on viability of tourism development in the region.

5.1 Coastal Tourism industry impacts

Tourism projects may result in resource consumption, socio-cultural conflicts, increased pollution and waste generation thus, putting a stress on the existing infrastructure such as roads, effluent treatment works, power and water supply which may not have been designed to handle the increased requirements of the tourism industry. Major impacts may be loss of biodiversity, increased carbon-dioxide emissions due to energy use in tourism related transportation and air-conditioning and heating of tourism facilities

Examples of beneficial and adverse impacts of coastal tourism are listed below:

Beneficial Impacts

12. Improved facilities like ports, roads and infrastructure, communication, recreational facilities
13. Increased revenues, employment opportunities, patronage for arts and crafts

14. Preservation of historic and archaeological sites

Adverse Impacts

15. Overcrowding of public transportation system and road network.
16. Over-exploitation of water resources/groundwater
17. Physical degradation of the coasts due to pressure on beaches (e.g. beach or coastal erosion; disappearance of beaches due to encroachment of structures).
18. Exploitation of precious natural resources for craft items
19. Impact on ecologically sensitive and endangered species
20. Removal of sea grass for swimming beaches
21. Use of sea/wetlands for treated and untreated wastewater disposal resulting in environmental pollution
22. Visual impairment and decreased aesthetics due to disposal of solid wastes and possible haphazard development at the tourist spot.
23. Air and noise pollution from DG sets etc
24. Blocking of visual and public access to the coast
25. Socio-cultural and lifestyle conflicts with the locals
26. Socio-economic impacts like high land costs, loss of agricultural productivity etc.

5.2 Need for an EIA

Planned and cautious tourism development can prevent costly mistakes so that tourism is sustainable and the environmental quality is within its carrying capacity. Environmental Impact Assessment (EIA) identifies potential impacts and proposes actions to avoid, reduce or mitigate them. The functions of an EIA is to

- Identify pre-project environmental status and project activities that may affect the environment,
- Estimate the impacts of the proposed development,
- Evaluate the consequences of impacts on human life and environment,
- Assess the need for alternative actions and remedial measures.

A thorough EIA shall provide decision makers and the general public with sufficient information to determine whether:

- a tourism project could be initiated in its proposed format, balancing environmental considerations with the social and economic benefits of the project; or
- certain restrictions, design considerations or process alternatives could reduce/mitigate environmental impacts without seriously affecting tourism benefits.

It is appropriate that EIAs be carried out early in the project cycle, i.e., conceptual or master plan stage allowing significant impacts to be filtered out of the projects. This process helps planning mitigation measures whilst avoiding adverse impacts.

5.3 Type of Coastal Tourism EIA

Depending on the type of the project, the coastal tourism EIA can be classified as one of the following.

2. Project-specific when an individual beach resort/amusement park etc is developed
3. Sectoral, when a carrying capacity type of study is undertaken when a State Government or State/Union Territory Tourism Department aims to provide approval for a large scale tourism development.
4. Regional, when the development of coastal tourism projects form a part of plans for regional development. For example developing a region with landing jetty, air-field, roads, hotels, industries and also tourism projects.

Project-specific EIAs often miss impacts that occur off the development site and the cumulative impacts of other projects at the same destination. Typically, a project-specific EIA for coastal tourism project shall address the following issues, depending on the scale of development

1. Local environmental impacts at the project site due to

27. resource (energy and water) use
28. waste generation (liquid effluent and solidwaste)
29. increased air and noise pollution
30. alteration of the habitat/ecosystem
31. alteration of beach and shoreline
32. alteration of landscape and aesthetics
33. socio-economic and socio-cultural changes

2. Regional impacts of the project due to

34. Resource (energy and water) use
35. Traffic congestion due to additional vehicles
36. Stress on existing waste treatment plants
37. Conflicting landuse patterns

3. Existing conditions at the tourist site such as

38. Type and number of tourism projects at the tourist site
39. Future development proposals
40. Traffic volume and traffic network
41. Source of water and power and utilisation pattern
42. Waste treatment and disposal facilities
43. Air and noise pollution sources

Tourism planning shall not be carried out in isolation as the industry revolves around issues such as landuse, protected area, and infrastructure and transportation network of the tourism region. Therefore it is imperative that a comprehensive form of assessment occurs while planning tourism destinations so that all the attributes and their sensitivities in a region/destination can be identified and weighed appropriately.

Sectoral and regional EIAs shall involve the inventory of all assets of an area/region and assessment of each asset's sensitivity to different levels or types of development. An evaluation of the limits to acceptable change in each environmental attribute based on the fragility of the environment shall be based on estimates, which essentially gives a measure of "how much can be changed" whilst still utilisation of resources is within the carrying capacity.

5.4 Components of EIA

The EIA for a coastal tourism project shall consist of the following components

- Need for the project at the location.
- Analysis of location (siting), activity and process alternatives.
- Description of project facilities and break-up of activities at the facility, consisting of construction and operation details and time-period.
- Scoping to identify the significant impacts of the project and to confine the baseline study to the required set of parameters.
- Baseline study to assess the environmental status of the project site.
- Prediction or assessment of impacts on the environment due to the project activities.
- Environmental/Area management plan for maintaining/ managing the environmental quality at the project site thereby mitigating the adverse impacts if any.

Environmental Regulations

6.0 ENVIRONMENTAL CLEARANCE

The area from 0 to 200m from the HTL of CRZ III is a no development zone. All tourism projects located between 200 to 500 m of the High Tide Line (HTL) i.e., in CRZ-III, or at locations with an elevation of more than 1000 meters with an investment of more than Rs.5 crores, fall under Schedule-1 of the MoEF EIA notification, 1994 and hence require an EIA. [The reader is advised to refer to http://envfor.nic.in/ for the latest CRZ notification, which is updated from time to time].

Construction of hotels/beach resorts between 200 and 500 from the HTL in designated areas of CRZ-III requires Coastal Regulation Zone (CRZ) clearance from the MoEF. Guidelines for development of beach resorts /hotels in the designated areas of CRZ-III for temporary occupation of tourists/visitors is given in Annexure II of the CRZ Notification, 1991 (Extract provided in Table 2.1).

- Siting of tourism project shall be based on the Coastal Zone Management Plan (CZMP) for the area.
- Public hearing has been made mandatory for all the cases where the environmental clearance is required. Figure 2.1 explains the stepwise process involved in environmental clearance of tourism projects.

6.1 Environmental Regulations relevant to tourism projects

National legislations applicable to a tourism project have been listed herein to give a brief idea of the existing laws and regulations. It is recommended that the reader refer to the latest rules and standards available at http://envfor.nic.in/

a. Environmental Protection Act 1986

44. EIA Notification (1994 as amended on 27th Jan 2000)
45. Coastal Regulation Zone Notification, (1991, as amended upto 3rd Oct 2001)
46. Municipal Solid Wastes (Management & Handling) Rules, 2000
47. Hazardous Wastes (Management & Handling) Rules (1989)
48. Noise Pollution (Prevention and Control) Rules, 2000

- Others

49. The Air (Prevention and Control of Pollution) Act, 1981 as amended by amendment Act 1989
50. The Water (Prevention and Control of Pollution) Act, 1974 as amended upto 1988
51. The Indian Wildlife (Protection) Act, 1972 as amended upto 1993
52. Forest (Conservation) Rules, 1981 amended upto 1992

Table 2.1 Annexure –II of the CRZ Notification, 1991 by the MoEF

(as amended upto 3rd October 2001)

GUIDELINES FOR DEVELOPMENT OF BEACH RESORTS/HOTELS IN THE DESIGNAED AREAS OF CRZ-III FOR TEMPORARY OCCUPATION OF TOURIST/VISITORS, WITH PRIOR APPROVAL OF THE MINISTRY OF ENVIRONMENT & FORESTS.

7(1) Construction of beach resorts/hotels with prior approval of MEF in the designated areas of CRZ-III for temporary occupation of tourists/visitors shall be subject to the following conditions:

(i) The project proponents shall not undertake any construction (including temporary constructions and fencing or such other barriers) within 200 metres (in the landward wide) from the High Tide Line and within the area between the Low Tide and High Tide Line;

(ia) live fencing and barbed wire fencing with vegetative cover may be allowed around private properties subject to the condition that such fencing shall in no way hamper public access to the beach;

(ib) no flattening of sand dunes shall be carried out;

(ic) no permanent structures for sports facilities shall be permitted except construction of goal posts, net posts and lamp posts.

(id) construction of basements may be allowed subject to the condition that no objection certificate is obtained from the State Ground Water Authority to the effect that such construction will not adversely affect free flow of ground water in that area. The State Ground Water Authority shall take into consideration the guidelines issued by the Central Government before granting such no objection certificate.

Explanation:

Though no construction is allowed in the no development zone for the purposes of calculation of FSI, the area of entire plot including 50% of the portion which falls within the no development zone shall be taken into account.

(ii) The total plot size shall not be less than 0.4 hectares and the total covered area on all floors shall not exceed 33 per cent of the plot size i.e. the FSI shall not exceed 0.33. The open area shall be suitably landscaped with appropriate vegetal cover;

(iii) The construction shall be consistent with the surrounding landscape and local architectural style;

(iv) The overall height of construction upto highest ridge of the roof, shall not exceed 9 metres and the construction shall not be more than 2 floors (ground floor plus one upper floor);

(v) Ground water shall not be tapped within 200m of the HTL; within the 200 metre – 500 metre zone, it can be tapped only with the concurrence of the Central/State Ground Water Board;

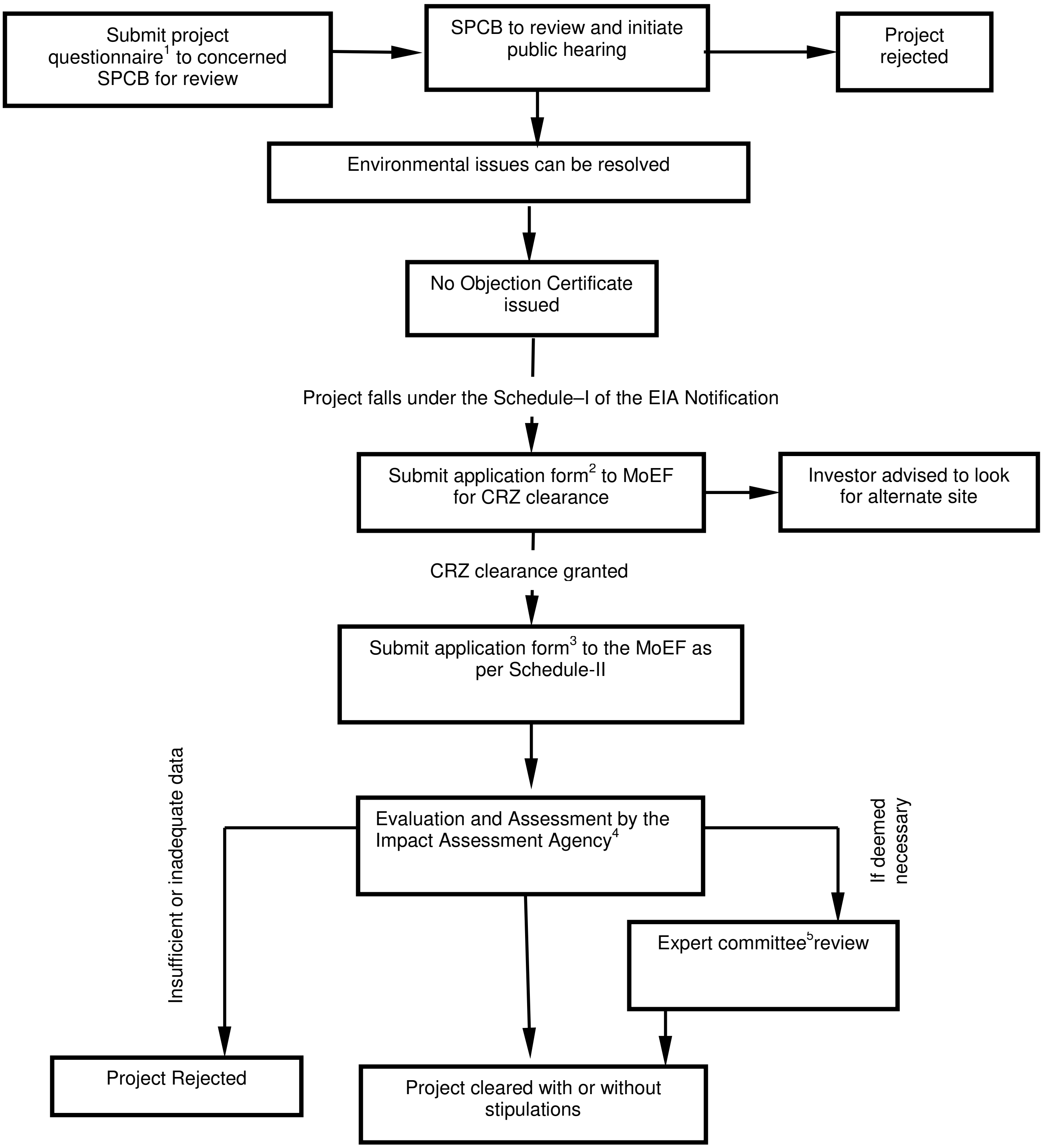
(vi) Extraction of sand, levelling or digging of sandy stretches except for structural foundation of building, swimming pool shall not be permitted within 500 metres of the High Tide Line;

(vii) The quality of treated effluents, solid wastes, emissions and noise levels, etc. from the project area must conform to the standards laid down by the competent authorities including the Central/State Pollution Control Board and under the Environment (Protection) Act, 1986;

(viii) Necessary arrangements for the treatment of the effluents and solid wastes must be made. It must be ensured that the untreated effluents and solid wastes are not discharged into the water or on the beach; and no effluent/solid waste shall be discharged on the beach;

(ix) To allow public access to the beach, at least a gap of 20 metres width shall be provided between any two hotels/beach resorts; and in no case shall gaps be less than 500 metres apart; and

(x) If the project involves diversion of forestland for non-forest purposes, clearance as required under the Forest



1. List of documents to be submitted to the SPCB is as per Schedule-IV of the EIA notification

2. Based on the guidelines for development of beach resorts in CRZ-III as per Annexure II of the CRZ notification, 1991

3. List of documents consist of EIA report/EMP and details of public hearing as specified in Schedule-IV

4. Impact Assessment Agency is the Union Ministry of Environment and Forests

5. Expert committee composition is according to the Schedule-III of the EIA notification

Fig. 6.1 PROCEDURE FOR OBTAINING ENVIRONMENTAL CLEARANCE

Siting and project alternatives

7.0 INTRODUCTION

Tourism projects are generally located in regions with natural, cultural and ecological features. This chapter aims to provide a brief insight into the siting requirements/restrictions, alternatives and facilities of a tourism project and is a precursor to the impacts of such projects.

7.1 Siting

Eco-tourism based projects and recreational tourism require pristine natural environments such as beaches, coral reefs, mangroves, lagoons, backwaters and visual landscape. For constructed sites such as recreational/ amusement/ theme parks infrastructure, access and clean environment are desired attributes. Tourism development needs to be planned in conformance with existing land use pattern of the area.

While the legal requirement for siting a coastal tourism project is governed by the Coastal Regulation Zone Notification of the MoEF, the suitability of the site for the intended tourism proposal shall be based on a detailed investigation of technical, economic and environmental siting considerations.

8.0 Economic siting criteria

Economic viability consists of forecasting the long-term performance of the proposed development and balances a range of factors including target market, the envisaged facilities, and the site's environment. Economic considerations for siting depends on the following factors

- Accessibility determines the potential target market (i.e. the tourist's visiting the site). For example, a site in a remote location may be inconvenient to the tourists who may not return again or recommend the location to others. Cost of accessibility will also affect the tourist's decision to visit.
- Seasonality determines the peak tourist inflow. Seasonal and spatial concentration of tourists has serious implications in terms of resource availability and management at the destination. For example, drinking water supplies, transport services, power supplies etc may be inadequate during peak tourist period and management during such periods consists of procuring additional water, providing additional bus services, provision of DG sets etc. Seasonal variations shall also involve planning for heating and cooling systems. Seasonal rough weather and dangerous sea conditions will also reduce tourist influx.

- Clean environment like good air quality, landscape and aesthetics, healthy habitats and living resources, sufficiently high quality of coastal waters (so as to provide a healthy and aesthetically pleasing environment for water-based recreation) is utmost essential at the tourist location. A polluted tourist location will prompt tourists to seek alternative locations.

- Environmental complexity determined by fragile ecosystem needs extensive management involving environmental rehabilitation and regeneration during development and operational phases. Additional costs are incurred by establishing and maintaining an Environmental Management System (EMS). For example, an inadequate economic analysis of an environmentally complex site may involve cost overruns due to EMP and Monitoring.

- Resource availability includes land, water supply (drinking, washing, etc), power supply, construction materials etc. (gravel, sand, timber, etc).

- Safety concerns consists of weather-related risks (such as high waves, undertows, dangerous currents, etc.) for recreational boating and underwater recreation (e.g. diving, snorkelling etc); availability of adequate lifeguard systems, first aid facilities, telephones, hospitals etc; hazards such as jellyfish, underwater obstructions, unstable cliffs, inundation etc.

9.0 Technical siting criteria

The technical requirements for siting depend on the type of facilities that are planned to cater to the tourists visiting natural, cultural sites or recreational facilities for a constructed site. Technical suitability of a tourist site shall be based on

- Study of existing transport network, volume of traffic, suitability of the transport system to handle the increased traffic, scope for expansion etc.

- Study of topographical features (slopes, soil types for foundation and soak pits), drainage patterns (location of water table for foundations), precipitation (rainwater harvesting), water resource (surface and groundwater), land use (rural, urban, wetlands, forest etc), hydrodynamics (tidal variations, littoral drift, wave heights, currents, etc), coastal features (natural inlets / sheltered bays or exposed coasts).

- Study of the existing public water supply, sewerage system, wastewater and solid waste disposal system, suitability of the system to handle additional loads.

- Standard, volume, type, and capacity of accommodation and type of facilities such as recreational, sports etc and scope for any possible future expansion.

- Orientation of buildings to wind (passive cooling, power generation, etc) and sun (solar heating).

10.0Environmental siting criteria

For tourism industry, economic sustainability depends largely on environmental conditions and therefore, the environmental sensitivity/complexity is an integral part of economic siting criteria. However, the following environmental considerations needs to be assessed

- Fragility of the environment due to the presence of
    54. ecologically sensitive areas such as coral reefs, mangroves, sea grass,
    55. endangered marine species such as sea turtles,
    56. breeding and spawning grounds etc.
- Construction in sand dunes, beach/ dune vegetation etc.
- Socio-cultural aspects such as traditional practices, presence of indigenous tribes etc.

11.0Site Design

Site design is a process of location of structures and utilities in a manner that natural and cultural values are made available to visitors. A responsible site design is based on the needs of the site's environment, as it shall integrate the natural features and the constructed environment. Landscape development shall be planned in conformance with the surroundings rather than by overlaying routine designs and solutions.

A preliminary site survey of the local tourist spot can include

- ***Proximity analysis*** **where optimal locations are identified for proposed facilities based on the site's environmental setting and the proximity to environmentally sensitive resources (mangroves, coral reefs) and cultural resources (religious, historical), which could be affected by development.**
- ***Line of sight analyses*** **to recommend where certain facilities should not or should be located given visibility from key attractions and scenic view locations.**
- ***Topographic analyses*** **to identify favourable building sites as indicated by slope.**
- ***Flow analyses*** **to identify probable paths of water flow and therefore locations subject to erosion or flooding.**
- ***Density analyses*** **to determine clusters of ecological and/or cultural values that might be threatened by development**

General guidelines to be followed in siting tourism facilities are

1. ***Retain ecological features***

- Avoid changing or damaging ecological (mangroves, corals, wetlands, sand dunes, estuaries, nesting sites) and cultural (religious, historical) features.
- Locate facilities, paths, and roads such that visitors are directed away from sensitive areas

2. ***Create or use existing buffer zones***

- Buffer areas (trees, shrubs) could be naturally present at the tourist location or can be artificially created. The site can be zoned around existing buffers without removing trees, vegetation and dune covers. Artificial buffers can however be created to limit visitor access to ecologically sensitive zones or for public recreation.
- Minimise or eliminate clearance of trees, vegetation. Disturbances to natural vegetation can be achieved by minimising earthworks, avoiding steep slopes, confining development to areas of previous disturbance and protecting existing vegetation.

3. ***Locate facilities in conformance with existing natural, cultural and architectural environment***

- Locate small buildings between existing vegetation
- Avoid visually prominent areas such as undeveloped cliffs, ridges etc.
- Locate electricity and telecommunication lines underground and work around natural drainage patterns. Roads can be designed to follow natural contours and building roads on steep slopes, drainage lines and areas requiring extensive cut and fill can be avoided
- Car parks, toilet blocks can be located to blend with the natural setting. Locate roads, car parks and other facilities away from areas prone to shoreline erosion.
- Provide waste disposal facilities at locations away from well locations, swimming beaches, fishing areas and other water intake locations
- Locate cottages and guest rooms away from areas of recreation activity as noise and light disturbances can have negative impact
- Maintain public access to beaches and other ocean frontages
- Provide safe access in case of severe weather conditions and avoid creating dead end routes that are a potential fire trap

11.1 Alternatives

12.0 Project alternatives

The facilities in a coastal tourism project depend on the attraction available at the site (Section 1.1.1). There are several coastal tourism project alternatives. Depending on the scale of development they can be classified as follows

- Beach resorts with hotels, guest rooms, cottages, conference halls etc with a variety of ancillary services (like swimming pools, health club, amusement facilities etc).
- Marinas, harbour cruises, submarines, sport fishing, scuba diving, snorkelling, day sailing, reef tours on glass bottom boats, pools, jet skis etc which require piers, cruise ship docks etc.
- Amusement parks, aquarium, restaurants, open-air theatres, food and beverage service facilities etc on the beach.
- Resorts/hotels/restaurants in religious/historical places/protected areas.

Any coastal tourism project may be a combination of one or more of the above alternatives. For example, a large beach resort may alone form a project or it could have associated waterside, landside amusement / entertainment facilities.

13.0 Technology alternatives

Appropriate planning of layout and design, construction of buildings and facilities are some of the technology alternatives. In addition, there should be sound management procedures during the operation of the facilities.

- Alternative designs to minimise resource consumption and waste generation

The directions of wind (passive cooling, power generation, etc) and sun (solar heating) need to be taken into account while planning buildings. Construction on shoreline (causing interference with the coastal processes) and on steep slopes, sand dunes etc. may be avoided by appropriate planning of structures, considering the site layout. Also existing drainage patterns may be maintained while undertaking levelling of the site. Landfilling especially in wetlands and marine areas shall be avoided.

- Incorporation of environmentally sound alternatives in the project

Unpaved parking areas enable groundwater recharge. Providing basic wastewater treatment facilities and incineration of solidwastes or linking the solidwaste disposal to the local municipal collection system shall prevent degradation of the aesthetics and landscape while preserving groundwater quality. Organic solidwastes can be composted.

- Area management plans and/or sound house-keeping practice (EMP)

Landscaping, waste management techniques such as recycling, reuse and composting, power conservation measures such as use of thermostats, timers, use of solar water heaters etc., water conservation measures such as low flow valves, rainwater harvesting and change in purchasing policies for "closing the recycling loop" etc., are some of the practices which may be adopted at the planning stage to reduce capital investments in environmental mitigation/management.

13.1 Project facilities

Possible facility requirements for coastal tourism projects are presented in Table 3.1. Activities independent of these facilities are surfing, windsurfing, hiking, scuba diving, bathing, religious/historical sites, scenic sites, national parks etc.

Table 7.1 Facility requirements for coastal tourism projects

Basic facilities	Infrastructure requirements	Recreational facilities
Hotels/ resorts/ guest rooms/ cottages Multi-cuisine restaurants Parking lots Shops, fast-food stalls	Transportation system Water supply & storage system Wastewater treatment and disposal system Power supply (Generator sets) Communication systems. Solid waste management system	Party/ conference halls/ open air installations Marinas, recreational boating harbours, beaches, fishing facilities Swimming pools Golf areas & tennis courts Amusement parks

14.0Project Activities

Activities of coastal tourism projects can be broadly categorised under construction phase and operations phase as given in the Table 3.2

Table 7.2 Project Activities

Phase	Land-side Activity	Water-side activity

Phase	Land-side Activity	Water-side activity
Construction	• **Land acquisition and development** • **Site clearing** • **Transportation of raw materials** • **Construction activities** • **Labour camps** • **Land reclamation / Disposal of dredged material on land**	• **Dredging** • **Disposal of dredged material at sea** • **Construction of piers, landing jetties etc**
Operation	• **Vehicular traffic** • **Wastewater discharge from hotels and from employees quarters & treatment – Sewage treatment facilities** • **Solid waste disposal** • **Beach maintenance**	• **Brine discharge from desalination plants** • **Discharge from power plants (cooling water and gaseous emissions)** • **Sport fishing** • **Scuba diving and snorkelling** • **Swimming** • **Yachting** • **Motor boating & water skiing**

Identification of likely impacts

15.0 PRELIMINARY EVALUATION OF IMPACT CHARACTERISTICS (SCOPING)

Environmental impacts of coastal tourism are generally small, often dispersed, critically placed. Scoping emphasises identification of the most obvious, given the preliminary knowledge of baseline environment and type of development. Scoping is a key to fixing the scope of baseline assessment and level of impact prediction.

Significance of an impact is a function of the relative change to an environmental attribute and the sensitivity to that change. While planning for the baseline study, activities with potentially insignificant impacts need to be de-emphasised and potentially significant impacts need to be studied in detail.

Following are the most important questions related to the existence of critical habitats in the proposed project site.

7. Is there a national park, sanctuary or reserved forest in the area?
8. Are there any coral reefs in the area?
9. Are there mangroves/seagrass beds in the area?
10. Are there significant areas of breeding/spawning grounds in the vicinity?
11. Does the area form a part of migratory route or nesting grounds for aquatic and avi-fauna?
12. Are there endangered species in the area?

Scoping is usually based on a preliminary site survey, which shall involve visual inspection of the project site and its surroundings for the existing conditions and address issues such as

12. Groundwater, other sources of water supply
13. General water quality (good, medium, bad)
14. Air pollutant sources
15. Air quality (good, medium, poor)
16. Background noise levels (high, medium, low)
17. Wastewater/effluent discharge sources, disposal methods/location of disposal
18. Types of solid waste generated (refuse, garbage) and their management
19. General aesthetics (good, medium, poor)
20. Landuse (rural, urban, residential, industrial, commercial, agriculture etc)
21. Landscape and terrain (slope, hilly, plain)

22. History of natural hazards (cyclones, floods, earthquakes, landslides etc)
23. Nature of soil (clayey, silty, sandy)
24. Flora and fauna (terrestrial, aquatic & endemic species)
25. Traffic system and transportation facilities (roads, railways, airways, waterways)
26. Socioeconomic conditions (occupation, health care, schools, water and power supply etc)
27. Socioculture (historical, religious, traditions, indegenous tribes etc)

15.1 Identification of likely impacts

Identification of likely impacts of a project is essential in planning an EIA study. This identifies project activities that have an environmental impact, provides parameters for baseline data collection and helps incorporate mitigative measures in the project/process design at the planning stage itself

The environmental parameters likely to be affected due to the activities of the coastal tourism project are listed in Table 4.1

Table 15.1 Overview of likely impacts

Project Activities	Primary environmental aspects affected						
	Air	Noise	Land	Water*	Sediment	Ecology	Socio-Economics
Land development / Site clearing	✓	✓	✓	✓		✓	✓
Transportation of raw materials	✓	✓					
Construction activities	✓	✓	✓	✓			
Labour force			✓	✓			✓
Land reclamation/ dumping of dredged material on land			✓	✓	✓	✓	
Capital dredging		✓		✓	✓	✓	
Disposal of dredged material at sea				✓	✓	✓	
Pier Construction		✓		✓	✓	✓	
Vehicular traffic	✓	✓					

Project Activities	Primary environmental aspects affected						
	Air	Noise	Land	Water*	Sediment	Ecology	Socio-Economics
Wastewater discharge from hotels and employee quarters			✓	✓	✓	✓	
Solid waste disposal			✓	✓			
Beach maintenance			✓		✓	✓	
Brine discharge from desalination plants				✓	✓	✓	
Cooling water discharge from power plants & gaseous emissions	✓	✓		✓		✓	
Sport fishing, Scuba diving and snorkelling, Swimming, Yachting, Motor boating & water skiing	✓	✓		✓	✓	✓	✓
Boat maintenance	✓	✓	✓	✓	✓	✓	

*Water environment consists of marine & fresh water resources

Table 4.2 gives details of the parameters likely to be affected by each of the activity, impact characteristics and their level of significance, from which a scoping exercise is performed to identify issues of environmental concern.

16.0 Characteristics of Impacts

Impacts of proposed activity affect the environment depending upon how, when, where and by how much they occur. Impacts are characterised by

- Nature (positive, negative, direct, indirect, cumulative, synergistic)

    57. An increased employment opportunity is a direct- positive impact.

    58. Loss of wetlands, destruction of eco-systems, coastal erosion or changes in shoreline, impact on water quality and its availability, relocation of households, increased air emissions are some direct-negative impacts, which occur around the same time as the action that causes them.

59. Human health problems, impacts on marine organisms due to water quality deterioration or dredging are indirect-negative impacts, which occur later in time or in a place other than where the original impacts occurred.

60. Impacts from various activities and subprojects can be additive and result in cumulative impacts

61. Impacts from various activities and subprojects can interact with other sources and create new or larger impacts than those originally occurring resulting in synergistic impacts

- Magnitude

62. Estimation of the size of impact; e.g. Small quantities of release of toxic substances can cause large scale impacts on human and aquatic life

- Extent/location (area/volume covered, distribution)

63. Spatial distribution of toxic/hazardous substance release (risk contours), extent of area affected due to emissions from DG sets, dredging activities, etc.

- Timing (during construction, operation,)
- Duration (long-term, short-term, intermittent, continuous)

64. Noise arising from equipments during construction are typical short term impacts

65. Inundation of land, accretion, erosion etc are typical long-term impacts

66. Blasting operations may be intermittent while noise due to pile driving operations may be continuous.

67. Discharge of wastewater may be continuous, while spills during transfer operations may be short-term.

- Reversibility/irreversibility

68. Restoration of the environmental quality to pre-existing stage is defined as reversible. Air quality impacts due to transportation of raw material occurs only during construction stage and hence reversible, whereas construction of on shorelines causes an irreversible change to the coastline.

- Likelihood (risk, uncertainty)

69. Some impacts occur less frequently but have a high consequence while others occur more frequently and have less consequence.

17.0 Extent of environmental impact

Siting and/or development of tourism projects result in environmental impacts, which may not confine to the project location and its environs, but may extend spatially over the following zones:

- Source region, i.e., the tourist generating region
- Beach and shoreline
- Coastal waters
- Coastal plains
- Estuaries, backwaters and lagoons
- Offshore waters

Table 4.2 gives the evaluation of impact characteristics, i.e., scoping to enable filtering of impacts that may be insignificant based on the environmental setting of the project.

Table 15.2Preliminary Evaluation of Impact Characteristics for a Coastal Tourism Project - Scoping

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Land acquisition and development	Land	Landuse and/ or socio-economics	Loss of cultivable lands / forest areas / fishing grounds and / or loss of livelihood	Pre - construction phase	Negative Long-term Irreversible	High when there is loss of livelihood / production / conflicting landuse pattern; Low when alternate means of livelihood is provided or with adequate compensation
		Water quality	Increased impervious surfaces causing more runoff containing toxics, suspended particles and oil and grease. Groundwater recharge is also reduced	Construction & Operations Phase	Negative Long-term Irreversible	High when wetlands are developed and when surfaces are sealed or impervious
Site clearing	Air quality	Suspended Particulate Matter (SPM)	Wind erosion of dislodged fine soil particles due to earth moving/ removal of vegetative cover etc	Construction Phase	Negative Short-term Reversible	High when wind speeds are high with removal of vegetative cover / trees; Low in the proximity of barriers like buildings / trees and / or when wind speeds are insufficient to cause wind erosion

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Noise	Noise levels	Use of earth moving equipment, power tools, diesel engines etc.	Construction Phase	Negative Short-term Reversible	Low when there are no noise sensitive receptors, when workers are provided with ear masks or when adequate vegetative cover exists/ retained
	Water	Water quality	Soil loss by runoff into water body in the vicinity causing increased turbidity	Construction phase	Negative Short term Reversible	Low when vegetative cover is not removed and/ or when gravel washings are less due to scanty rainfall.
Site clearing (contd)	Land	Soil	Removal of vegetative cover and root structures that protect soil and/ or change in the gradient of existing slopes causes soil erosion	Construction phase	Negative Short term Irreversible	Low when minimum vegetative cover is removed and / or when natural slopes are not altered
	Terrestrial ecology	Flora & fauna	Removal of vegetation	Construction phase	Negative Long term Irreversible	Low when minimum vegetative cover is removed / when vegetative cover is commercially unimportant or when fauna is absent; High when fauna are endangered species

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Socio economics	Livelihood	Resettlement, removal of vegetation and/ or change or loss of livelihood	Construction phase	Negative Long term Irreversible	High when there is loss of commercially valuable area/ resettlement of population and changes in livelihood
Transportation of raw materials	Air	SPM, SO_2, NOx,	Vehicular emissions & generation of dust due to handling and transport of fine & coarse gravel in uncovered trucks	Construction Phase	Short term Negative Reversible	Low with low cost EMP such as use of tarpaulin sheets for covering trucks or water sprays for dust suppression and regular emission checks; High when transported through unpaved or poor condition roads
	Noise	Noise levels	Vehicular noise	Construction Phase	Short term Negative Reversible	High when heavy trucks ply through noise sensitive areas especially at night. Low when there are no noise sensitive receptors
Construction activities	Air	SPM, NOx, SO_2,	Fugitive dust generation due to concrete mixing, cement handling, & gaseous emissions from welding, asphalt heating, mixing, and laying, operation of construction machinery	Construction Phase	Short term Negative Reversible	Low, when construction area is protected by barriers and/ or with low cost EMP such as sprinkling water and wearing mask. Low when regular emission checks are done for the construction machinery.

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Noise	Noise levels	Use of construction equipment and power tools	Construction Phase	Short term Negative Reversible	Medium when there are noise sensitive receptors in the vicinity; Low, with low cost EMP like providing workers with ear plugs or when there are no noise sensitive receptors in the vicinity
	Water	Water, quality and quantity	Water consumption for construction impacts water availability Turbid runoff from construction site washings	Construction Phase	Short term Negative Reversible	Low, if groundwater is not tapped. Low turbidity levels when runoff is minimized by construction of small bunds
Labour camps	Water	Water Quantity & Quality (DO, BOD, TSS, Nutrients, Faecal Coliform)	Water consumption for domestic usage Disposal of untreated liquid waste.	Construction Phase	Short term Negative Reversible	Low, if workers are local as the usage pattern is maintained or when water resource is not a constraint Low, with basic treatment units such as soak pits, septic tanks etc

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Land	Landuse and Aesthetics	Generation of solid wastes, Haphazard growth of temporary buildings / dwellings/ hutments	Constructio n Phase	Short term Negative Reversible	Low, when proper collection and disposal of solid wastes is practised; Low when shelter, basic requirements and sanitation for the workers are provided or when temporary construction is regulated
Labour camps (contd)	Socio-Economics	Employment	Increased employment opportunities	Constructio n Phase	Short term Positive Reversible	Low, if the employment is temporary and only during the construction phase
Disposal of dredged material along the coast or Land reclamation	Ecology	Micro & Macrobenthos	Trapping of intertidal benthos	Constructio n phase	Long term Negative Irreversible	Low if the area is a barren and devoid of ecologically sensitive species / commercially valuable species. Low if dredged material is not contaminated.
	Sediment transport, shoreline slopes (land)	Hydrodynamic s	Change in hydrodynamics due to material dumping may cause shoreline changes	Constructio n phase	Long term Negative Irreversible	Low if the site is not close to the water front

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Groundwater sources, quality	Water resources	Dumping of toxic sediments may impact groundwater resources from leaching	Constructio n	Long term Negative Irreversible	Low if there is no groundwater resource or if dredged material is not contaminated.
Capital dredging	Noise	Noise levels	Use of dredging equipment and power tools	Constructio n phase	Short term Negative Reversible	Low if the soil at the dredging location is soft and of clayey nature or with no noise sensitive marine species at close proximity Medium for a rocky profile
	Water	Water quality	Sediment resuspension; Release of toxic substances and nutrients from the sediments	Constructio n phase	Short term Negative Reversible	Medium for turbidity when the material is clay and low for toxicity when sediment toxicity is minimal
	Ecology	Micro and Macro benthos	Disturbance of bottom sediments and removal or destruction of spawning grounds	Constructio n phase	Short term Negative Reversible	Low, when commercially valuable species/ breeding/ spawning grounds are not present

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Disposal of dredged material at sea	Water	Water quality	Dumping of dredged material increases total suspended solids, turbidity levels, may release nutrients and toxics.	Construction phase	Short term Negative Reversible	Low when the dredged material conforms to the sediment properties at the disposal site. High when dredged material is toxic or in the presence of fishing / breeding / spawning grounds
Construction of piers, landing jetties	Noise	Noise levels	Use of pile drivers, boring equipment, power tools, drill bits etc.	Construction phase	Continuous for a Short period Negative Reversible	Medium when noise sensitive receptors are in the vicinity Low, with low cost EMP such as ear protection devices
	Water	Water quality	Increased suspended solids and turbidity during piling	Construction phase	Short term Negative Reversible	Low, when piled foundations are used as it is localised and area of impact is negligible
	Sediment transport	Hydrodynamics	Change in hydrodynamics may cause accretion / deposition	Construction & Operation Phase	Long term Negative Irreversible	Low, if the structure does not alter flow pattern

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Ecology	Micro and Macro benthos	Disturbance of bottom sediments and covering up or destruction of spawning grounds	Constructio n phase	Short term Negative Reversible	Low, when commercially valuable species/ breeding/ spawning grounds are not present or when structures are found on piles.
Vehicular traffic (use of motor vehicles and speed boats)	Air	SPM SO_2 and NOx,	Vehicular emissions due to combustion of fuel Vehicles on dusty roads	Operation phase	Long term Negative Irreversible	Low, if there is no receptors of impact
	Noise	Noise levels	Generation of noise from vehicles	Operation phase	Long term Negative Irreversible	Low, when vehicles do not traverse through thickly populated areas and with low cost EMP like regular emission checks.
Power plants	Air	CO, NOx, SPM, SO_2 and HC	Emissions from DG sets	Operation phase	Long term Negative Irreversible	Low when the DG sets are used only for emergency purposes and when frequent emission checks are made and when there are no sensitive receptors in the downwind direction

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Noise	Noise levels	Noise generation from DG sets	Operation phase	Long term Negative Irreversible	Low when the DG sets are used only for emergency purposes and when there are no sensitive receptors in the downwind direction
Wastewater discharges from hotels and employee quarters.	Water	Water quality	Discharge of treated or untreated sewage into the water bodies	Operation phase	Long term Negative Irreversible	Low when the wastewater is treated before discharge
	Ecology	Marine flora and fauna	Discharge of wastes	Operation phase	Negative	Low when the wastewater is treated before discharge
Solidwaste disposal	Water	Water quality (Groundwater & other resources)	Ground leaching of pollutants from solidwaste	Operation phase	Long term Negative Irreversible	Low when solidwaste is incinerated or dumped in approved landfills
	Land	Aesthetics	Solidwaste generation from hotels, resorts and cruises and recreational boats	Operation phase	Long term Negative Reversible	Low when the proponent practises solidwaste handling and disposal system such segregation, composting and/ or incineration.

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Presence of physical structures	Land	Groundwater	Sealing of the areas with buildings, roads, parking lots restricting the recharge capacity and changing the drainage pattern	Operation phase	Long term Negative Irreversible	High when the region is the main recharge area for the local town, Medium when groundwater is the main resource.
	Sediment	Hydrodynamic s	Construction near beaches, removal of natural coastline protection, interference with balance of materials near the beaches, removal of protective beach vegetation etc. causes erosion	Operation phase	Long term Negative Irreversible	Low when the construction is not too close to the coast, where removal of sand for construction is minimal and when beach vegetation is not disturbed
Discharge from desalination plants	Water	Salinity, DO	Discharge of brine	Operation phase	Long term Negative Irreversible	Low when discharge location is at sufficient depth to facilitate dilution
	Ecology	Marine organisms	Discharge of water that has greater salinity than what is available to the organisms	Operation phase	Long term Negative Irreversible	Low when there are no ecologically sensitive species at and near the location of disposal

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Cooling water discharge from the power plants (seawater withdrawal for cooling)	Water quality	Temperature	Discharge of effluent which has higher temperature than that of the water body	Operation phase	Long term Negative Irreversible	Low when the cooling water is sufficiently diluted with cold water and when there are no ecologically sensitive species at and near the location of disposal
	Ecology	Marine organisms	Discharge of effluent with temperatures above the ambient	Operation phase	Long term Negative Irreversible	Low when there are no ecologically sensitive species at and near the location of disposal
Tourist Influx	Socio cultural	Traditional values and culture	Influx of tourists and introduction of capital based economy may affect traditional values	Operation phase	Long term, Negative, Irreversible	Medium to high depending on the location of the tourist industry

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Tourist influx (contd.)	Socio economics	Economic stability and employment	Influx of additional population, traders and job-seekers Resettlement of local population Priority to tourists and hence limited beach access and traditional fishing opportunities to the local population Loss of valuable agricultural areas Abandoning agricultural professions Restricted supplies of essential crops, fruits and vegetables to locals Increased land prices, cost of living, energy costs	Operation phase	Long term Negative Irreversible	Medium to high depending on the location of the tourist industry

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Recreational Activities	Water	Water quality (DO, TSS, Nutrients, pathogens, Oil and grease) & aesthetic degradation of surface waters	Continuous use of the water by tourists, washings, discharge from boats etc.	Operation phase	Negative	High to low depending on quantity of wastewater generated and whether it is discharged with/ without treatment.
			Dumping of solidwaste generated during cruises			Low when solidwaste generated are collected and brought onshore for disposal.
Recreational activities (contd.)	Ecology	Marine flora and fauna	Discharge of wastewater and dumping of solidwaste Ecosystems like sea-grass beds, coral reefs are affected by anchors and propellers of powerboats, wash generated by motorboats and grounding of boats. Resort illumination, streetlights etc can disorient marine turtles. Noise from boat engines and propellers can disorient marine species.	Operations phase	Negative	High when there is presence of breeding and spawning grounds / ecologically sensitive species and large-scale water-sports and cruises.

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Coastal area	Shoreline	Erosion along the shoreline due to wakes from speedboats. Use of skiis, motorbikes or cars and animal rides in close proximity to the shoreline.	Operations phase	Negative	Medium to low depending upon the type of soil or when speed restrictions on boats are imposed.
	Land	Aesthetics	Generation and dumping of solidwaste	Operations phase	Negative	Low when solidwaste is incinerated or disposed off in approved landfills.

Baseline assessment

18.0 BASELINE STUDIES

Baseline studies help define the existing environmental conditions at the project site. This involves identification of environmental parameters that are environmentally critical and sensitive at that location and those that might be affected by development of coastal tourism projects. Though not exhaustive, this chapter gives an introduction to overall baseline data types and requirements for an EIA study. However, project specific baseline data collection needs to be designed on the basis of scoping. The results of scoping would result in a partial list of parameters (listed in this chapter) and in very special cases would require detailed studies designed by experts which is beyond the scope of this guideline.

19.0Data types for baseline studies

The data collected at first-hand, by undertaking field visits/surveys, collecting samples and conducting analyses are referred to as primary data. However, the likely impact of a particular activity shall determine the baseline study requirement. Generally secondary information on landuse, census, standard of living (socio-economic conditions), water availability etc., and data from preliminary site visits should be considered sufficient for projects that do not have large scale facilities like DG sets, desalination units or involve activities like capital dredging, land filling/reclamation etc.

Secondary data are those already collected by others for various purposes. These are available in departments or institutions, which undertake studies routinely for various purposes, including monitoring the quality of the environment, scientific and research activities.

Tourism projects generally require Rapid EIA (REIA) where primary data are required for water; air and noise quality parameters for one season other than monsoon. It is also necessary to undertake secondary data collection programmes and concentrate on the availability of water resources; presence of coral reefs, mangroves and other ecologically sensitive areas; existing solid waste disposal system; source of energy; socio economics and socio cultural details at the site etc.

The REIA report shall be reviewed by the MoEF and the consultant for acceptance and approval. Depending on the site and proposed activities, the MoEF may also choose to advise the proponent to further undertake a comprehensive EIA, which is a one year- three-season baseline study.

19.1 Typical environmental attributes for coastal tourism projects

Environmental attributes are defined as characteristics of the environment where changes to these attributes indicate impacts. The project activities and environmental setting define the environmental attributes to be assessed.

The basic environmental attributes are classified under air, water, land, ecology, sound, and socio-economics, and consist of a number of measurable parameters. Baseline studies that characterise the existing condition need to be designed according to the local conditions. At the same time, baseline study will be used to compare the change in the environmental characteristics due the project during the construction/operation phases. Tables 5.1 to 5.5 represent indicative requirements for a baseline study and do not necessarily indicate a regulatory requirement, unless specified. It is also recommended that average and peak measurements must be considered in planning a sampling schedule.

20.0Air Environment

The air environment consists of meteorological parameters (wind direction, wind speed, temperature gradients, atmospheric stability, daily rainfall) and air quality parameters (gaseous and particulate matter). The meteorological parameters influence the transport and dispersion of the air quality parameters in the atmosphere.

Table 5.1 gives details of air quality data collection. For assessing an air quality impact the following baseline parameters are required

- Existing air quality at the site i.e. the background concentrations of suspended particulate matter, SO_2, NO_x, CO, HC etc
- Wind direction to determine the receptor
- Wind speed which influences the horizontal mixing of pollutants
- Wind speed, temperature gradients and rainfall that determine the atmospheric stability which further affects the vertical mixing of pollutants
- Topography (hills, buildings, trees etc) which influences the mechanical mixing of pollutants
- Land use at the project site to determine receptors

Table 18.1 Air quality data collection

Attribute	*Sub-attribute*	*Sampling criteria*		
		Specification	*Frequency & Period*	*Source*
Meteorology	Wind direction	Distribution with height	1 year daily data	IMD
	Wind speed	Distribution with height	1 year daily data	IMD

Attribute	*Sub-attribute*	*Sampling criteria*		
		Specification	*Frequency & Period*	*Source*
	Temperature gradient	Distribution with height	1 year daily data	IMD
	Atmospheric stability	Distribution with height	1 year daily data	IMD
	Rainfall	Distribution	1 year daily data	IMD
Air quality	Suspended particulate matter (SPM), SO_2, NOx, CO and HC	24-hr average for one season other than monsoon	Twice a week for 3 months	Baseline study
Topography	Hills, buildings, trees and other mechanical obstructions	Layout map of the area	Present data	Visual examination

Sampling stations for air quality may be located at the project site, peak hour/heavy traffic locations, and at receptor locations.

21.0Noise

Table 5.2 gives details of data collection for noise. To determine the impact on noise levels due to a project, it is essential to collect baseline data on

- Existing noise levels at the site i.e. the background concentrations
- Noise attenuating factors such as hills, trees, barriers, humidity etc
- Land use map to locate the noise sensitive receptors such as schools, hospitals, residential areas, concert halls, etc

Table 18.2 Noise level data collection

Attribute	*Specification*	*Frequency & Period*	*Source*
Noise levels	Intermittent/ Impulsive/ Continuous	1 sample each during day and night	Baseline study
Noise attenuating factors	Trees, hills, valleys, buildings	Latest information Future development plans	Site Visit SOI Toposheet Town planning department

Noise sensitive receptors	Types of receptors, location and distances	Latest information Future development plans	Site visit Layout maps of project site Town planning department

Noise levels may be measured at the proposed site, peak hour / heavy traffic periods/locations, noise sensitive receptor locations etc.

22.0Land

The extent of assessment of the landuse shall be concentrated within a 10 Km radius around the project area. The extent of landuse within a 25 Km radius is required when the project is proposed near an ecologically sensitive area.

Land environment comprises land use pattern, soil, slope, drainage characteristics, topography, etc. To determine the impact on land, the following baseline parameters are essential

- Existing land use pattern
- Terrestrial ecology (trees, vegetation etc)
- Soil, slope and drainage characteristics that affect runoff and groundwater infiltration
- Topography such as hills, valleys & landscape

Baseline parameters shall also address the land environment specific to the project site. Typical sampling data type, specifications and data source for the above parameters are given in Table 5.3. When secondary data is not available, primary surveys may be conducted.

Table 18.3 Land environment data collection

Attribute	*Specification*	*Sampling criteria*	
		Frequency & Period	*Source*
Landuse	Residential, Industrial, commercial, agricultural, etc	Latest information	State Metropolitan Development Authority, Town planning department, Panchayat etc
Soil, slope and drainage characteristics	Soil types, gradient, hydrology	Latest information	Survey of India (SOI) Toposheets, State Soil Conservation Departments
Topography	Hills, valleys, terrain	Latest information	• **Survey of India (SOI) Toposheets, State Revenue Department** • **Site specific data collection by project personnel**
Terrestrial ecology	Flora and fauna	Latest information	• **Biological Survey of India, Zoological Survey of India, State Metropolitan Development Authority** • **Site specific data collection by project personnel**
Ground water hydrology*	Type of groundwater sources (open wells, tube wells)	Latest information	• **Public Works Department, Corporation, Panchayats** • **Primary data from site visits**
	Well yield, Water levels, Consumption rates	Data for last 1 year	• **Public Works Department, Corporation, Panchayat** • **Primary data from pumping tests**
	Quality – pH, Turbidity, Salinity	One season data	• **PWD, Corporation etc** • **Primary water quality analysis**

*A detailed survey may be required depending on level of extraction and background information of available resource

Assessment of the local landform type and its constituent materials enables evaluation of potential hazards of the proposed activity on the local physical environment. Landform types are based upon the characteristics of topography, viz., local relief and slope. Project activities affect the availability or suitability of land for certain uses i.e., the land-use patterns.

23.0 Water

Water environment (coastal waters) consists of oceanographic, water quality and biological attributes. Oceanographic/hydrographic parameters are depth, tide, wave height, current speed and direction, shoreline profile etc. Water quality attributes are turbidity, temperature, suspended solids, salinity, pH, DO, BOD, nutrients etc. Biological attributes could be categorised as pathogenic (faecal coliforms) and ecological like benthos, phytoplankton, zooplankton, fish etc.

Transport mechanism of pollutants is influenced by advection - diffusion factors due to tides, waves, and currents. For assessing the impact on water environment, the following baseline information is essential

- Existing water quality at the project location (sea, creek) i.e. the background concentrations
- Water resources available at the project site
- Water utilisation/requirement at the site without the project
- Oceanographic parameters such as tides, waves, current speed, current direction and bathymetry that influence mixing and diffusion of water quality parameters
- Sensitive receptors at the site such as coral reefs, mangroves, breeding areas, water intake locations, etc

The sampling data type, specifications, frequency and data source for the above parameters are given in Table 5.4. Water sampling stations shall be selected based on the effluent discharge points, sewage outfalls, dredging/dumping sites etc, and shall be based on the environmental setting of the project site. Sampling stations shall be representative to indicate average conditions.

Table 18.4 Water Environment

Attribute	*Sub-attribute*	*Sampling criteria*		*Source*
		Specification	*Frequency &Period*	
Hydrodynamic	Current, tides and waves	High and low tide Wave heights Current speed and direction	15 days for one season*	Naval Hydrographic Office (NHO) charts, Indian Tide Tables, Ocean R&D Institutes, DOD
Bathymetry	Depths	Contours upto 30m depth	Once	NHO charts
Physical quality	pH, salinity, temperature TSS, TDS, Oil and grease	1 season sample	1 sample* each during high and low tides	Baseline data
Chemical quality	DO, BOD & Nutrients	1 season sample	1 sample* each during high and low tides	Baseline data
Biological quality	Fecal coliforms, Streptoccocci, phytoplankton, zooplankton	1 season sample	1 sample* each during high and low tides	Baseline data

*If impacts are significant, MoEF may suggest that a comprehensive EIA with three season date be conducted

24.0 Ecology

An ecological environment consists of terrestrial and aquatic ecology. This section covers floral and faunal characteristics that are not addressed in sections 5.2.3 and 5.2.4

Attributes critical in assessing the suitability of the project at the selected site are:

- Natural vegetation, endemic and endangered/ ecologically sensitive species such as seagrass, corals, mangroves etc.,
- Fisheries data for the last five years – secondary data can be obtained from the Fisheries Dept.

Biological sampling shall

70. Be conducted in fishing, breeding and polluted zones
71. Include analyses at various trophic levels and
72. Identify endangered species/critical habitats

25.0 Socio-economics and Socio-culture

Social environment refers to people and their surroundings, human beings and their products, their property, groups, heritage etc. The effects of a project on people and their responses may be direct and immediate or remote and attenuated. Estimation of the change in the income in an area, value of structures, equipment, standard of living, statistical information on population growth etc form socio-economic studies. To assess impact on socio-economic environment and culture, it is essential to collect the following data

- Details on occupation, level of education of the population surrounding the project site, likely receptors of impact
- Traditional practices, customs, beliefs, values, etc
- Standard of living at the site i.e. the infrastructure available to local population such as water supply, sanitation, electricity, transportation, education, medical treatment etc
- Commercially valuable species and materials at the project site

Information of socio-economic and cultural environment can be obtained from revenue department, fisheries and by undertaking site visits.

26.0 Resources

- Water, power, fuel & non-fuel resources are assessed for labour camps, construction activities, operational requirement etc.

26.1 Typical baseline requirement

Table 5.5 gives typical baseline parameters required for various activities of a large coastal tourism project. The extent of baseline study is a function of the nature of activities. Annexure A gives an example study requirement of a small-scale and a large-scale resort.

Table 18.5 Baseline Parameters for activities

Activity	Environmental Parameters					
	Air	Noise	Land	Water	Ecology	Socio-Economics
Site clearing/ Land development/ Transportation of raw materials	SPM, NOx, SO_2	Noise Levels	Landuse, layout of buildings	TSS in water bodies in the vicinity	Terrestrial flora & fauna	Traditional fishing areas
Construction activities	SPM	Noise levels		TSS, Water source & availability		
Labour camps			Aesthetics, solid waste disposal location	pH, Temp, salinity, TSS, DO, BOD, Nutrients, Faecal coliforms, Water source & availability		Number of people likely to be employed
Land reclamation	SPM		Extent, Landuse, Soil type at the proposed reclamation site		Benthos, plankton (if intertidal) at the proposed reclamation site	
Capital dredging		Noise levels, Noise sensitive receptors		Silt charge, hydrodynamics DO, TSS, Nutrients	Benthos, plankton	Commercially valuable marine species
Dumping of dredged material at sea				DO, TSS, Nutrients	Benthos, plankton	

Activity	Environmental Parameters					
	Air	Noise	Land	Water	Ecology	Socio-Economics
Construction of jetty on piles		Noise levels, Noise sensitive receptors		TSS		
Vehicular traffic	SPM, NOx, SO_2	Noise levels				
Wastewater discharge from hotels and employee quarters				pH, Temp, salinity, TSS, DO, BOD, Nutrients, Faecal coliforms, Water source & availability		Number of people likely to be employed
Solid waste disposal			Aesthetics, solid waste disposal location			
Beach Maintenance			Aesthetic, dunes, slopes	Hydrodynamics	Benthos	
Brine discharge from desalination plants				pH, Temp, salinity, TSS, DO	Benthos, plankton	
Emissions from DG sets	SPM, NOx, SO_2 HC*, CO*	Noise levels				

Activity	Environmental Parameters					
	Air	Noise	Land	Water	Ecology	Socio-Economics
Cooling waster discharge from power plants				Temp, DO	Benthos, plankton	
Recreational activities / cruise	CO, NOx, SO_2	Noise levels		Faecal coliform, nutrients Oil & grease		
Boat maintenance			Aesthetics, solid waste disposal location	Oil & grease		

* Optional Parameters- shall be measured when such emissions are expected depending on fuel used

Prediction of impacts

27.0 PREDICTION

Prediction or analysis of impacts gives an estimate of magnitude and spatial distribution of impact enabling assessment of future condition of the environment with the project. Prediction is an essential component of any EIA as it provides a measure of sustainability of a project.

Predictions can be quantitative and/or qualitative. Quantitative methods give an estimate of the impact using mathematical expressions/computer models and experimental/physical models. Simple quantitative methods are typically analytical with broad assumptions requiring hand calculations, while the complex models are computer based and address many of the complexities of the natural environment. Qualitative methods are based on professional judgement/examples of similar occurrences/events in other locations/projects or cited in literature.

Results of prediction can be illustrated with contours or plots showing critical concentrations, in conjunction with receptor locations to determine the significance of impacts.

27.1 Scenario for prediction

Predictions must consider the worst case and most probable case scenarios for each environmental parameter. Examples of worst-case scenarios can be periods of inversion for air quality, storm surges for inundation or festivals/religious events that attract a large number of people. Most probable scenarios can be air quality during normal conditions (based on statistics), discharge of wastewater during peak season and traffic during peak tourist season.

27.2 Water environment

The two broad areas of impact on the water environment by coastal tourism projects are the water resources and the coastal waters. While water resource concerns may arise from overexploitation of potable water, the impact on marine environment primarily arise from shoreline changes and marine water quality deterioration.

28.0Impact on water resources

In coastal areas that rely on groundwater, excessive pumping can cause saltwater intrusion due to lowered water tables or depleted freshwater lenses.

Construction of buildings, roads, paving parking areas etc lead to increased impervious areas and change in top soil characteristics, which may significantly reduce infiltration and groundwater recharge.

In general, the annual extraction of groundwater must be less than or equal to the recharge, else over pumping will gradually deplete the stored resource causing existing wells to run dry, at times requiring expensive deep drilling to locate new wells. Landuse consisting of productive farms may lose irrigation water as wells go dry.

Groundwater tests must be conducted to assess safe yield and ensure that neighbouring wells have minimum drawdown. The depth and pumping rate must be such that there is no upcoming of saltwater.

However, if water supply is made from remote sources, to meet peak tourist demand, an assessment of water table lowering and resource-use conflict in the remote location is necessary.

29.0 Impacts of sediment transport

The sediment transport issues are generally related to the physical alterations of the coastline such as construction on shoreline, presence of breakwater, seawall or reclamation. When stabilizing beach vegetation is removed for construction on the shoreline or when construction is carried out on slopes, changes may occur to the shoreline and the along-shore wave movement, causing erosion and depositional patterns.

The most important factor controlling coastal processes and coastal engineering design is the waves generated by winds. Waves result in large forces on coastal structures, near-shore currents, long-shore currents and control beach profiles. Typically the data requirements for prediction of waves (for projects requiring marine infrastructure such as jetties, slipways etc.) are the site area bathymetry and wave characteristics (wave heights for various periods). These aspects will be addressed in the technical feasibility of a project and may be made available to the EIA consultant by the engineering consultant.

The impact of a coastal structure on the shoreline can be simulated using physical models or mathematical models. Mathematical models require the long-shore current component, which is typically generated from wave radiation models. The long-shore sediment transport is calculated using the continuity equation for sediment volumes. The primary input for the computation is the wave climate, cross-shore profile, sediment properties and the coastline orientation.

30.0 Impacts on marine water quality

When a pollutant is discharged into a water body, the water quality in the surrounding area is a function of the currents, mixing, water chemistry and biological processes of the natural water body. Today, these processes can be represented by models ranging from simple planning type models to sophisticated computer based water quality models.

The simplest method available for predicting concentrations is for a continuous discharge into a receiving water body under steady state conditions. The currents in the water body will transport the pollutant downstream; spreading the waste by molecular and turbulent diffusion processes and for some pollutants, transforms the pollutant by chemical and biological processes. While the steady state assumption is useful for an “order of magnitude” estimate, it may not be acceptable to the coastal environment, which is dynamic. This has resulted in the utilisation of mathematical models that are capable of simulating the dynamic nature.

In a coastal environment, advection is governed by current speeds and direction while dispersion is characterised by turbulence and molecular diffusion. A typical water quality model is one that simulates the advection and dispersion of the pollutant.

Hydrodynamic models contain sub modules to estimate the concentration of pollutant in the water body due to wastewater discharges. The concentration of some pollutants such as pathogenic bacteria and BOD may be modelled by simple 'first-order' decay equations, where the mass of the pollutant decreases with time. Dredge spoils may also be simulated using the first-order equations when the grain size is fairly uniform, sediments are non cohesive and currents are low

Parameters such as trace metals and organic chemicals are more complex, requiring sediment concentrations in water to estimate the partitioning of the pollutant in its dissolved and particulate phases.

Dissolved Oxygen is an important water quality and ecosystem health indicator and is always indicated in water quality standards. The origin of DO modelling began with the Streeter-Phelps equation that modelled DO as a function of Biochemical Oxygen Demand (BOD) and re-aeration of oxygen from the atmosphere. Today, DO models include many complex ecosystem components such as nutrient uptake, algal photosynthesis, primary productivity, benthic processes, etc.

Simple oil spill models use wind and steady state currents to estimate dispersion and surficial spreading. More complex models generally use advection-dispersion model base and include processes such as volatilisation, settling of tars and wind dispersion.

Brine discharges have high concentrations of salt, turbidity and certain chemicals that are used for the pre-treatment of feed water & cleaning of filters. There are simple models (like USEPA's CORMIX) available for modeling small quantities of saline water discharges.

Cooling water discharges have higher temperature than receiving waters, potentially causing depletion of oxygen and thermal shock to marine life. Temperature also affects rate of chemical and biological reactions, solubility of oxygen and other gases in water and may induce density stratification. Water temperatures can be modelled by adding all the heat inputs and subtracting all heat losses. The inputs to these models include heat exchange with the atmosphere, which is a function of evaporation, solar radiation and convective losses.

30.1 Air environment

The air pollutants emitted into the atmosphere will be diluted and dispersed depending on local meteorological and geographical conditions. A continuous stream of pollutants when released into the atmosphere will rise, bend and then travel in the direction of the wind, which enables dilution and carries the pollutants away from the source. This plume of pollutants will also spread out or disperse in both horizontal and vertical directions from its centreline.

The simplest method available for predicting concentrations is the steady state Gaussian equation, designed for conditions where a continuous stream of pollutant is released into a steady wind in an open atmosphere. In nature, the pollutant plume will rise and bend over, get transported by the wind, and concentrations will decrease away from the source. The plume spread will be influenced by molecular diffusion, turbulent eddies of the average wind flow, thermal gradients, random shifting of winds and mechanical mixing of the air moving over the land. The dispersion of an air pollutant released into the atmosphere depends on the following factors

- Properties of pollutant (stable, unstable)
    73. SO_2, CO and SPM are stable pollutants, as they do not participate in chemical processes in the atmosphere.
    74. NO_x and certain hydrocarbons are unstable pollutants which actively participate in chemical reactions thereby forming secondary pollutants
- Release rate & type (puff, plume)
    75. An accidental release of chemical from a pipeline or hose is an example of puff release (instantaneous)
    76. Emissions from power plants, stream of vehicles are continuous and an example of plume release
- Meteorology (Atmospheric stability)
    77. Atmospheric stability is defined by wind speed and vertical temperature gradient which influence mixing of pollutant
    78. Wind speed influences the horizontal diffusion/dispersion of an air pollutant while wind direction determines the region and receptor of impact.
    79. Temperature gradient affects vertical mixing of pollutants
- Local terrain conditions (hills, valleys, buildings)
    80. The local terrain conditions influence the mechanical mixing of the pollutants.
- Height of release above the ground
    81. Emissions from a DG set may occur at different heights based on stack height, while releases from pipeline occur at ground level. Releases from a lower height will have greater ground level pollutant concentrations than releases from a greater height
- Release geometry (point, line, area source)
    82. Emissions from ships, DG sets, pinhole leakage from pipeline are point sources
    83. Emissions from vehicular traffic during peak hours are line sources

A critical scenario for air pollution predictions is when temperature in the ground levels is higher than the upper layers. This prevents the air pollutants from rising vertically, thus dispersing the pollutants along the ground and exposing receptors to dangerous levels of pollutant concentrations.

Modelling of pollutant dispersion needs to take into consideration, the thermal stratification existing in the atmosphere. Differential heating/cooling of the different layers result in density stratifications, the most critical of which is the 'thermal inversion', which prevent vertical diffusion/dispersion across them (vertically). The inversion occurring close to the ground surface almost each night to pre-dawn periods, caused by the back radiation from heated earth-surface and building structures are termed 'ground-based inversion' and significantly affect pollutant-dispersions resulting in increased ground level concentrations.

The understanding and characterisation of these inversions is absolutely essential to any meaningful modelling of pollutant dispersions. Thermal stratification and consequent mixing heights can be taken into account by using 'stability classes'. IS: 8829-1978 gives the methodology for determination of stability classes.

Air quality issues can be modelled using Guassian models, which provide concentration distribution in vertical and horizontal directions using simple dispersion coefficients. Basic inputs for this model in predicting the concentration are

- Emission rate of pollutant
- Vertical and horizontal dispersion coefficients which are a function of the downwind distance
- Wind velocity in the downwind direction
- Vertical distance above ground
- Lateral distance from the centreline of the plume
- Length of the line source (in case of line source emissions)

Meteorological data needed for pollutant dispersion modelling shall include:

- Average wind direction: to define co-ordinates
- Average wind speed: to provide velocity
- Atmospheric stability: to determine the vertical and horizontal dispersion coefficients
- Ambient temperature: to calculate the effective height of (stack) emission above ground level
- Atmospheric temperature lapse rate: to determine stability classes

Table 6.1 gives the characteristics of pollutants and their source geometry for coastal tourism project activities.

Table 27.1 Air pollution source characteristics

Activity	Geometry of source	Location of source	Pollutant type
Site clearing	Area	Ground level	SPM and RPM

Soil excavation	Area	Ground level	SPM and RPM
Transportation of raw materials	Line	Ground level	NOx, RPM, and SPM
Construction activities	Area	Ground level	SPM and RPM
Vehicular traffic during operation	Line	Ground level	Nox, SPM and RPM
Boat operation	Point	Ground level	NOx, SPM and RPM
DG sets/ Captive Power Plant emissions	Point	Stack height	NOx, HC, CO, SO_2 and SPM

Respirable Particulate Matter – RPM; Suspended Particulate Matter - SPM

30.2 Noise Environment

Sound or noise is a disturbance, which propagates away from the source through an elastic medium, namely air, water or solids and reaches a receiver. The noise level (dB) at the receiver's location is a function of the characteristics of the sound source (power, intensity and frequency spectra), the properties of transmission medium and the presence of objects or barriers.

For simple cases, such as point source, the sound energy is radiated over spherical surfaces away from the source. The presence of objects in the path of sound propagation results in reduction in the sound pressure level. For a source located on the ground, the sound will propagate in a hemispherical pattern.

The prediction of noise should address the type of source, type of environmental conditions at the site and the receptors

Type of noise source

Noise sources may be classified as impulsive or sudden; intermittent-unsteady; continuous-steady noise. Table 6.2 gives the types of noise sources for coastal tourism project activities.

Table 27.2 Noise pollution source characteristics

Activity	Source type
Site clearing	Continuous-Steady
Soil excavation	Continuous-Steady
Transportation of raw materials	Intermittent-unsteady
Construction activities	Continuous – unsteady
Vehicular traffic during operation	Intermittent-unsteady

Activity	Source type
Boat operation	Intermittent-unsteady
DG sets/ Captive Power Plant emissions	Continuous-Steady

Types of environment or attenuating factors

The type of environment determines the degree of noise attenuation, where the greater the attenuation, the lesser the impact on the receptor. Examples of attenuating factors are:

- Atmospheric conditions like humidity, wind direction, wind speed etc; and
- Barriers such as walls, vegetation etc.

Type of receptors

Receptors could be insensitive or sensitive. For example inmates of hospitals or bird sanctuaries, aquatic species etc., are sensitive noise receptors while industrial, commercial areas are relatively insensitive. Limits of acceptable noise levels for each category of receptor or areas/zones are specified in the National Ambient Air Quality Standards in respect of noise (Section 2.1).

30.3 Land Environment

Tourism industry usually involves extensive land and infrastructure development. In this perspective impact on soil, land use and hydrology are the most significant elements that are required to be evaluated.

- ***Soil Erosion***: Site clearing, soil excavation etc., lead to soil erosion. . Erosion rates may change during construction phase of a project when large areas of land may be cleared and left exposed. Methods like Universal Soil Loss Equation (USLE) are useful to make estimations of soil erosion
- ***Soil Permeability:*** Land disposal of wastewater, solidwaste / hazardous wastes, dredged material, oily wastes from boat maintenance etc., may lead to leaching into groundwater. The permeability characteristics are essential to design the lining of the soil for disposal of wastes. Also leaching characteristics of the site needs to be evaluated to assess impact on water resources and recharge areas and soil microorganisms.
- ***Land-use patterns***: Labour force affects the aesthetics due to construction of temporary hutment and disposal of solid wastes. However, assessment of whether the labour force belongs to the local region or needs to be brought in can be made, based on which area management can be planned and implemented.
- ***Hydrology***: Prediction of impact on hydrology can be made by assessing the projects water requirements during the construction and operation phases and determination of permissible

safe yields, i.e, the maximum sustained withdrawal rate from an aquifer. Runoff from the site can also be evaluated using empirical equations and simple models

30.4 Impacts on biology/ecology

The productivity of a coastal area is enhanced by the presence of the mud flats, mangroves, coral reefs, lagoons and other ecologically sensitive species and a function of nature of tides, currents etc. Productivity can be evaluated by estimating the phytoplankton, zooplankton and fish population. The loss of biomass due to piling, dredging, land reclamation, etc can be evaluated by simple mathematical equations. Professional and scientific judgement can be used to estimate the impact of temperature, salinity, DO and suspended solids on ecology.

Tools to assist the expert in the prediction of impacts are:

- **Statistical estimates of bio-diversity such as the Shannon-Weavers Diversity Index or species richness indices from the rarefaction method or Jack-Knife estimates. These statistical estimates should be compared with other values for similar environments only;**
- **Biomass and energy pyramids that are aids to define the food chains and the health of the ecosystem. The baseline structure helps in the assessment of the impact of the abiotic environment on the ecosystem;**
- **Nutrient cycles that can help define potential impacts such as eutrophication, contribution to green house gases.**

Mathematical models have also been developed for ecological energetic or the study of the flow of energy within an ecosystem and ecological modelling for specialised ecosystem. If an EIA consultant uses these methods, a determination must be made to ensure appropriateness to the tropical coastal ecosystem of India.

30.5 Impact on socio-economics / socio culture

Construction activities provide temporary employment opportunities for skilled and unskilled labour. Some of the social impacts that need to be assessed are:

Socio-economics

- Additional employment opportunities to the locals and the improved infrastructure;

- Additional population increase (service sector) due to the project and data on tourist influx during peak season;
- Resettlement issues due to the displacement of indigenous population;
- Restriction on fishing due to constrained access to private beaches;
- Loss of rural areas and agricultural lands and exodus of indigenous population from agricultural profession into service sector;
- Increased cost of living for the locals due to competition from the tourist influx;
- High energy costs due to requirement of increased power supply demands

Socio-cultural

Qualitative assessment from professional experience needs to be made for the effects of:

- Change in lifestyle for local ethnic population with market economics.
- Possible increase in alcohol, drug abuse, prostitution, allied to major health risks

30.6 Summary of prediction

Predictions consist of estimating the impacts of the proposed project and overlaying the baseline on it, from which impacts of the project can be evaluated. Comparison with national standards for air, noise and water quality can be made from these estimates. Significance of impacts needs to be assessed with proposed environmental management plans and/or with best housekeeping practises.

However this summary must be compared with other sites where similar summaries were generated. The other method is to compare the impact magnitude against known standards. The drawback with this is that standards are not available for all cases. Given these constraints, the EIA consultant can choose to provide a matrix of adverse impacts and state their significance. Impacts need to be summarised in an EIA study to determine whether they are significant, manageable or insignificant.

31.0Significance of impacts

One method to determine impact significance is by consideration of the impact characteristic (Section 4.1.1) and the importance (weightage) attached to them.

Significance $= f\,\{\text{Impact characteristic, importance}\}$

The predicted impacts need to superimposed on the existing background concentrations and compared with standards. There may however be no appropriate technical standard for a social or a visual impact and resources that require sustainability. Significance in such cases must be derived from community preferences and can be discovered through public involvement or other special methods. (E.g. Delphi techniques).

The key basis for assessing impact significance are: level of public concern over health and safety, scientific and professional judgement, disturbance/destruction of valued ecological systems and degree of negative impact on social values and quality of life.

Significance can be determined based on ecological importance, social importance and environmental standards.

32.0Example of Summary of Prediction

Issues considered for prediction[1]	*Results of Prediction*	*Impact Significance*
	Air quality Impacts	
Vehicular emissions during transportation of raw materials for 137 numbers/ day of additional vehicles	The increase in the concentration of NOx, CO and HC at a distance of 500m is negligible and the overall concentrations conform to NAAQS	Low
	Noise quality Impacts	
Piling operations	Noise levels are reduced to background levels within 50m from the source and conform to NAAQS. No noise sensitive receptors within 500m	Low
	Water quality Impacts	
Release of bilge, oily wastes and wastewaters from cruise liners	The baseline levels near the pier show signals of WQ standard violations.	The discharge needs to be monitored and regulated
	Land / Biology / benthic Ecology	
Ecological impacts of dredge dump disposal on land	Non toxic sediments shall not impact groundwater quality at the dump location No flora/ fauna at the dump location No benthos as dumping is not carried out in intertidal areas	Low
	Socio Economics	
Employment	Temporary employment during construction phase and employment for unskilled jobs during operations phase	Positive impact
Net Significance		**Low and requires regular monitoring**

Environmental Management

33.0 INTRODUCTION

Poor tourism management can damage natural resources, which in turn shall adversely affect the tourism industry. In order to achieve sustainable tourism and economic growth, it is essential that strategic plans be developed at the planning level and environmental controls are implemented at the tourism site.

Broad areas, which need to be covered at the planning level, are:

- Standards for tourism resort ambience (density, building height, landscaping etc.) governed by the CRZ Notification, 1991 by the MoEF Annexure–II (Table 2.1);
- Site selection and site and building design including water and wastewater management systems, drainage etc;
- Management of construction activities; and
- Evaluation of supporting infrastructure such as transportation and road networks, waste collection and disposal etc. (State coastal development & management plans – e.g. CZMP)
- Carrying capacity studies before designating an area for tourism development.

Site-specific areas of environmental control are:

- Limiting the number of tourists or promoting off-season tourism, i.e., capacity management.
- Promotion of public transport or shuttle services during peak seasons to minimise large number of private vehicles and consequent congestion.
- Improvement of infrastructure like water, wastewater, solid waste and other such services to handle peak tourist requirements.
- Restriction on amount of water pumped from aquifers, installation of water recycling and rainwater harvesting systems.
- Designation of “no anchoring” areas in coral, sea grass beds, or other fragile habitats.
- Educating the tourists and tourist industries about environmentally sound practices.

33.1 Best Management Practice

Pollution prevention and control is required to mitigate or eliminate the impacts of tourism, since pollution prevention is more cost effective than repairing damage caused by uncontrolled tourism. Mitigation/planning measures shall be followed for minimising environmental impacts for each category of the tourism project during construction and operational stages of the project. Additionally, attitudes promoted and information shared with guests, help reduce impacts on the natural system.

Requirements for best management practice (BMP) at the planning level shall cover:

- Site and building design
- Construction / operations phase mitigation measures

Area of operations for which BMP have to be identified include:

- Facilities maintenance
- Recreation
- Waste management
- Water and energy usage
- Public/social interaction

34.0Site and building design

The objective of site management is to maintain the attributes of the site by managing the impacts through design improvements as suggested below.

- Integration of site and building designs with the environmental setting of the location.
- Provision of beach access to locals shall be planned.
- Construction on slopes shall be avoided in order to minimise/prevent erosion; Buildings shall be sufficiently away from the beach.
- Direct discharge into water bodies from drains, roadways and parking lots etc. shall be avoided. Roads shall be designed so as to reduce runoff from the site.
- Design and materials that improve conservation of energy shall be used
- Water conservation designs and strategies shall be followed. Use of permeable surfaces wherever possible shall be made. Rainwater harvesting measures shall be implemented.

35.0 Construction & operation phase mitigation measures

The impacts of the various activities of the project and the specific measures that need to be implemented during construction and operation phases of the project are suggested in tables 7.1 to 7.5

Table 33.1 Transportation of raw materials

Potential Impacts	Mitigation	Implemented by	Timing
Generation of Noise	• **Periodic maintenance of vehicles shall be ensured**	Contractor	Construction
Generation of dust	• **Materials shall be covered with tarpaulin sheets during transport**	Contractor	Construction
Vehicular emissions	• **There shall be periodic emission check for vehicles**	Contractor	Construction

Table 33.2 Construction activities / fabrication and welding

Potential Impacts	Mitigation	Implemented by	Timing
Generation of Noise	• **Ear protection devices and helmets shall be provided for workers**	Contractor	Construction
Generation of dust	• **Concrete mixing plants shall be located atleast 500m away from dwellings/offices** • **Masks shall be provided for workers** • **Waste materials shall not be burnt**	Contractor	Construction
Equipment emissions	• **Equipment/ machinery shall be periodically checked for emission levels** • **Regular maintenance of equipment shall be done**	Contractor	Construction
Exploitation of water resources	• **Water shall be obtained only from approved locations**	Contractor	Construction
Increased turbid runoff	• **Stockpile of materials shall be located atleast 100m away from waterfront** • **Sediment runoff shall be intercepted by hay bales or detention trenches**	Contractor	Construction

Table 33.3 Labour Force

Potential Impacts	Mitigation	Implemented by	Timing

Generation of wastewater	• **Proper sanitary facilities shall be provided** • **Septic tanks/soak pits shall be provided for collection of toilet wastes** • **Ensure treatment of domestic sewage and treated effluent shall comply with standards**	Contractor	Construction / Operation
Exploitation of water resources	• **Water shall be obtained only from approved sources**	Contractor	Construction
Generation of solid waste	• **Solid wastes shall be collected in dustbins and dispose it in approved land fill sites and organic solidwastes can be composted.**	Contractor	Construction

Table 33.4 Marina development/Capital / Maintenance Dredging

Potential Impacts	Mitigation	Implemented by	Timing
Turbidity/ water quality deterioration	• **Confined method of dredging with turbidity reduction measures such as hopper dredging, or silt fences** • **Disposal shall be done in designated areas**	Contractor	Constructio n
Coastal erosion	• **Limited number of boats shall be used to limit wakes** • **Coastal vegetation shall be preserved/rehabilitated/regenerated**	Contractor	Constructio n
Generation of noise	• **Workers shall be provided with ear plugs**	Contractor	Constructio n
Emissions from dredging equipment	• **Emission check on equipment shall be done before every operation**	Contractor	Constructio n
Accumulation of anti-fouling agents shall harm shellfish and other marine life	• **Anti-fouling paints shall not be used** • **Boat maintenance shall be restricted to approved areas**	Proponent	Constructio n

Table 33.5 Boat operations/Cruise ships

Potential Impacts	Mitigation	Implemented by	Timing
Water quality impacts from discharge of oil and oil sludge, domestic refuse (raw sewage, plastics), engine room waste, wastewater, bilge water etc.	• **All liquids containing oil shall pass into the sea only via oil separation systems** • **Sludge shall not be discharged. The sludge and the separated oil residues are either to be incinerated on board in special furnaces or discharged to oil collection facilities** • **Adequate facilities for discharging oily residues shall be provided and effective supervision and monitoring of adherence to the regulations shall be done** • **Different types of refuse shall be collected in separate containers and temporarily stored till they are disposed to appropriate facilities on shore**	Proponent	Operation
Exhaust emissions	• **Exhausts shall be frequently cleaned** • **Use of fuel of approved quality** • **Correct adjustment and maintenance of engines and boilers shall be ensured**	Proponent	Operation
Destructin of coral, sea grass beds due to dropping of anchors.	• **Designation of "no anchoring" areas in fragile habitat areas, placement of stable mooring buoys in reef/lagoon areas** • **Distribution of maps of the area for identification of fragile areas.**	Proponent	Operation
Shoreline erosion from boat wakes and sediment disturbance from large boats	• **Control on boat speeds in narrow stretches** • **Designated areas for anchoring of large boats**	Proponent	Operation

36.0Facilities maintenance

Implementation of effective management systems can occur along every point in the supply chain comprising the sectors providing accommodation, transportation, travel agents, supplies and the tourists themselves. For example, hotels can exert influence on suppliers to provide products that minimize environmental impacts. Similarly travel agents can influence tourists through education and provision of options to reduce resource use. The following sections describe some specific measures for effective management.

Waste Management

Collection, treatment and removal of wastewater and solidwaste shall either be the responsibility of the tourism project proponent or shall be integrated in the local waste disposal plan. However, if the local Panchayat/municipalities are not equipped to handle such wastes, it is the responsibility of the project proponent to provide sewage treatment and solidwaste disposal facilities.

Issues to be considered while planning solidwaste handling can be:

- Segregation of different kinds of solidwastes
- Type of disposal (incineration, composting, landfill etc.)

Implementation of environmentally acceptable purchase policies, effective staff training, environmental management etc. is necessary for reducing the amount of wastes, recycling and treating, the responsibility of which lies with the project proponent. Some possible measures to reduce the amount of solidwaste are:

- Purchase of liquids in bulk, eliminating the supply of canned drinks, disposable bottles or packaged foodstuffs, plastic plates, cups, containers etc., use of linen / hand towels instead of paper napkins
- Recycling of organic wastes by composting
- Education of staff / tourists in environmental awareness

Management of effluents include:

- Designing the wastewater system to permit separation of grey water from sewage, which can be used in irrigation, green belt development and flush toilets.
- Eliminating the use of detergent containing phosphates.

Water conservation:

- Regular checks of plumbing fixtures to reduce leaks shall be carried out
- Low flow showerheads, low flush toilets etc., shall be used
- Recycling of water (laundry water and grey water for flushing toilets, watering lawns etc.) shall be practised
- Groundwater recharge measures such as rainwater harvesting, leaving parking lots unpaved etc. shall be adopted

Energy conservation

- Wherever possible, solar energy shall be utilised for water heating and exterior lighting.
- Routine maintenance of electrical appliances (refrigerators, air conditioners etc) shall be carried out
- Fluorescent lighting shall be used instead of incandescent bulbs
- Wherever possible, public areas shall be designed to be open spaces

Recreation facilities management

- Heavily used beaches shall have night cleanup for garbage.

- Jet skis or other motorised equipment shall not be operated in swimming areas
- Piers and moorings shall be placed with minimal or no obstruction to the coastal hydrodynamics
- Dune vegetation and seagrass shall not be removed from the beach
- Boat maintenance shall be done away from the seashore

36.1 Monitoring and EMP implementation

Monitoring is a tool to identify environmental damage and propose changes when a project is not meeting the environmental standards. Audits can be used to identify significant wastage of water and energy at sites with poor environmental practice Regular data collection can identify environmental deterioration and/or improvement.

Implementation of EMP can be done effectively by defining responsibilities for which the following points shall be taken into consideration

- A management representative for e.g., an Environmental Management Cell (EMC) head shall be made responsible for implementing and maintaining the Environmental Management System (EMS) who shall have clearly defined roles, responsibilities and authorities.
- An organization structure may be developed for implementing the EMP with responsibilities and authorities assigned.
- Job functions that could have an impact on the environment can be identified and job descriptions written for each of them
- Operating procedures may be prepared to define specific responsibilities and critical functions of each position in a single paragraph or a small series of bulleted points
- Training can be provided such that each person/operator understands his/her responsibilities and the extent of his/her authority, as well as general roles of others.

It must be recognised that it is not be feasible to employ personnel exclusively for EMP implementation and/or monitoring, or the EMC head cannot be solely responsible for all issues pertaining to environmental management. Environmental responsibilities shall form an integral part of each personnel's job. For this approach to be successful, employees have to understand exactly how their jobs impact the environment. While the EMC head is responsible for overall environmental management and quality, key personnel in the implementation of the Environmental Management Plans (EMP) are:

84. Managers, engineers' in-charge of various development activities (site engineer, estate managers, safety officers etc.);
85. Contractors, machinery / equipment operators or marina, boat operators etc;
86. Operators who maintain and test various sporting equipments and boats;

87. Maintenance staff.

For example, the estate manager could do routine monitoring of sporting equipment / boats using his judgement. The responsibility of advising the operator in maintaining the equipment should form an integral part of the estate manager's job. Only in the event of non-compliance or due to reasons beyond the estate manager's control will he report to the EMC/management to initiate appropriate action

For effective implementation of the EMP, it is the management's direct responsibility to understand what resources are necessary for routine operations and special operations and to ensure that they are made available.

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A n n e x u r e A

SAMPLE EIA

&

BASELINE STUDY DESIGN

Sample EIA

The extent of baseline study requirement is a function of the project activities. A small-scale tourist facility may consist of a resort; a restaurant etc and use the existing infrastructure at the site. A large-scale facility may consist of resorts, cottages, swimming pools, multi-cuisine restaurants, amusement parks etc, which may require additional infrastructure such as DG sets for power generation, desalination plant for water supply etc.

A small-scale development requires only a limited amount of pre-project environmental assessment. While most of the data required for the analysis can be obtained as secondary information from the municipalities, town panchayats, town-planning authorities etc., a few parameters may be required to be analysed on-site depending on the project and environmental setting. The baseline study requirement is determined from the scoping process.

A sample EIA study for a small scale and a large-scale facility is described in the following sections to give a brief insight into the process.

SAMPLE EIA FOR LARGE SCALE BEACH RESORT

Table A-1 Baseline Study Design

Proposed facility	Project setting	Environmental setting	Resource requirement / waste generation	Pa
40 double bedroom, 8 single bedroom, Swimming pool, Parking facility, Landscaping, Internal access roads, Multi-cuisine restaurant, 20 single bedroom staff quarters for employees	Existing infrastructure such as roads, water supply, wastewater and solidwaste collection system etc.	Terrain, coastal features, vegetation, sand dunes, drainage pattern, slopes, land use, land cover etc. Sources of water supply / quality. Solidwaste disposal sites in the locality	200 cum of water / day 3500 kW / day 200 cum of wastewater 20 tons of solidwaste	Quantity/ qu TDS, Chlori magnesium Soil type, pe Specific faur Visual inspe secondary d municipality authority
DG sets	Two numbers (one standby) of capacities 750 KVA; Available power from SEB_________	Sources of air pollution and noise generation. Present air quality & noise level status (comparison with NAAQS)	Peak diesel consumption 160litres/ hour	Air Quality Noise sensit Temperatur direction, m
Desalination plant	Intake and discharge locations. Process and Instrumentation details.	Presence of ecologically sensitive mangroves, corals, seagrass etc.	Capacity of desalination unit 300 cum/ day Details of additional facilities like settling tanks etc. Quantity of brine generated 200cum/ day.	Current spe tides Depth conto Marine wate suspended s chlorides, Biological cl zooplankton Sediment qu
Wastewater treatment facility	Process and Instrumentation details. Additional facilities like settling tanks, clarifiers, sludge drying beds exist.	Location of potable water sources in the vicinity Quality of treated effluent	Capacity of treatment unit 200cum/ day	Water quali the plant's v TDS, Chlori fecal colifor
Amusement parks	Existing infrastructure such as roads, water supply, wastewater and solidwaste collection system etc.	Terrain, coastal features, vegetation, sand dunes, drainage pattern, slopes, land use, land cover etc. Sources of water supply/ quality.	10 cum of water / day 50 kW / day	Noise sensit Landuse pa Air Quality

Proposed facility	Project setting	Environmental setting	Resource requirement / waste generation	P
			5 cum of wastewater 2 tons of solidwaste	
Marina development	Existing infrastructure such as landing piers, jetties.	Coastal features, sand dunes	10 cum of water / day 10 kW / day 5 cum of wastewater 2 tons of solidwaste	Quantity/ q nutrients, fa Aesthetics, s Air Quality Noise sensit

Summary of baseline

Baseline investigations on water quality, noise levels, ecology and socio-economic revealed the following:

- Ground water does not indicate any pollution
- Marine water quality meets the appropriate standards and does not indicate any pollution stress
- Air quality and noise levels conform to NAAQS
- There is dense vegetation in the project location. Rare or endemic species of fauna are not reported. There are some stunted mangroves located 5 Km south off the proposed site
- There are no sand dunes
- Traditional occupation of the locals are fishing and agriculture. Literacy levels are low and infrastructure is poor

Summary of prediction

- Construction phase impacts on air quality shall be negligible and limited to the project vicinity
- Local labour shall be used for construction so that there shall be no water demand or sanitation problems.
- Pier construction for marina development shall be done on piles and therefore there shall be no change to hydrodynamics. Boat repairs shall be carried out in designated areas and the aesthetics shall be maintained
- Water is obtained from municipal water supply. There shall be no groundwater withdrawal and therefore groundwater will not be affected. Additional water requirements shall be met from desalination plant. Modeling of the dishcarge of brine water indicates that the concentrations of brine shall return to background levels within 500 m of the discharge location.
- Feedwater for desalination plants shall be obtained from infiltration well to eliminate chemical pretreatment
- Desalination shall use Reverse Osmosis process which is considered to be energy efficient. Sludge, coagulants etc., from desalination plant shall not be disposed in coastal waters but transferred to a landfill site identified
- Wastewater treatment facility shall be designed for handling peak discharges. There shall be routine maintenance of the treatment facilities. Treated water shall be used for green belt development..
- Air quality modeling for DG set operation was carried out using Guassian dispersion models. The air quality issues associated with the facility operation would be negligible and within standards during wind speeds of 4m/s.. However, DG sets shall not be operated during periods of inversion or when wind speeds drop below 2m/s..
- The additional number of vehicles due to the facility shall be about 50 cars and 5-10 heavy vehicles/day. This will have a limited impact on the local traffic system and create congestion during peak seasons. Modeling of air quality and noise levels using Guassian models indicate that the pollution associated with the additional numbers of vehicles shall be incremental over the existing levels and conform to NAAQS
- There is no dredging or dumping. Also the discharge from desalination plant reaches background levels within 500m and therefore there shall not be any impact on stunted mangroves located 5 Km away.
- Solidwaste shall be segregated. Organic wastes shall be composted and others shall be incinerated.

Environmental Management Practice

- Twice the number of vegetative cover removed shall be planted before the commencement of construction
- Parking lots shall not be paved. Rainwater harvesting shall be done from rooftops and gently graded open areas.
- Liquids shall be procured in bulk. Canned items shall not be procured
- Plastic disposable cups / bottles shall not be used
- Locals shall be employed for jobs like gardening, cleaning etc.

Conclusions

- The project generates negligible pollution during construction phase from transportation of raw materials
- There shall be temporary employment for the locals during construction phase
- The facility requires an efficient environmental management system for regular monitoring of the wastewater treatment plant and DG set operation and shall cause an incremental impact on the existing environment which is within acceptable limits.

Table A-2 Baseline Study Design

Proposed facility	Project setting	Environmental setting	Resource requirement / waste generation	Pa
20 double bedroom resort, Swimming pool, Parking facility, Landscaping, Multi-cuisine restaurant	Existing infrastructure such as roads, water supply, wastewater and solidwaste collection system etc.	Terrain, coastal features, vegetation, sand dunes, drainage pattern, slopes, land use, land cover etc. Sources of water supply / quality, Solidwaste disposal sites in the locality	50 cum of water / day 500 kW / day 30 cum of wastewater 4 tons of solidwaste	Quantity/ qu TDS, Chlori magnesium Specific fau Visual inspe secondary d municipality authority
Wastewater treatment facility	Process and Instrumentation details	Location of potable water sources in the vicinity Quality of treated effluent	Septic tank capacity 500 cum	Water quali the plant's v TDS, Chlori fecal colifor
Beach access	Umbrellas, lifeguard, refreshment kiosks.	Terrain, coastal features, vegetation, sand dunes	2 cum of water / day 5 kW / day 0.5 cum of wastewater 500 kg of solidwaste	Noise sensit Sand dunes

Summary of baseline

Baseline investigations on water quality, noise levels, ecology and socio-economic revealed the following:

- Ground water does not indicate any pollution
- Noise levels conform to NAAQS
- There is dense vegetation in the project location, but rare or endemic species.of flora or fauna are not reported
- There are no sand dunes
- Traditional occupation of the locals are fishing and agriculture. Literacy levels are low and infrastructure is poor

Summary of prediction

- Contruction phase impacts on air quality shall be negligible and limited to the project vicinity
- Local labour shall be used for construction so that there shall be no water demand or sanitation problems
- Water is obtained from municipal water supply. There shall be no groundwater withdrawal and therefore groundwater will not be affected.
- Wastewater from bathrooms and kitchen shall be collected separately and used for gardening purposes and grit removal. Decanted water from septic tank shall be used for green belt development after disinfection.
- There are no air quality problems associated with the facility operation. No air pollution from DG sets or other sources in the vicinity. The additional number of vehicles due to the facility shall be about 20 cars and 2-3 heavy vehicles/day, which shall have negligible impacts on air and noise quality
- Solidwaste shall be segregated. Organic wastes shall be composted and others shall be incinerated.

Environmental Management Practice

- Twice the number of vegetative cover removed shall be planted before the commencement of construction
- Parking lots shall not be paved. Rainwater harvesting shall be done from rooftops and gently graded open areas.
- Liquids shall be procured in bulk. Canned items shall not be procured
- Plastic disposable cups / bottles shall not be used
- Locals shall be employed for jobs like gardening, cleaning etc. Staff shall be provided accommodation in the nearby villages.

Conclusions

- The project generates negligible pollution during construction phase from transportation of raw materials
- There shall be temporary employment for the locals during construction phase
- The proposed facility shall not have any significant impact on the environment

Guidelines for

Environmental Impact Assessment

of

Coastal Tourism Projects

for

The Department of Ocean Development

Under the

Integrated Coastal and Marine Area Management Program

Prepared by

National Institute of Ocean Technology
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Introduction

37.0 COASTAL TOURISM IN INDIA

The Indian Peninsula, including the two emerald archipelagos of Lakshadweep and Andaman, bounded by the Arabian Sea, the Bay of Bengal and the Indian Ocean has a long coastline of over 7500 km, with spectacular golden beaches, pristine natural beauty, lush green tropical forests, and unique fauna and flora. This provides immense scope for development of coastal tourism, basically marketing the "sand, sea and sun" (3S) phenomenon.

There is also high population density in the coastal belt of India with most of the major cities and metros situated on the coast. The coastal cities are well connected domestically and internationally through highways, railways, harbours and airports. This infrastructure provides access to domestic and international travellers, laying the foundation for increased coastal tourism.

The tourism sector is one of the fastest growing sectors in the country's economy. Although tourism activity consists of both domestic and international tourism, tourism development strategy places primary emphasis upon international tourists, as international tourism provides foreign exchange earnings to the destination country while domestic tourism leads largely to a redistribution of national income.

37.1 Typical Coastal Tourism Industry

The origin, transit and destination regions constitute the basic tourism system. Components of this system have complex inter-relationship between and among several sectors (transportation, commerce, water supply etc.), service providers (travel agents, tour operators, hotels, merchandisers) and stakeholders (tourists, local population). The distribution of each of these categories of the tourism sector varies from origin to transit to destination as shown in Fig. 1.1.

While the primary attraction of the coastal tourism industry is the pristine natural environment, present-day coastal tourism includes large-scale constructed facilities such as theme/amusement parks, resorts, marinas, fishing piers and recreational boating harbours. Typical attributes of tourism sites are provided in the following sections.

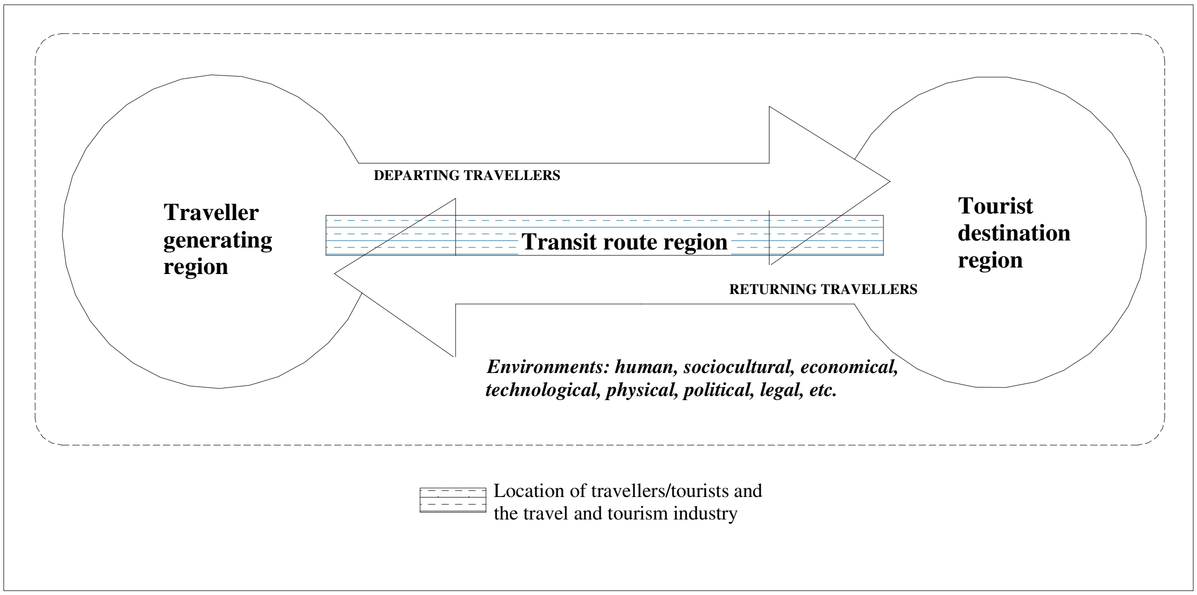
38.0Tourist Attractions

Tourist attractions can be based on:

- Natural sites (beaches, coral reefs, mangrove forests, lakes, rivers, waterfalls etc);

- Natural events (tides, bird migrations etc.);
- Cultural / heritage sites (historical monuments, ancient temples, ethnic neighbourhood etc);
- Cultural events (festivals, fairs); and
- Constructed sites/Recreational events (resorts, theme/amusement parks, golf courses, ski hills, stadium, sports etc.).

A clean environment is the primary resource for the tourism industry, without which the tourism site will lose its value.



[Source: Fig. 2.1 A basic whole tourism system (Source:Leiper 1995) -'Tourism Management' by David Weaver & Martin Oppermann)]

Fig. 37.1 TOURISM SECTOR COMPONENTS

39.0 Accessibility

Accessibility can be classified as spatial and seasonal. Spatial accessibility to tourist destination is a key criterion for siting of a tourist facility. Accessibility can be provided by construction of roads, airstrips, piers, landing jetties etc.

40.0 Infrastructure

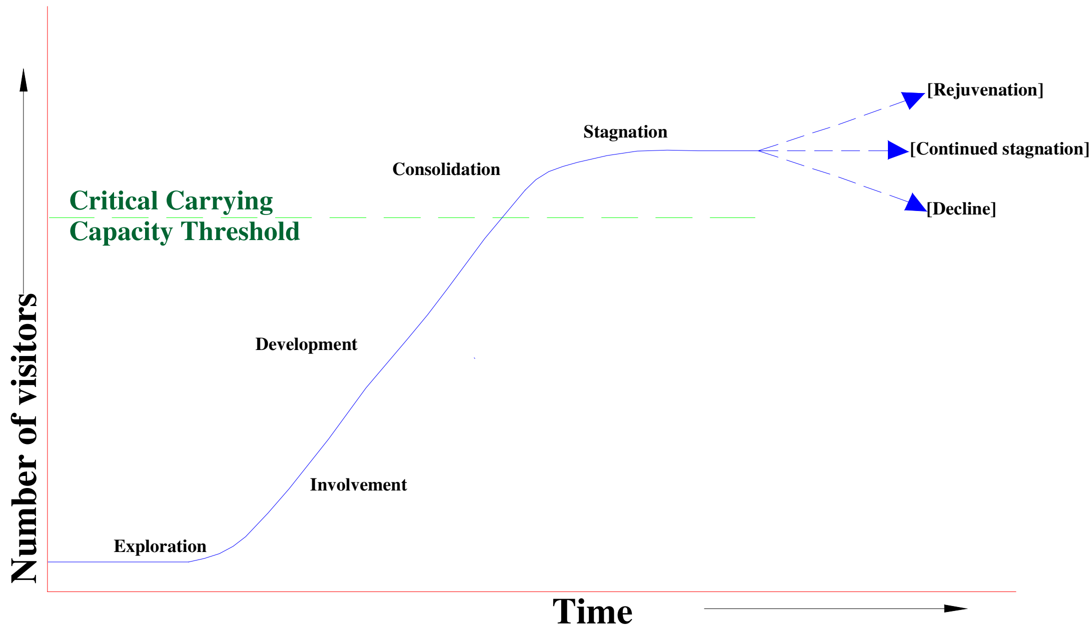
Land is the primary requirement for tourism industry while other infrastructure requirements include transportation, water and sanitation, power, accommodation, food and beverages.

40.1 Tourism industry life-cycle

Tourist spots along coasts develop and gain popularity within a very short period of time, resulting in concentrated activity in a complex, spatially constrained and vulnerable environment. *Each destination can sustain a specific level of acceptance of tourist development and use, beyond which further development can result in environmental and social deterioration or a decline in the quality of the experience gained by visitors. In other words, the carrying capacity of a destination is determined (i) by its ability to absorb tourist development before negative impacts are felt by the host community; and (ii) by the level of tourist development beyond which tourist flows will decline because the destination area ceases to satisfy and attract them. [Alexis Saveriades – Tourism Management 21 (2000) 147-156]*

One of the most discussed models for destination development is the Butler's life cycle model as a device to assist tourism project proponents as well as decision-makers to assess the various phases of the industry's life cycle in conjunction with carrying capacity threshold. Fig. 1.2 illustrates the life cycle of tourism development in a high demand location on the environment.

- ***Exploratio****n* is the initial stage, characterised by very few tourists with little or no adverse impact
- ***Involvemen****t* is the stage, where the local community responds to opportunities created by tourism by offering specialised services, associated with a gradual increase in tourists.
- ***Development*** is the stage when growth is accelerated within a relatively short period of time.
- ***Consolidation*** phase is the stage when tourism totally dominates the destination and local carrying capacities are exceeded with decrease in growth rate.
- ***Stagnation*** is the stage where the tourism industry stagnates due to deterioration of the destination.
- ***Declination*** is the likely scenario if appropriate measures are not taken to restore the destination or reduce the stress on the environment.
- ***Rejuvenation*** is possible if appropriate measures are taken to restore the destination or increase the carrying capacity, resulting in renewed development.



[Source: Fig. 10.1 Butler sequence -'Tourism Management' by David Weaver & Martin Oppermann]

Fig. 37.2 TOURISM INDUSTRY LIFE CYCLE

40.2 Techno-economic feasibility study for tourism development

Techno-economic feasibility study helps identify tourism investment options before committing time and money, by evaluating alternative proposals (which may be alternative projects or alternative processes for a single project). It is imperative that promoters plan tourism development in consultation with local or regional authorities, in order to ensure compatibility with regional plans, environment and ecology.

The end product of a complete feasibility study shall be a sustainable tourism product with a clearly identified market and form. Unlike other industries, tourism industry's main resource is the natural environment. In a popular tourist site, there could be a spurt of several tourism projects (Fig. 1.2), using the same resource, i.e., the environment. In the absence of self-regulatory mechanisms by tourism promoters, quality of the natural environment shall continuously deteriorate. This deterioration of environmental quality beyond the carrying capacity threshold could lead to collapse of the tourism market or impact the profile of tourists visiting a location, thereby altering the economics of a project. Promoters should bear in mind that environmental protection is cheaper than environmental rehabilitation for sustainability of the tourism market.

For long-term sustainability of tourism industry, it is critical to consider environmentally sound designs and approaches right at the techno-economic feasibility stage. A number of alternatives shall be considered at the planning stage, including the "no project" alternative and each of them shall be subject to a qualitative environmental review, so as to identify the environmentally preferable alternative, which addresses the sustainability of the industry.

Key data (Table 1.1) required for the proposed development are collected during the techno-economic feasibility stage. The data in most cases can be obtained from local planning agencies, revenue departments' research and educational institutions etc. It must be recognised that the techno-economic feasibility and the environmental impact assessment have common goals and thus common data requirements.

Since tourism activities are site-specific, the general tendency is to confine the study to the site/premises, where environmental management can be attained through proper housekeeping practices. However, incremental loads on existing traffic network, water supply, sewer system etc. from project needs, extend impacts over the region, necessitating integrated planning of the tourism project within a regional development perspective.

Table 37.1 Data required for feasibility study

Economic	Technical	Environmental
14. Market potential 15. Growth potential and likely returns 16. Existing competition 17. Proposed type of products and services 18. Costs of economic, social, political and environmental risks, 19. Costs of environmental management and compliance requirements 20. Time delays and corresponding costs in obtaining approvals, finance and construction	21. Accessibility, public roads 22. Site suitability for construction (such as in sand dunes) 23. Slope, soil type, drainage patterns, water table 24. Availability of infrastructure (sewerage, water and power supply) 25. Risks from natural hazards (inundation and unstable cliffs, slopes etc.) 26. Seasons, climate, precipitation etc. 27. Topography, coastal features 28. Hydrodynamic information (data on waves, tides, currents etc.) 29. Aesthetics and landscape	30. Standard of living of the community at the site 31. Ecological sensitivity of the site such as location of coral reefs, mangroves, endangered species etc. 32. Existence of indigenous tribes etc. 33. Baseline environmental quality

41.0Summary of feasibility studies

The feasibility stage is like a preliminary assessment to identify technical, environmental, social and economic issues pertinent to the proposed development that might influence its siting, design, construction and management to make the project economically workable and environmentally appropriate.

The feasibility studies shall address queries like

What is the planned recuperation period of the invested capital?

A short period of recuperation means that there may be little or no incentive to manage the industry and the environment in the long term.

What is the extent of short-term and long-term environmental effects including secondary effects of tourism development?

Some impacts may be short-term and easily mitigable, while long-term impacts could be permanent. Tourism development may stimulate significant secondary environmental impacts. For example, tourism development may promote large-scale tourism and in turn put pressure on the existing transportation network, landuse, water and power resources etc., i.e., carrying capacity of the region. (Fig. 1.2)

What is the extent of cumulative effects of the proposal?

During the feasibility study it is necessary to focus on combined effects of a series of activities occurring over a longer period of time, compared to the project specific action. Some impacts may not be significant when considered at project specific level, but may assume significance when considering the cumulative effect of a series of activities.

What is the degree to which the current project proposal may establish precedent for future proposals or shut out future proposals?

Project proposals may form a precedent to other future developments or may represent a decision in shutting out future proposals due to its environmental significance, thus focussing on viability of tourism development in the region.

41.1 Coastal Tourism industry impacts

Tourism projects may result in resource consumption, socio-cultural conflicts, increased pollution and waste generation thus, putting a stress on the existing infrastructure such as roads, effluent treatment works, power and water supply which may not have been designed to handle the increased requirements of the tourism industry. Major impacts may be loss of biodiversity, increased carbon-dioxide emissions due to energy use in tourism related transportation and air-conditioning and heating of tourism facilities

Examples of beneficial and adverse impacts of coastal tourism are listed below:

Beneficial Impacts

88. Improved facilities like ports, roads and infrastructure, communication, recreational facilities
89. Increased revenues, employment opportunities, patronage for arts and crafts

90. Preservation of historic and archaeological sites

Adverse Impacts

91. Overcrowding of public transportation system and road network.
92. Over-exploitation of water resources/groundwater
93. Physical degradation of the coasts due to pressure on beaches (e.g. beach or coastal erosion; disappearance of beaches due to encroachment of structures).
94. Exploitation of precious natural resources for craft items
95. Impact on ecologically sensitive and endangered species
96. Removal of sea grass for swimming beaches
97. Use of sea/wetlands for treated and untreated wastewater disposal resulting in environmental pollution
98. Visual impairment and decreased aesthetics due to disposal of solid wastes and possible haphazard development at the tourist spot.
99. Air and noise pollution from DG sets etc
100. Blocking of visual and public access to the coast
101. Socio-cultural and lifestyle conflicts with the locals
102. Socio-economic impacts like high land costs, loss of agricultural productivity etc.

41.2 Need for an EIA

Planned and cautious tourism development can prevent costly mistakes so that tourism is sustainable and the environmental quality is within its carrying capacity. Environmental Impact Assessment (EIA) identifies potential impacts and proposes actions to avoid, reduce or mitigate them. The functions of an EIA is to

- Identify pre-project environmental status and project activities that may affect the environment,
- Estimate the impacts of the proposed development,
- Evaluate the consequences of impacts on human life and environment,
- Assess the need for alternative actions and remedial measures.

A thorough EIA shall provide decision makers and the general public with sufficient information to determine whether:

- a tourism project could be initiated in its proposed format, balancing environmental considerations with the social and economic benefits of the project; or
- certain restrictions, design considerations or process alternatives could reduce/mitigate environmental impacts without seriously affecting tourism benefits.

It is appropriate that EIAs be carried out early in the project cycle, i.e., conceptual or master plan stage allowing significant impacts to be filtered out of the projects. This process helps planning mitigation measures whilst avoiding adverse impacts.

41.3 Type of Coastal Tourism EIA

Depending on the type of the project, the coastal tourism EIA can be classified as one of the following.

5. Project-specific when an individual beach resort/amusement park etc is developed
6. Sectoral, when a carrying capacity type of study is undertaken when a State Government or State/Union Territory Tourism Department aims to provide approval for a large scale tourism development.
7. Regional, when the development of coastal tourism projects form a part of plans for regional development. For example developing a region with landing jetty, air-field, roads, hotels, industries and also tourism projects.

Project-specific EIAs often miss impacts that occur off the development site and the cumulative impacts of other projects at the same destination. Typically, a project-specific EIA for coastal tourism project shall address the following issues, depending on the scale of development

4. **Local environmental impacts at the project site due to**

103. resource (energy and water) use
104. waste generation (liquid effluent and solidwaste)
105. increased air and noise pollution
106. alteration of the habitat/ecosystem
107. alteration of beach and shoreline
108. alteration of landscape and aesthetics
109. socio-economic and socio-cultural changes

5. **Regional impacts of the project due to**

110. Resource (energy and water) use
111. Traffic congestion due to additional vehicles
112. Stress on existing waste treatment plants
113. Conflicting landuse patterns

6. **Existing conditions at the tourist site such as**

114. Type and number of tourism projects at the tourist site

115. Future development proposals

116. Traffic volume and traffic network

117. Source of water and power and utilisation pattern

118. Waste treatment and disposal facilities

119. Air and noise pollution sources

Tourism planning shall not be carried out in isolation as the industry revolves around issues such as landuse, protected area, and infrastructure and transportation network of the tourism region. Therefore it is imperative that a comprehensive form of assessment occurs while planning tourism destinations so that all the attributes and their sensitivities in a region/destination can be identified and weighed appropriately.

Sectoral and regional EIAs shall involve the inventory of all assets of an area/region and assessment of each asset's sensitivity to different levels or types of development. An evaluation of the limits to acceptable change in each environmental attribute based on the fragility of the environment shall be based on estimates, which essentially gives a measure of "how much can be changed" whilst still utilisation of resources is within the carrying capacity.

41.4 Components of EIA

The EIA for a coastal tourism project shall consist of the following components

- Need for the project at the location.
- Analysis of location (siting), activity and process alternatives.
- Description of project facilities and break-up of activities at the facility, consisting of construction and operation details and time-period.
- Scoping to identify the significant impacts of the project and to confine the baseline study to the required set of parameters.
- Baseline study to assess the environmental status of the project site.
- Prediction or assessment of impacts on the environment due to the project activities.
- Environmental/Area management plan for maintaining/ managing the environmental quality at the project site thereby mitigating the adverse impacts if any.

Environmental Regulations

42.0 ENVIRONMENTAL CLEARANCE

The area from 0 to 200m from the HTL of CRZ III is a no development zone. All tourism projects located between 200 to 500 m of the High Tide Line (HTL) i.e., in CRZ-III, or at locations with an elevation of more than 1000 meters with an investment of more than Rs.5 crores, fall under Schedule-1 of the MoEF EIA notification, 1994 and hence require an EIA. [The reader is advised to refer to http://envfor.nic.in/ for the latest CRZ notification, which is updated from time to time].

Construction of hotels/beach resorts between 200 and 500 from the HTL in designated areas of CRZ-III requires Coastal Regulation Zone (CRZ) clearance from the MoEF. Guidelines for development of beach resorts /hotels in the designated areas of CRZ-III for temporary occupation of tourists/visitors is given in Annexure II of the CRZ Notification, 1991 (Extract provided in Table 2.1).

- Siting of tourism project shall be based on the Coastal Zone Management Plan (CZMP) for the area.
- Public hearing has been made mandatory for all the cases where the environmental clearance is required. Figure 2.1 explains the stepwise process involved in environmental clearance of tourism projects.

42.1 Environmental Regulations relevant to tourism projects

National legislations applicable to a tourism project have been listed herein to give a brief idea of the existing laws and regulations. It is recommended that the reader refer to the latest rules and standards available at http://envfor.nic.in/

b. Environmental Protection Act 1986

120. EIA Notification (1994 as amended on 27th Jan 2000)
121. Coastal Regulation Zone Notification, (1991, as amended upto 3rd Oct 2001)
122. Municipal Solid Wastes (Management & Handling) Rules, 2000
123. Hazardous Wastes (Management & Handling) Rules (1989)
124. Noise Pollution (Prevention and Control) Rules, 2000

- Others

125. The Air (Prevention and Control of Pollution) Act, 1981 as amended by amendment Act 1989

126. The Water (Prevention and Control of Pollution) Act, 1974 as amended upto 1988

127. The Indian Wildlife (Protection) Act, 1972 as amended upto 1993

128. Forest (Conservation) Rules, 1981 amended upto 1992

Table 2.1 Annexure –II of the CRZ Notification, 1991 by the MoEF

(as amended upto 3rd October 2001)

GUIDELINES FOR DEVELOPMENT OF BEACH RESORTS/HOTELS IN THE DESIGNAED AREAS OF CRZ-III FOR TEMPORARY OCCUPATION OF TOURIST/VISITORS, WITH PRIOR APPROVAL OF THE MINISTRY OF ENVIRONMENT & FORESTS.

7(1) Construction of beach resorts/hotels with prior approval of MEF in the designated areas of CRZ-III for temporary occupation of tourists/visitors shall be subject to the following conditions:

(i) The project proponents shall not undertake any construction (including temporary constructions and fencing or such other barriers) within 200 metres (in the landward wide) from the High Tide Line and within the area between the Low Tide and High Tide Line;

(ia) live fencing and barbed wire fencing with vegetative cover may be allowed around private properties subject to the condition that such fencing shall in no way hamper public access to the beach;

(ib) no flattening of sand dunes shall be carried out;

(ic) no permanent structures for sports facilities shall be permitted except construction of goal posts, net posts and lamp posts.

(id) construction of basements may be allowed subject to the condition that no objection certificate is obtained from the State Ground Water Authority to the effect that such construction will not adversely affect free flow of ground water in that area. The State Ground Water Authority shall take into consideration the guidelines issued by the Central Government before granting such no objection certificate.

Explanation:

Though no construction is allowed in the no development zone for the purposes of calculation of FSI, the area of entire plot including 50% of the portion which falls within the no development zone shall be taken into account.

(ii) The total plot size shall not be less than 0.4 hectares and the total covered area on all floors shall not exceed 33 per cent of the plot size i.e. the FSI shall not exceed 0.33. The open area shall be suitably landscaped with appropriate vegetal cover;

(iii) The construction shall be consistent with the surrounding landscape and local architectural style;

(iv) The overall height of construction upto highest ridge of the roof, shall not exceed 9 metres and the construction shall not be more than 2 floors (ground floor plus one upper floor);

(v) Ground water shall not be tapped within 200m of the HTL; within the 200 metre – 500 metre zone, it can be tapped only with the concurrence of the Central/State Ground Water Board;

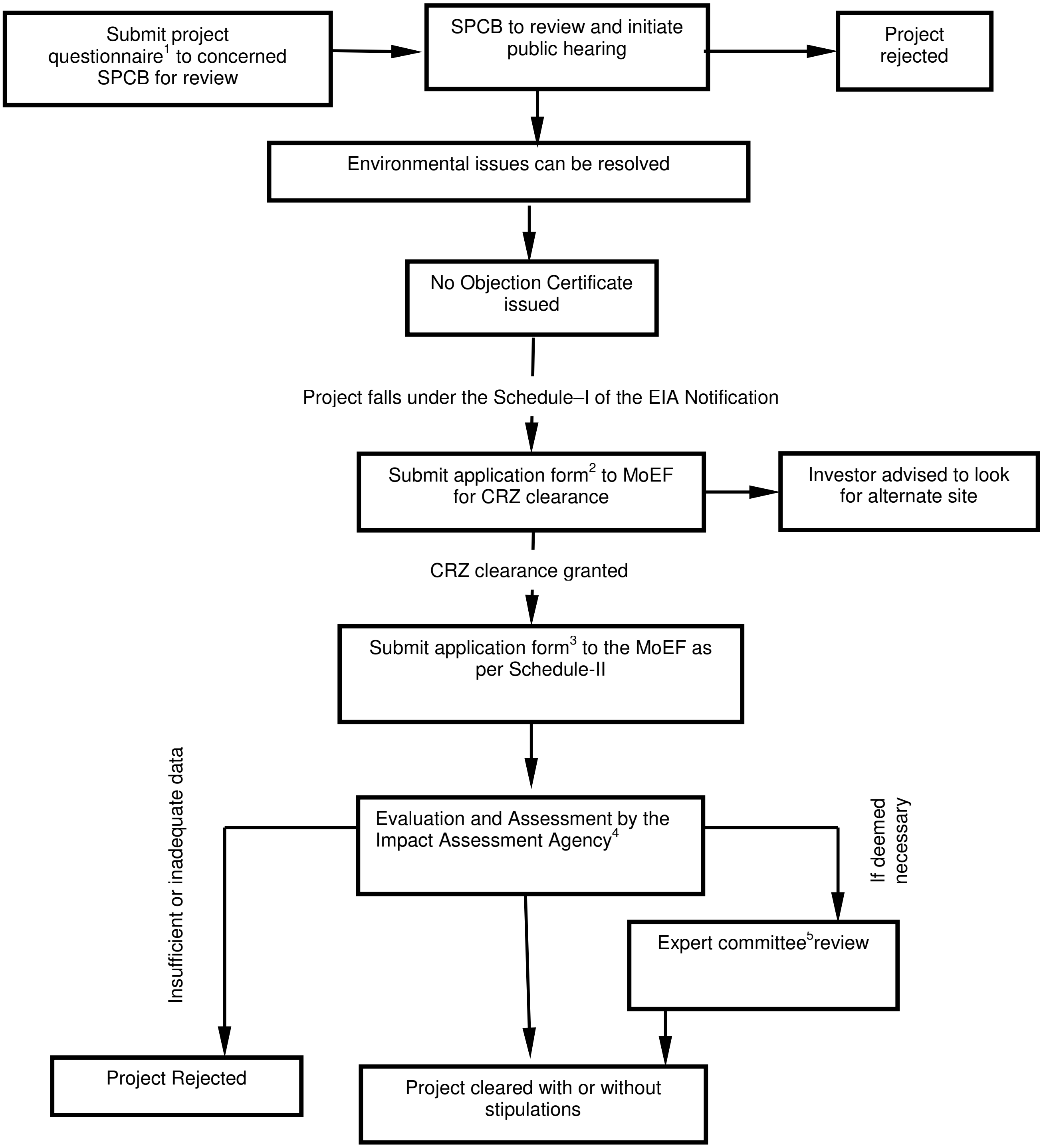
(vi) Extraction of sand, levelling or digging of sandy stretches except for structural foundation of building, swimming pool shall not be permitted within 500 metres of the High Tide Line;

(vii) The quality of treated effluents, solid wastes, emissions and noise levels, etc. from the project area must conform to the standards laid down by the competent authorities including the Central/State Pollution Control Board and under the Environment (Protection) Act, 1986;

(viii) Necessary arrangements for the treatment of the effluents and solid wastes must be made. It must be ensured that the untreated effluents and solid wastes are not discharged into the water or on the beach; and no effluent/solid waste shall be discharged on the beach;

(ix) To allow public access to the beach, at least a gap of 20 metres width shall be provided between any two hotels/beach resorts; and in no case shall gaps be less than 500 metres apart; and

(x) If the project involves diversion of forestland for non-forest purposes, clearance as required under the Forest



1. List of documents to be submitted to the SPCB is as per Schedule-IV of the EIA notification

2. Based on the guidelines for development of beach resorts in CRZ-III as per Annexure II of the CRZ notification, 1991

3. List of documents consist of EIA report/EMP and details of public hearing as specified in Schedule-IV

4. Impact Assessment Agency is the Union Ministry of Environment and Forests

5. Expert committee composition is according to the Schedule-III of the EIA notification

Fig. 42.1 PROCEDURE FOR OBTAINING ENVIRONMENTAL CLEARANCE

Siting and project alternatives

43.0 INTRODUCTION

Tourism projects are generally located in regions with natural, cultural and ecological features. This chapter aims to provide a brief insight into the siting requirements/restrictions, alternatives and facilities of a tourism project and is a precursor to the impacts of such projects.

43.1 Siting

Eco-tourism based projects and recreational tourism require pristine natural environments such as beaches, coral reefs, mangroves, lagoons, backwaters and visual landscape. For constructed sites such as recreational/ amusement/ theme parks infrastructure, access and clean environment are desired attributes. Tourism development needs to be planned in conformance with existing land use pattern of the area.

While the legal requirement for siting a coastal tourism project is governed by the Coastal Regulation Zone Notification of the MoEF, the suitability of the site for the intended tourism proposal shall be based on a detailed investigation of technical, economic and environmental siting considerations.

44.0Economic siting criteria

Economic viability consists of forecasting the long-term performance of the proposed development and balances a range of factors including target market, the envisaged facilities, and the site's environment. Economic considerations for siting depends on the following factors

- Accessibility determines the potential target market (i.e. the tourist's visiting the site). For example, a site in a remote location may be inconvenient to the tourists who may not return again or recommend the location to others. Cost of accessibility will also affect the tourist‘s decision to visit.

- Seasonality determines the peak tourist inflow. Seasonal and spatial concentration of tourists has serious implications in terms of resource availability and management at the destination. For example, drinking water supplies, transport services, power supplies etc may be inadequate during peak tourist period and management during such periods consists of procuring additional water, providing additional bus services, provision of DG sets etc. Seasonal variations shall also involve planning for heating and cooling systems. Seasonal rough weather and dangerous sea conditions will also reduce tourist influx.

- Clean environment like good air quality, landscape and aesthetics, healthy habitats and living resources, sufficiently high quality of coastal waters (so as to provide a healthy and aesthetically pleasing environment for water-based recreation) is utmost essential at the tourist location. A polluted tourist location will prompt tourists to seek alternative locations.
- Environmental complexity determined by fragile ecosystem needs extensive management involving environmental rehabilitation and regeneration during development and operational phases. Additional costs are incurred by establishing and maintaining an Environmental Management System (EMS). For example, an inadequate economic analysis of an environmentally complex site may involve cost overruns due to EMP and Monitoring.
- Resource availability includes land, water supply (drinking, washing, etc), power supply, construction materials etc. (gravel, sand, timber, etc).
- Safety concerns consists of weather-related risks (such as high waves, undertows, dangerous currents, etc.) for recreational boating and underwater recreation (e.g. diving, snorkelling etc); availability of adequate lifeguard systems, first aid facilities, telephones, hospitals etc; hazards such as jellyfish, underwater obstructions, unstable cliffs, inundation etc.

45.0 Technical siting criteria

The technical requirements for siting depend on the type of facilities that are planned to cater to the tourists visiting natural, cultural sites or recreational facilities for a constructed site. Technical suitability of a tourist site shall be based on

- Study of existing transport network, volume of traffic, suitability of the transport system to handle the increased traffic, scope for expansion etc.
- Study of topographical features (slopes, soil types for foundation and soak pits), drainage patterns (location of water table for foundations), precipitation (rainwater harvesting), water resource (surface and groundwater), land use (rural, urban, wetlands, forest etc), hydrodynamics (tidal variations, littoral drift, wave heights, currents, etc), coastal features (natural inlets / sheltered bays or exposed coasts).
- Study of the existing public water supply, sewerage system, wastewater and solid waste disposal system, suitability of the system to handle additional loads.
- Standard, volume, type, and capacity of accommodation and type of facilities such as recreational, sports etc and scope for any possible future expansion.
- Orientation of buildings to wind (passive cooling, power generation, etc) and sun (solar heating).

46.0 Environmental siting criteria

For tourism industry, economic sustainability depends largely on environmental conditions and therefore, the environmental sensitivity/complexity is an integral part of economic siting criteria. However, the following environmental considerations needs to be assessed

- Fragility of the environment due to the presence of
    130. ecologically sensitive areas such as coral reefs, mangroves, sea grass,
    131. endangered marine species such as sea turtles,
    132. breeding and spawning grounds etc.
- Construction in sand dunes, beach/ dune vegetation etc.
- Socio-cultural aspects such as traditional practices, presence of indigenous tribes etc.

47.0Site Design

Site design is a process of location of structures and utilities in a manner that natural and cultural values are made available to visitors. A responsible site design is based on the needs of the site's environment, as it shall integrate the natural features and the constructed environment. Landscape development shall be planned in conformance with the surroundings rather than by overlaying routine designs and solutions.

A preliminary site survey of the local tourist spot can include

- ***Proximity analysis*** **where optimal locations are identified for proposed facilities based on the site's environmental setting and the proximity to environmentally sensitive resources (mangroves, coral reefs) and cultural resources (religious, historical), which could be affected by development.**
- ***Line of sight analyses*** **to recommend where certain facilities should not or should be located given visibility from key attractions and scenic view locations.**
- ***Topographic analyses*** **to identify favourable building sites as indicated by slope.**
- ***Flow analyses*** **to identify probable paths of water flow and therefore locations subject to erosion or flooding.**
- ***Density analyses*** **to determine clusters of ecological and/or cultural values that might be threatened by development**

General guidelines to be followed in siting tourism facilities are

4. ***Retain ecological features***

- Avoid changing or damaging ecological (mangroves, corals, wetlands, sand dunes, estuaries, nesting sites) and cultural (religious, historical) features.
- Locate facilities, paths, and roads such that visitors are directed away from sensitive areas

5. ***Create or use existing buffer zones***

- Buffer areas (trees, shrubs) could be naturally present at the tourist location or can be artificially created. The site can be zoned around existing buffers without removing trees, vegetation and dune covers. Artificial buffers can however be created to limit visitor access to ecologically sensitive zones or for public recreation.
- Minimise or eliminate clearance of trees, vegetation. Disturbances to natural vegetation can be achieved by minimising earthworks, avoiding steep slopes, confining development to areas of previous disturbance and protecting existing vegetation.

6. ***Locate facilities in conformance with existing natural, cultural and architectural environment***

- Locate small buildings between existing vegetation
- Avoid visually prominent areas such as undeveloped cliffs, ridges etc.
- Locate electricity and telecommunication lines underground and work around natural drainage patterns. Roads can be designed to follow natural contours and building roads on steep slopes, drainage lines and areas requiring extensive cut and fill can be avoided
- Car parks, toilet blocks can be located to blend with the natural setting. Locate roads, car parks and other facilities away from areas prone to shoreline erosion.
- Provide waste disposal facilities at locations away from well locations, swimming beaches, fishing areas and other water intake locations
- Locate cottages and guest rooms away from areas of recreation activity as noise and light disturbances can have negative impact
- Maintain public access to beaches and other ocean frontages
- Provide safe access in case of severe weather conditions and avoid creating dead end routes that are a potential fire trap

47.1 Alternatives

48.0Project alternatives

The facilities in a coastal tourism project depend on the attraction available at the site (Section 1.1.1). There are several coastal tourism project alternatives. Depending on the scale of development they can be classified as follows

- Beach resorts with hotels, guest rooms, cottages, conference halls etc with a variety of ancillary services (like swimming pools, health club, amusement facilities etc).
- Marinas, harbour cruises, submarines, sport fishing, scuba diving, snorkelling, day sailing, reef tours on glass bottom boats, pools, jet skis etc which require piers, cruise ship docks etc.
- Amusement parks, aquarium, restaurants, open-air theatres, food and beverage service facilities etc on the beach.
- Resorts/hotels/restaurants in religious/historical places/protected areas.

Any coastal tourism project may be a combination of one or more of the above alternatives. For example, a large beach resort may alone form a project or it could have associated waterside, landside amusement / entertainment facilities.

49.0 Technology alternatives

Appropriate planning of layout and design, construction of buildings and facilities are some of the technology alternatives. In addition, there should be sound management procedures during the operation of the facilities.

- Alternative designs to minimise resource consumption and waste generation

The directions of wind (passive cooling, power generation, etc) and sun (solar heating) need to be taken into account while planning buildings. Construction on shoreline (causing interference with the coastal processes) and on steep slopes, sand dunes etc. may be avoided by appropriate planning of structures, considering the site layout. Also existing drainage patterns may be maintained while undertaking levelling of the site. Landfilling especially in wetlands and marine areas shall be avoided.

- Incorporation of environmentally sound alternatives in the project

Unpaved parking areas enable groundwater recharge. Providing basic wastewater treatment facilities and incineration of solidwastes or linking the solidwaste disposal to the local municipal collection system shall prevent degradation of the aesthetics and landscape while preserving groundwater quality. Organic solidwastes can be composted.

- Area management plans and/or sound house-keeping practice (EMP)

Landscaping, waste management techniques such as recycling, reuse and composting, power conservation measures such as use of thermostats, timers, use of solar water heaters etc., water conservation measures such as low flow valves, rainwater harvesting and change in purchasing policies for "closing the recycling loop" etc., are some of the practices which may be adopted at the planning stage to reduce capital investments in environmental mitigation/management.

49.1 Project facilities

Possible facility requirements for coastal tourism projects are presented in Table 3.1. Activities independent of these facilities are surfing, windsurfing, hiking, scuba diving, bathing, religious/historical sites, scenic sites, national parks etc.

Table 43.1 Facility requirements for coastal tourism projects

Basic facilities	Infrastructure requirements	Recreational facilities
Hotels/ resorts/ guest rooms/ cottages Multi-cuisine restaurants Parking lots Shops, fast-food stalls	Transportation system Water supply & storage system Wastewater treatment and disposal system Power supply (Generator sets) Communication systems. Solid waste management system	Party/ conference halls/ open air installations Marinas, recreational boating harbours, beaches, fishing facilities Swimming pools Golf areas & tennis courts Amusement parks

50.0Project Activities

Activities of coastal tourism projects can be broadly categorised under construction phase and operations phase as given in the Table 3.2

Table 43.2 Project Activities

Phase	Land-side Activity	Water-side activity

Phase	Land-side Activity	Water-side activity
Construction	• Land acquisition and development • Site clearing • Transportation of raw materials • Construction activities • Labour camps • Land reclamation / Disposal of dredged material on land	• Dredging • Disposal of dredged material at sea • Construction of piers, landing jetties etc
Operation	• Vehicular traffic • Wastewater discharge from hotels and from employees quarters & treatment – Sewage treatment facilities • Solid waste disposal • Beach maintenance	• Brine discharge from desalination plants • Discharge from power plants (cooling water and gaseous emissions) • Sport fishing • Scuba diving and snorkelling • Swimming • Yachting • Motor boating & water skiing

Identification of likely impacts

51.0 PRELIMINARY EVALUATION OF IMPACT CHARACTERISTICS (SCOPING)

Environmental impacts of coastal tourism are generally small, often dispersed, critically placed. Scoping emphasises identification of the most obvious, given the preliminary knowledge of baseline environment and type of development. Scoping is a key to fixing the scope of baseline assessment and level of impact prediction.

Significance of an impact is a function of the relative change to an environmental attribute and the sensitivity to that change. While planning for the baseline study, activities with potentially insignificant impacts need to be de-emphasised and potentially significant impacts need to be studied in detail.

Following are the most important questions related to the existence of critical habitats in the proposed project site.

13. Is there a national park, sanctuary or reserved forest in the area?
14. Are there any coral reefs in the area?
15. Are there mangroves/seagrass beds in the area?
16. Are there significant areas of breeding/spawning grounds in the vicinity?
17. Does the area form a part of migratory route or nesting grounds for aquatic and avi-fauna?
18. Are there endangered species in the area?

Scoping is usually based on a preliminary site survey, which shall involve visual inspection of the project site and its surroundings for the existing conditions and address issues such as

28. Groundwater, other sources of water supply
29. General water quality (good, medium, bad)
30. Air pollutant sources
31. Air quality (good, medium, poor)
32. Background noise levels (high, medium, low)
33. Wastewater/effluent discharge sources, disposal methods/location of disposal
34. Types of solid waste generated (refuse, garbage) and their management
35. General aesthetics (good, medium, poor)
36. Landuse (rural, urban, residential, industrial, commercial, agriculture etc)
37. Landscape and terrain (slope, hilly, plain)

38. History of natural hazards (cyclones, floods, earthquakes, landslides etc)
39. Nature of soil (clayey, silty, sandy)
40. Flora and fauna (terrestrial, aquatic & endemic species)
41. Traffic system and transportation facilities (roads, railways, airways, waterways)
42. Socioeconomic conditions (occupation, health care, schools, water and power supply etc)
43. Socioculture (historical, religious, traditions, indegenous tribes etc)

51.1 Identification of likely impacts

Identification of likely impacts of a project is essential in planning an EIA study. This identifies project activities that have an environmental impact, provides parameters for baseline data collection and helps incorporate mitigative measures in the project/process design at the planning stage itself

The environmental parameters likely to be affected due to the activities of the coastal tourism project are listed in Table 4.1

Table 51.1 Overview of likely impacts

Project Activities	Primary environmental aspects affected						
	Air	Noise	Land	Water*	Sediment	Ecology	Socio-Economics
Land development / Site clearing	✓	✓	✓	✓		✓	✓
Transportation of raw materials	✓	✓					
Construction activities	✓	✓	✓	✓			
Labour force			✓	✓			✓
Land reclamation/ dumping of dredged material on land			✓	✓	✓	✓	
Capital dredging		✓		✓	✓	✓	
Disposal of dredged material at sea				✓	✓	✓	
Pier Construction		✓		✓	✓	✓	
Vehicular traffic	✓	✓					

Project Activities	Primary environmental aspects affected						
	Air	Noise	Land	Water*	Sediment	Ecology	Socio-Economics
Wastewater discharge from hotels and employee quarters			✓	✓	✓	✓	
Solid waste disposal			✓	✓			
Beach maintenance			✓		✓	✓	
Brine discharge from desalination plants				✓	✓	✓	
Cooling water discharge from power plants & gaseous emissions	✓	✓		✓		✓	
Sport fishing, Scuba diving and snorkelling, Swimming, Yachting, Motor boating & water skiing	✓	✓		✓	✓	✓	✓
Boat maintenance	✓	✓	✓	✓	✓	✓	

*Water environment consists of marine & fresh water resources

Table 4.2 gives details of the parameters likely to be affected by each of the activity, impact characteristics and their level of significance, from which a scoping exercise is performed to identify issues of environmental concern.

52.0 Characteristics of Impacts

Impacts of proposed activity affect the environment depending upon how, when, where and by how much they occur. Impacts are characterised by

- Nature (positive, negative, direct, indirect, cumulative, synergistic)

    133. An increased employment opportunity is a direct- positive impact.

    134. Loss of wetlands, destruction of eco-systems, coastal erosion or changes in shoreline, impact on water quality and its availability, relocation of households, increased air emissions are some direct-negative impacts, which occur around the same time as the action that causes them.

135. Human health problems, impacts on marine organisms due to water quality deterioration or dredging are indirect-negative impacts, which occur later in time or in a place other than where the original impacts occurred.

136. Impacts from various activities and subprojects can be additive and result in cumulative impacts

137. Impacts from various activities and subprojects can interact with other sources and create new or larger impacts than those originally occurring resulting in synergistic impacts

- Magnitude

138. Estimation of the size of impact; e.g. Small quantities of release of toxic substances can cause large scale impacts on human and aquatic life

- Extent/location (area/volume covered, distribution)

139. Spatial distribution of toxic/hazardous substance release (risk contours), extent of area affected due to emissions from DG sets, dredging activities, etc.

- Timing (during construction, operation,)
- Duration (long-term, short-term, intermittent, continuous)

140. Noise arising from equipments during construction are typical short term impacts

141. Inundation of land, accretion, erosion etc are typical long-term impacts

142. Blasting operations may be intermittent while noise due to pile driving operations may be continuous.

143. Discharge of wastewater may be continuous, while spills during transfer operations may be short-term.

- Reversibility/irreversibility

144. Restoration of the environmental quality to pre-existing stage is defined as reversible. Air quality impacts due to transportation of raw material occurs only during construction stage and hence reversible, whereas construction of on shorelines causes an irreversible change to the coastline.

- Likelihood (risk, uncertainty)

145. Some impacts occur less frequently but have a high consequence while others occur more frequently and have less consequence.

53.0Extent of environmental impact

Siting and/or development of tourism projects result in environmental impacts, which may not confine to the project location and its environs, but may extend spatially over the following zones:

- Source region, i.e., the tourist generating region
- Beach and shoreline
- Coastal waters
- Coastal plains
- Estuaries, backwaters and lagoons
- Offshore waters

Table 4.2 gives the evaluation of impact characteristics, i.e., scoping to enable filtering of impacts that may be insignificant based on the environmental setting of the project.

Table 51.2Preliminary Evaluation of Impact Characteristics for a Coastal Tourism Project - Scoping

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Land acquisition and development	Land	Landuse and/ or socio-economics	Loss of cultivable lands / forest areas / fishing grounds and / or loss of livelihood	Pre - constructio n phase	Negative Long-term Irreversible	High when there is loss of livelihood / production / conflicting landuse pattern; Low when alternate means of livelihood is provided or with adequate compensation
		Water quality	Increased impervious surfaces causing more runoff containing toxics, suspended particles and oil and grease. Groundwater recharge is also reduced	Constructio n & Operations Phase	Negative Long-term Irreversible	High when wetlands are developed and when surfaces are sealed or impervious
Site clearing	Air quality	Suspended Particulate Matter (SPM)	Wind erosion of dislodged fine soil particles due to earth moving/ removal of vegetative cover etc	Constructio n Phase	Negative Short-term Reversible	High when wind speeds are high with removal of vegetative cover / trees; Low in the proximity of barriers like buildings / trees and / or when wind speeds are insufficient to cause wind erosion

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Noise	Noise levels	Use of earth moving equipment, power tools, diesel engines etc.	Construction Phase	Negative Short-term Reversible	Low when there are no noise sensitive receptors, when workers are provided with ear masks or when adequate vegetative cover exists/ retained
	Water	Water quality	Soil loss by runoff into water body in the vicinity causing increased turbidity	Construction phase	Negative Short term Reversible	Low when vegetative cover is not removed and/ or when gravel washings are less due to scanty rainfall.
Site clearing (contd)	Land	Soil	Removal of vegetative cover and root structures that protect soil and/ or change in the gradient of existing slopes causes soil erosion	Construction phase	Negative Short term Irreversible	Low when minimum vegetative cover is removed and / or when natural slopes are not altered
	Terrestrial ecology	Flora & fauna	Removal of vegetation	Construction phase	Negative Long term Irreversible	Low when minimum vegetative cover is removed / when vegetative cover is commercially unimportant or when fauna is absent; High when fauna are endangered species

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Socio economics	Livelihood	Resettlement, removal of vegetation and/ or change or loss of livelihood	Construction phase	Negative Long term Irreversible	High when there is loss of commercially valuable area/ resettlement of population and changes in livelihood
Transportation of raw materials	Air	SPM, SO_2, NOx,	Vehicular emissions & generation of dust due to handling and transport of fine & coarse gravel in uncovered trucks	Construction Phase	Short term Negative Reversible	Low with low cost EMP such as use of tarpaulin sheets for covering trucks or water sprays for dust suppression and regular emission checks; High when transported through unpaved or poor condition roads
	Noise	Noise levels	Vehicular noise	Construction Phase	Short term Negative Reversible	High when heavy trucks ply through noise sensitive areas especially at night. Low when there are no noise sensitive receptors
Construction activities	Air	SPM, NOx, SO_2,	Fugitive dust generation due to concrete mixing, cement handling, & gaseous emissions from welding, asphalt heating, mixing, and laying, operation of construction machinery	Construction Phase	Short term Negative Reversible	Low, when construction area is protected by barriers and/ or with low cost EMP such as sprinkling water and wearing mask. Low when regular emission checks are done for the construction machinery.

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	**Component**	**Cause**		**Duration/ Nature / Reversibility**	
	Noise	Noise levels	Use of construction equipment and power tools	Construction Phase	Short term Negative Reversible	Medium when there are noise sensitive receptors in the vicinity; Low, with low cost EMP like providing workers with ear plugs or when there are no noise sensitive receptors in the vicinity
	Water	Water, quality and quantity	Water consumption for construction impacts water availability Turbid runoff from construction site washings	Construction Phase	Short term Negative Reversible	Low, if groundwater is not tapped. Low turbidity levels when runoff is minimized by construction of small bunds
Labour camps	Water	Water Quantity & Quality (DO, BOD, TSS, Nutrients, Faecal Coliform)	Water consumption for domestic usage Disposal of untreated liquid waste.	Construction Phase	Short term Negative Reversible	Low, if workers are local as the usage pattern is maintained or when water resource is not a constraint Low, with basic treatment units such as soak pits, septic tanks etc

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Land	Landuse and Aesthetics	Generation of solid wastes, Haphazard growth of temporary buildings / dwellings/ hutments	Construction Phase	Short term Negative Reversible	Low, when proper collection and disposal of solid wastes is practised; Low when shelter, basic requirements and sanitation for the workers are provided or when temporary construction is regulated
Labour camps (contd)	Socio-Economics	Employment	Increased employment opportunities	Construction Phase	Short term Positive Reversible	Low, if the employment is temporary and only during the construction phase
Disposal of dredged material along the coast or Land reclamation	Ecology	Micro & Macrobenthos	Trapping of intertidal benthos	Construction phase	Long term Negative Irreversible	Low if the area is a barren and devoid of ecologically sensitive species / commercially valuable species. Low if dredged material is not contaminated.
	Sediment transport, shoreline slopes (land)	Hydrodynamics	Change in hydrodynamics due to material dumping may cause shoreline changes	Construction phase	Long term Negative Irreversible	Low if the site is not close to the water front

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Groundwater sources, quality	Water resources	Dumping of toxic sediments may impact groundwater resources from leaching	Construction	Long term Negative Irreversible	Low if there is no groundwater resource or if dredged material is not contaminated.
Capital dredging	Noise	Noise levels	Use of dredging equipment and power tools	Construction phase	Short term Negative Reversible	Low if the soil at the dredging location is soft and of clayey nature or with no noise sensitive marine species at close proximity Medium for a rocky profile
	Water	Water quality	Sediment resuspension; Release of toxic substances and nutrients from the sediments	Construction phase	Short term Negative Reversible	Medium for turbidity when the material is clay and low for toxicity when sediment toxicity is minimal
	Ecology	Micro and Macro benthos	Disturbance of bottom sediments and removal or destruction of spawning grounds	Construction phase	Short term Negative Reversible	Low, when commercially valuable species/ breeding/ spawning grounds are not present

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Disposal of dredged material at sea	Water	Water quality	Dumping of dredged material increases total suspended solids, turbidity levels, may release nutrients and toxics.	Construction phase	Short term Negative Reversible	Low when the dredged material conforms to the sediment properties at the disposal site. High when dredged material is toxic or in the presence of fishing / breeding / spawning grounds
Construction of piers, landing jetties	Noise	Noise levels	Use of pile drivers, boring equipment, power tools, drill bits etc.	Construction phase	Continuous for a Short period Negative Reversible	Medium when noise sensitive receptors are in the vicinity Low, with low cost EMP such as ear protection devices
	Water	Water quality	Increased suspended solids and turbidity during piling	Construction phase	Short term Negative Reversible	Low, when piled foundations are used as it is localised and area of impact is negligible
	Sediment transport	Hydrodynamics	Change in hydrodynamics may cause accretion / deposition	Construction & Operation Phase	Long term Negative Irreversible	Low, if the structure does not alter flow pattern

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Ecology	Micro and Macro benthos	Disturbance of bottom sediments and covering up or destruction of spawning grounds	Construction phase	Short term Negative Reversible	Low, when commercially valuable species/ breeding/ spawning grounds are not present or when structures are found on piles.
Vehicular traffic (use of motor vehicles and speed boats)	Air	SPM SO_2 and NOx,	Vehicular emissions due to combustion of fuel Vehicles on dusty roads	Operation phase	Long term Negative Irreversible	Low, if there is no receptors of impact
	Noise	Noise levels	Generation of noise from vehicles	Operation phase	Long term Negative Irreversible	Low, when vehicles do not traverse through thickly populated areas and with low cost EMP like regular emission checks.
Power plants	Air	CO, NOx, SPM, SO_2 and HC	Emissions from DG sets	Operation phase	Long term Negative Irreversible	Low when the DG sets are used only for emergency purposes and when frequent emission checks are made and when there are no sensitive receptors in the downwind direction

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Noise	Noise levels	Noise generation from DG sets	Operation phase	Long term Negative Irreversible	Low when the DG sets are used only for emergency purposes and when there are no sensitive receptors in the downwind direction
Wastewater discharges from hotels and employee quarters.	Water	Water quality	Discharge of treated or untreated sewage into the water bodies	Operation phase	Long term Negative Irreversible	Low when the wastewater is treated before discharge
	Ecology	Marine flora and fauna	Discharge of wastes	Operation phase	Negative	Low when the wastewater is treated before discharge
Solidwaste disposal	Water	Water quality (Groundwater & other resources)	Ground leaching of pollutants from solidwaste	Operation phase	Long term Negative Irreversible	Low when solidwaste is incinerated or dumped in approved landfills
	Land	Aesthetics	Solidwaste generation from hotels, resorts and cruises and recreational boats	Operation phase	Long term Negative Reversible	Low when the proponent practises solidwaste handling and disposal system such segregation, composting and/ or incineration.

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Presence of physical structures	Land	Groundwater	Sealing of the areas with buildings, roads, parking lots restricting the recharge capacity and changing the drainage pattern	Operation phase	Long term Negative Irreversible	High when the region is the main recharge area for the local town, Medium when groundwater is the main resource.
	Sediment	Hydrodynamics	Construction near beaches, removal of natural coastline protection, interference with balance of materials near the beaches, removal of protective beach vegetation etc. causes erosion	Operation phase	Long term Negative Irreversible	Low when the construction is not too close to the coast, where removal of sand for construction is minimal and when beach vegetation is not disturbed
Discharge from desalination plants	Water	Salinity, DO	Discharge of brine	Operation phase	Long term Negative Irreversible	Low when discharge location is at sufficient depth to facilitate dilution
	Ecology	Marine organisms	Discharge of water that has greater salinity than what is available to the organisms	Operation phase	Long term Negative Irreversible	Low when there are no ecologically sensitive species at and near the location of disposal

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Cooling water discharge from the power plants (seawater withdrawal for cooling)	Water quality	Temperature	Discharge of effluent which has higher temperature than that of the water body	Operation phase	Long term Negative Irreversible	Low when the cooling water is sufficiently diluted with cold water and when there are no ecologically sensitive species at and near the location of disposal
	Ecology	Marine organisms	Discharge of effluent with temperatures above the ambient	Operation phase	Long term Negative Irreversible	Low when there are no ecologically sensitive species at and near the location of disposal
Tourist Influx	Socio cultural	Traditional values and culture	Influx of tourists and introduction of capital based economy may affect traditional values	Operation phase	Long term, Negative, Irreversible	Medium to high depending on the location of the tourist industry

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Tourist influx (contd.)	Socio economics	Economic stability and employment	Influx of additional population, traders and job-seekers Resettlement of local population Priority to tourists and hence limited beach access and traditional fishing opportunities to the local population Loss of valuable agricultural areas Abandoning agricultural professions Restricted supplies of essential crops, fruits and vegetables to locals Increased land prices, cost of living, energy costs	Operation phase	Long term Negative Irreversible	Medium to high depending on the location of the tourist industry

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
Recreational Activities	Water	Water quality (DO, TSS, Nutrients, pathogens, Oil and grease) & aesthetic degradation of surface waters	Continuous use of the water by tourists, washings, discharge from boats etc.	Operation phase	Negative	High to low depending on quantity of wastewater generated and whether it is discharged with/ without treatment.
			Dumping of solidwaste generated during cruises			Low when solidwaste generated are collected and brought onshore for disposal.
Recreational activities (contd.)	Ecology	Marine flora and fauna	Discharge of wastewater and dumping of solidwaste Ecosystems like sea-grass beds, coral reefs are affected by anchors and propellers of powerboats, wash generated by motorboats and grounding of boats. Resort illumination, streetlights etc can disorient marine turtles. Noise from boat engines and propellers can disorient marine species.	Operations phase	Negative	High when there is presence of breeding and spawning grounds / ecologically sensitive species and large-scale water-sports and cruises.

Activity	Impacts			Timing	Apparent Impact Characteristic	Significance Level
	Parameter	Component	Cause		Duration/ Nature / Reversibility	
	Coastal area	Shoreline	Erosion along the shoreline due to wakes from speedboats. Use of skiis, motorbikes or cars and animal rides in close proximity to the shoreline.	Operations phase	Negative	Medium to low depending upon the type of soil or when speed restrictions on boats are imposed.
	Land	Aesthetics	Generation and dumping of solidwaste	Operations phase	Negative	Low when solidwaste is incinerated or disposed off in approved landfills.

Baseline assessment

54.0 BASELINE STUDIES

Baseline studies help define the existing environmental conditions at the project site. This involves identification of environmental parameters that are environmentally critical and sensitive at that location and those that might be affected by development of coastal tourism projects. Though not exhaustive, this chapter gives an introduction to overall baseline data types and requirements for an EIA study. However, project specific baseline data collection needs to be designed on the basis of scoping. The results of scoping would result in a partial list of parameters (listed in this chapter) and in very special cases would require detailed studies designed by experts which is beyond the scope of this guideline.

55.0Data types for baseline studies

The data collected at first-hand, by undertaking field visits/surveys, collecting samples and conducting analyses are referred to as primary data. However, the likely impact of a particular activity shall determine the baseline study requirement. Generally secondary information on landuse, census, standard of living (socio-economic conditions), water availability etc., and data from preliminary site visits should be considered sufficient for projects that do not have large scale facilities like DG sets, desalination units or involve activities like capital dredging, land filling/reclamation etc.

Secondary data are those already collected by others for various purposes. These are available in departments or institutions, which undertake studies routinely for various purposes, including monitoring the quality of the environment, scientific and research activities.

Tourism projects generally require Rapid EIA (REIA) where primary data are required for water; air and noise quality parameters for one season other than monsoon. It is also necessary to undertake secondary data collection programmes and concentrate on the availability of water resources; presence of coral reefs, mangroves and other ecologically sensitive areas; existing solid waste disposal system; source of energy; socio economics and socio cultural details at the site etc.

The REIA report shall be reviewed by the MoEF and the consultant for acceptance and approval. Depending on the site and proposed activities, the MoEF may also choose to advise the proponent to further undertake a comprehensive EIA, which is a one year- three-season baseline study.

55.1 Typical environmental attributes for coastal tourism projects

Environmental attributes are defined as characteristics of the environment where changes to these attributes indicate impacts. The project activities and environmental setting define the environmental attributes to be assessed.

The basic environmental attributes are classified under air, water, land, ecology, sound, and socio-economics, and consist of a number of measurable parameters. Baseline studies that characterise the existing condition need to be designed according to the local conditions. At the same time, baseline study will be used to compare the change in the environmental characteristics due the project during the construction/operation phases. Tables 5.1 to 5.5 represent indicative requirements for a baseline study and do not necessarily indicate a regulatory requirement, unless specified. It is also recommended that average and peak measurements must be considered in planning a sampling schedule.

56.0Air Environment

The air environment consists of meteorological parameters (wind direction, wind speed, temperature gradients, atmospheric stability, daily rainfall) and air quality parameters (gaseous and particulate matter). The meteorological parameters influence the transport and dispersion of the air quality parameters in the atmosphere.

Table 5.1 gives details of air quality data collection. For assessing an air quality impact the following baseline parameters are required

- Existing air quality at the site i.e. the background concentrations of suspended particulate matter, SO_2, NO_x, CO, HC etc
- Wind direction to determine the receptor
- Wind speed which influences the horizontal mixing of pollutants
- Wind speed, temperature gradients and rainfall that determine the atmospheric stability which further affects the vertical mixing of pollutants
- Topography (hills, buildings, trees etc) which influences the mechanical mixing of pollutants
- Land use at the project site to determine receptors

Table 54.1 Air quality data collection

Attribute	*Sub-attribute*	*Sampling criteria*		
		Specification	*Frequency & Period*	*Source*
Meteorology	Wind direction	Distribution with height	1 year daily data	IMD
	Wind speed	Distribution with height	1 year daily data	IMD

Attribute	*Sub-attribute*	*Sampling criteria*		
		Specification	*Frequency & Period*	*Source*
	Temperature gradient	Distribution with height	1 year daily data	IMD
	Atmospheric stability	Distribution with height	1 year daily data	IMD
	Rainfall	Distribution	1 year daily data	IMD
Air quality	Suspended particulate matter (SPM), SO_2, NOx, CO and HC	24-hr average for one season other than monsoon	Twice a week for 3 months	Baseline study
Topography	Hills, buildings, trees and other mechanical obstructions	Layout map of the area	Present data	Visual examination

Sampling stations for air quality may be located at the project site, peak hour/heavy traffic locations, and at receptor locations.

57.0Noise

Table 5.2 gives details of data collection for noise. To determine the impact on noise levels due to a project, it is essential to collect baseline data on

- Existing noise levels at the site i.e. the background concentrations
- Noise attenuating factors such as hills, trees, barriers, humidity etc
- Land use map to locate the noise sensitive receptors such as schools, hospitals, residential areas, concert halls, etc

Table 54.2 Noise level data collection

Attribute	*Specification*	*Frequency & Period*	*Source*
Noise levels	Intermittent/ Impulsive/ Continuous	1 sample each during day and night	Baseline study
Noise attenuating factors	Trees, hills, valleys, buildings	Latest information Future development plans	Site Visit SOI Toposheet Town planning department

Noise sensitive receptors	Types of receptors, location and distances	Latest information Future development plans	Site visit Layout maps of project site Town planning department

Noise levels may be measured at the proposed site, peak hour / heavy traffic periods/locations, noise sensitive receptor locations etc.

58.0Land

The extent of assessment of the landuse shall be concentrated within a 10 Km radius around the project area. The extent of landuse within a 25 Km radius is required when the project is proposed near an ecologically sensitive area.

Land environment comprises land use pattern, soil, slope, drainage characteristics, topography, etc. To determine the impact on land, the following baseline parameters are essential

- Existing land use pattern
- Terrestrial ecology (trees, vegetation etc)
- Soil, slope and drainage characteristics that affect runoff and groundwater infiltration
- Topography such as hills, valleys & landscape

Baseline parameters shall also address the land environment specific to the project site. Typical sampling data type, specifications and data source for the above parameters are given in Table 5.3. When secondary data is not available, primary surveys may be conducted.

Table 54.3 Land environment data collection

Attribute	*Specification*	*Sampling criteria*	
		Frequency & Period	*Source*
Landuse	Residential, Industrial, commercial, agricultural, etc	Latest information	State Metropolitan Development Authority, Town planning department, Panchayat etc
Soil, slope and drainage characteristics	Soil types, gradient, hydrology	Latest information	Survey of India (SOI) Toposheets, State Soil Conservation Departments
Topography	Hills, valleys, terrain	Latest information	• **Survey of India (SOI) Toposheets, State Revenue Department** • **Site specific data collection by project personnel**
Terrestrial ecology	Flora and fauna	Latest information	• **Biological Survey of India, Zoological Survey of India, State Metropolitan Development Authority** • **Site specific data collection by project personnel**
Ground water hydrology*	Type of groundwater sources (open wells, tube wells)	Latest information	• **Public Works Department, Corporation, Panchayats** • **Primary data from site visits**
	Well yield, Water levels, Consumption rates	Data for last 1 year	• **Public Works Department, Corporation, Panchayat** • **Primary data from pumping tests**
	Quality – pH, Turbidity, Salinity	One season data	• **PWD, Corporation etc** • **Primary water quality analysis**

*A detailed survey may be required depending on level of extraction and background information of available resource

Assessment of the local landform type and its constituent materials enables evaluation of potential hazards of the proposed activity on the local physical environment. Landform types are based upon the characteristics of topography, viz., local relief and slope. Project activities affect the availability or suitability of land for certain uses i.e., the land-use patterns.

59.0 Water

Water environment (coastal waters) consists of oceanographic, water quality and biological attributes. Oceanographic/hydrographic parameters are depth, tide, wave height, current speed and direction, shoreline profile etc. Water quality attributes are turbidity, temperature, suspended solids, salinity, pH, DO, BOD, nutrients etc. Biological attributes could be categorised as pathogenic (faecal coliforms) and ecological like benthos, phytoplankton, zooplankton, fish etc.

Transport mechanism of pollutants is influenced by advection - diffusion factors due to tides, waves, and currents. For assessing the impact on water environment, the following baseline information is essential

- Existing water quality at the project location (sea, creek) i.e. the background concentrations
- Water resources available at the project site
- Water utilisation/requirement at the site without the project
- Oceanographic parameters such as tides, waves, current speed, current direction and bathymetry that influence mixing and diffusion of water quality parameters
- Sensitive receptors at the site such as coral reefs, mangroves, breeding areas, water intake locations, etc

The sampling data type, specifications, frequency and data source for the above parameters are given in Table 5.4. Water sampling stations shall be selected based on the effluent discharge points, sewage outfalls, dredging/dumping sites etc, and shall be based on the environmental setting of the project site. Sampling stations shall be representative to indicate average conditions.

Table 54.4 Water Environment

Attribute	*Sub-attribute*	*Sampling criteria*		*Source*
		Specification	*Frequency &Period*	
Hydrodynamic	Current, tides and waves	High and low tide Wave heights Current speed and direction	15 days for one season*	Naval Hydrographic Office (NHO) charts, Indian Tide Tables, Ocean R&D Institutes, DOD
Bathymetry	Depths	Contours upto 30m depth	Once	NHO charts
Physical quality	pH, salinity, temperature TSS, TDS, Oil and grease	1 season sample	1 sample* each during high and low tides	Baseline data
Chemical quality	DO, BOD & Nutrients	1 season sample	1 sample* each during high and low tides	Baseline data
Biological quality	Fecal coliforms, Streptoccocci, phytoplankton, zooplankton	1 season sample	1 sample* each during high and low tides	Baseline data

*If impacts are significant, MoEF may suggest that a comprehensive EIA with three season date be conducted

60.0 Ecology

An ecological environment consists of terrestrial and aquatic ecology. This section covers floral and faunal characteristics that are not addressed in sections 5.2.3 and 5.2.4

Attributes critical in assessing the suitability of the project at the selected site are:

- Natural vegetation, endemic and endangered/ ecologically sensitive species such as seagrass, corals, mangroves etc.,
- Fisheries data for the last five years – secondary data can be obtained from the Fisheries Dept.

Biological sampling shall

146. Be conducted in fishing, breeding and polluted zones
147. Include analyses at various trophic levels and
148. Identify endangered species/critical habitats

61.0 Socio-economics and Socio-culture

Social environment refers to people and their surroundings, human beings and their products, their property, groups, heritage etc. The effects of a project on people and their responses may be direct and immediate or remote and attenuated. Estimation of the change in the income in an area, value of structures, equipment, standard of living, statistical information on population growth etc form socio-economic studies. To assess impact on socio-economic environment and culture, it is essential to collect the following data

- Details on occupation, level of education of the population surrounding the project site, likely receptors of impact
- Traditional practices, customs, beliefs, values, etc
- Standard of living at the site i.e. the infrastructure available to local population such as water supply, sanitation, electricity, transportation, education, medical treatment etc
- Commercially valuable species and materials at the project site

Information of socio-economic and cultural environment can be obtained from revenue department, fisheries and by undertaking site visits.

62.0 Resources

- Water, power, fuel & non-fuel resources are assessed for labour camps, construction activities, operational requirement etc.

62.1 Typical baseline requirement

Table 5.5 gives typical baseline parameters required for various activities of a large coastal tourism project. The extent of baseline study is a function of the nature of activities. Annexure A gives an example study requirement of a small-scale and a large-scale resort.

Table 54.5 Baseline Parameters for activities

Activity	Environmental Parameters					
	Air	Noise	Land	Water	Ecology	Socio-Economics
Site clearing/ Land development/ Transportation of raw materials	SPM, NOx, SO_2	Noise Levels	Landuse, layout of buildings	TSS in water bodies in the vicinity	Terrestrial flora & fauna	Traditional fishing areas
Construction activities	SPM	Noise levels		TSS, Water source & availability		
Labour camps			Aesthetics, solid waste disposal location	pH, Temp, salinity, TSS, DO, BOD, Nutrients, Faecal coliforms, Water source & availability		Number of people likely to be employed
Land reclamation	SPM		Extent, Landuse, Soil type at the proposed reclamation site		Benthos, plankton (if intertidal) at the proposed reclamation site	
Capital dredging		Noise levels, Noise sensitive receptors		Silt charge, hydrodynamics DO, TSS, Nutrients	Benthos, plankton	Commercially valuable marine species
Dumping of dredged material at sea				DO, TSS, Nutrients	Benthos, plankton	

Activity	Environmental Parameters					
	Air	Noise	Land	Water	Ecology	Socio-Economics
Construction of jetty on piles		Noise levels, Noise sensitive receptors		TSS		
Vehicular traffic	SPM, NOx, SO_2	Noise levels				
Wastewater discharge from hotels and employee quarters				pH, Temp, salinity, TSS, DO, BOD, Nutrients, Faecal coliforms, Water source & availability		Number of people likely to be employed
Solid waste disposal			Aesthetics, solid waste disposal location			
Beach Maintenance			Aesthetic, dunes, slopes	Hydrodynamics	Benthos	
Brine discharge from desalination plants				pH, Temp, salinity, TSS, DO	Benthos, plankton	
Emissions from DG sets	SPM, NOx, SO_2 HC*, CO*	Noise levels				

Activity	Environmental Parameters					
	Air	Noise	Land	Water	Ecology	Socio-Economics
Cooling waster discharge from power plants				Temp, DO	Benthos, plankton	
Recreational activities / cruise	CO, NOx, SO_2	Noise levels		Faecal coliform, nutrients Oil & grease		
Boat maintenance			Aesthetics, solid waste disposal location	Oil & grease		

* Optional Parameters- shall be measured when such emissions are expected depending on fuel used

Prediction of impacts

63.0 PREDICTION

Prediction or analysis of impacts gives an estimate of magnitude and spatial distribution of impact enabling assessment of future condition of the environment with the project. Prediction is an essential component of any EIA as it provides a measure of sustainability of a project.

Predictions can be quantitative and/or qualitative. Quantitative methods give an estimate of the impact using mathematical expressions/computer models and experimental/physical models. Simple quantitative methods are typically analytical with broad assumptions requiring hand calculations, while the complex models are computer based and address many of the complexities of the natural environment. Qualitative methods are based on professional judgement/examples of similar occurrences/events in other locations/projects or cited in literature.

Results of prediction can be illustrated with contours or plots showing critical concentrations, in conjunction with receptor locations to determine the significance of impacts.

63.1 Scenario for prediction

Predictions must consider the worst case and most probable case scenarios for each environmental parameter. Examples of worst-case scenarios can be periods of inversion for air quality, storm surges for inundation or festivals/religious events that attract a large number of people. Most probable scenarios can be air quality during normal conditions (based on statistics), discharge of wastewater during peak season and traffic during peak tourist season.

63.2 Water environment

The two broad areas of impact on the water environment by coastal tourism projects are the water resources and the coastal waters. While water resource concerns may arise from overexploitation of potable water, the impact on marine environment primarily arise from shoreline changes and marine water quality deterioration.

64.0Impact on water resources

In coastal areas that rely on groundwater, excessive pumping can cause saltwater intrusion due to lowered water tables or depleted freshwater lenses.

Construction of buildings, roads, paving parking areas etc lead to increased impervious areas and change in top soil characteristics, which may significantly reduce infiltration and groundwater recharge.

In general, the annual extraction of groundwater must be less than or equal to the recharge, else over pumping will gradually deplete the stored resource causing existing wells to run dry, at times requiring expensive deep drilling to locate new wells. Landuse consisting of productive farms may lose irrigation water as wells go dry.

Groundwater tests must be conducted to assess safe yield and ensure that neighbouring wells have minimum drawdown. The depth and pumping rate must be such that there is no upcoming of saltwater.

However, if water supply is made from remote sources, to meet peak tourist demand, an assessment of water table lowering and resource-use conflict in the remote location is necessary.

65.0 Impacts of sediment transport

The sediment transport issues are generally related to the physical alterations of the coastline such as construction on shoreline, presence of breakwater, seawall or reclamation. When stabilizing beach vegetation is removed for construction on the shoreline or when construction is carried out on slopes, changes may occur to the shoreline and the along-shore wave movement, causing erosion and depositional patterns.

The most important factor controlling coastal processes and coastal engineering design is the waves generated by winds. Waves result in large forces on coastal structures, near-shore currents, long-shore currents and control beach profiles. Typically the data requirements for prediction of waves (for projects requiring marine infrastructure such as jetties, slipways etc.) are the site area bathymetry and wave characteristics (wave heights for various periods). These aspects will be addressed in the technical feasibility of a project and may be made available to the EIA consultant by the engineering consultant.

The impact of a coastal structure on the shoreline can be simulated using physical models or mathematical models. Mathematical models require the long-shore current component, which is typically generated from wave radiation models. The long-shore sediment transport is calculated using the continuity equation for sediment volumes. The primary input for the computation is the wave climate, cross-shore profile, sediment properties and the coastline orientation.

66.0 Impacts on marine water quality

When a pollutant is discharged into a water body, the water quality in the surrounding area is a function of the currents, mixing, water chemistry and biological processes of the natural water body. Today, these processes can be represented by models ranging from simple planning type models to sophisticated computer based water quality models.

The simplest method available for predicting concentrations is for a continuous discharge into a receiving water body under steady state conditions. The currents in the water body will transport the pollutant downstream; spreading the waste by molecular and turbulent diffusion processes and for some pollutants, transforms the pollutant by chemical and biological processes. While the steady state assumption is useful for an “order of magnitude” estimate, it may not be acceptable to the coastal environment, which is dynamic. This has resulted in the utilisation of mathematical models that are capable of simulating the dynamic nature.

In a coastal environment, advection is governed by current speeds and direction while dispersion is characterised by turbulence and molecular diffusion. A typical water quality model is one that simulates the advection and dispersion of the pollutant.

Hydrodynamic models contain sub modules to estimate the concentration of pollutant in the water body due to wastewater discharges. The concentration of some pollutants such as pathogenic bacteria and BOD may be modelled by simple ‘first-order’ decay equations, where the mass of the pollutant decreases with time. Dredge spoils may also be simulated using the first-order equations when the grain size is fairly uniform, sediments are non cohesive and currents are low

Parameters such as trace metals and organic chemicals are more complex, requiring sediment concentrations in water to estimate the partitioning of the pollutant in its dissolved and particulate phases.

Dissolved Oxygen is an important water quality and ecosystem health indicator and is always indicated in water quality standards. The origin of DO modelling began with the Streeter-Phelps equation that modelled DO as a function of Biochemical Oxygen Demand (BOD) and re-aeration of oxygen from the atmosphere. Today, DO models include many complex ecosystem components such as nutrient uptake, algal photosynthesis, primary productivity, benthic processes, etc.

Simple oil spill models use wind and steady state currents to estimate dispersion and surficial spreading. More complex models generally use advection-dispersion model base and include processes such as volatilisation, settling of tars and wind dispersion.

Brine discharges have high concentrations of salt, turbidity and certain chemicals that are used for the pre-treatment of feed water & cleaning of filters. There are simple models (like USEPA’s CORMIX) available for modeling small quantities of saline water discharges.

Cooling water discharges have higher temperature than receiving waters, potentially causing depletion of oxygen and thermal shock to marine life. Temperature also affects rate of chemical and biological reactions, solubility of oxygen and other gases in water and may induce density stratification. Water temperatures can be modelled by adding all the heat inputs and subtracting all heat losses. The inputs to these models include heat exchange with the atmosphere, which is a function of evaporation, solar radiation and convective losses.

66.1 Air environment

The air pollutants emitted into the atmosphere will be diluted and dispersed depending on local meteorological and geographical conditions. A continuous stream of pollutants when released into the atmosphere will rise, bend and then travel in the direction of the wind, which enables dilution and carries the pollutants away from the source. This plume of pollutants will also spread out or disperse in both horizontal and vertical directions from its centreline.

The simplest method available for predicting concentrations is the steady state Gaussian equation, designed for conditions where a continuous stream of pollutant is released into a steady wind in an open atmosphere. In nature, the pollutant plume will rise and bend over, get transported by the wind, and concentrations will decrease away from the source. The plume spread will be influenced by molecular diffusion, turbulent eddies of the average wind flow, thermal gradients, random shifting of winds and mechanical mixing of the air moving over the land. The dispersion of an air pollutant released into the atmosphere depends on the following factors

- Properties of pollutant (stable, unstable)
  149. SO_2, CO and SPM are stable pollutants, as they do not participate in chemical processes in the atmosphere.
  150. NO_x and certain hydrocarbons are unstable pollutants which actively participate in chemical reactions thereby forming secondary pollutants
- Release rate & type (puff, plume)
  151. An accidental release of chemical from a pipeline or hose is an example of puff release (instantaneous)
  152. Emissions from power plants, stream of vehicles are continuous and an example of plume release
- Meteorology (Atmospheric stability)
  153. Atmospheric stability is defined by wind speed and vertical temperature gradient which influence mixing of pollutant
  154. Wind speed influences the horizontal diffusion/dispersion of an air pollutant while wind direction determines the region and receptor of impact.
  155. Temperature gradient affects vertical mixing of pollutants
- Local terrain conditions (hills, valleys, buildings)
  156. The local terrain conditions influence the mechanical mixing of the pollutants.
- Height of release above the ground
  157. Emissions from a DG set may occur at different heights based on stack height, while releases from pipeline occur at ground level. Releases from a lower height will have greater ground level pollutant concentrations than releases from a greater height
- Release geometry (point, line, area source)
  158. Emissions from ships, DG sets, pinhole leakage from pipeline are point sources
  159. Emissions from vehicular traffic during peak hours are line sources

A critical scenario for air pollution predictions is when temperature in the ground levels is higher than the upper layers. This prevents the air pollutants from rising vertically, thus dispersing the pollutants along the ground and exposing receptors to dangerous levels of pollutant concentrations.

Modelling of pollutant dispersion needs to take into consideration, the thermal stratification existing in the atmosphere. Differential heating/cooling of the different layers result in density stratifications, the most critical of which is the 'thermal inversion', which prevent vertical diffusion/dispersion across them (vertically). The inversion occurring close to the ground surface almost each night to pre-dawn periods, caused by the back radiation from heated earth-surface and building structures are termed 'ground-based inversion' and significantly affect pollutant-dispersions resulting in increased ground level concentrations.

The understanding and characterisation of these inversions is absolutely essential to any meaningful modelling of pollutant dispersions. Thermal stratification and consequent mixing heights can be taken into account by using 'stability classes'. IS: 8829-1978 gives the methodology for determination of stability classes.

Air quality issues can be modelled using Guassian models, which provide concentration distribution in vertical and horizontal directions using simple dispersion coefficients. Basic inputs for this model in predicting the concentration are

- Emission rate of pollutant
- Vertical and horizontal dispersion coefficients which are a function of the downwind distance
- Wind velocity in the downwind direction
- Vertical distance above ground
- Lateral distance from the centreline of the plume
- Length of the line source (in case of line source emissions)

Meteorological data needed for pollutant dispersion modelling shall include:

- Average wind direction: to define co-ordinates
- Average wind speed: to provide velocity
- Atmospheric stability: to determine the vertical and horizontal dispersion coefficients
- Ambient temperature: to calculate the effective height of (stack) emission above ground level
- Atmospheric temperature lapse rate: to determine stability classes

Table 6.1 gives the characteristics of pollutants and their source geometry for coastal tourism project activities.

Table 63.1 Air pollution source characteristics

Activity	Geometry of	Location of	Pollutant type

	source	source	
Site clearing	Area	Ground level	SPM and RPM
Soil excavation	Area	Ground level	SPM and RPM
Transportation of raw materials	Line	Ground level	NOx, RPM, and SPM
Construction activities	Area	Ground level	SPM and RPM
Vehicular traffic during operation	Line	Ground level	Nox, SPM and RPM
Boat operation	Point	Ground level	NOx, SPM and RPM
DG sets/ Captive Power Plant emissions	Point	Stack height	NOx, HC, CO, SO_2 and SPM

Respirable Particulate Matter – RPM; Suspended Particulate Matter - SPM

66.2 Noise Environment

Sound or noise is a disturbance, which propagates away from the source through an elastic medium, namely air, water or solids and reaches a receiver. The noise level (dB) at the receiver's location is a function of the characteristics of the sound source (power, intensity and frequency spectra), the properties of transmission medium and the presence of objects or barriers.

For simple cases, such as point source, the sound energy is radiated over spherical surfaces away from the source. The presence of objects in the path of sound propagation results in reduction in the sound pressure level. For a source located on the ground, the sound will propagate in a hemispherical pattern.

The prediction of noise should address the type of source, type of environmental conditions at the site and the receptors

Type of noise source

Noise sources may be classified as impulsive or sudden; intermittent-unsteady; continuous-steady noise. Table 6.2 gives the types of noise sources for coastal tourism project activities.

Table 63.2 Noise pollution source characteristics

Activity	Source type
Site clearing	Continuous-Steady
Soil excavation	Continuous-Steady
Transportation of raw materials	Intermittent-unsteady

Activity	Source type
Construction activities	Continuous – unsteady
Vehicular traffic during operation	Intermittent-unsteady
Boat operation	Intermittent-unsteady
DG sets/ Captive Power Plant emissions	Continuous-Steady

Types of environment or attenuating factors

The type of environment determines the degree of noise attenuation, where the greater the attenuation, the lesser the impact on the receptor. Examples of attenuating factors are:

- Atmospheric conditions like humidity, wind direction, wind speed etc; and
- Barriers such as walls, vegetation etc.

Type of receptors

Receptors could be insensitive or sensitive. For example inmates of hospitals or bird sanctuaries, aquatic species etc., are sensitive noise receptors while industrial, commercial areas are relatively insensitive. Limits of acceptable noise levels for each category of receptor or areas/zones are specified in the National Ambient Air Quality Standards in respect of noise (Section 2.1).

66.3 Land Environment

Tourism industry usually involves extensive land and infrastructure development. In this perspective impact on soil, land use and hydrology are the most significant elements that are required to be evaluated.

- ***Soil Erosion***: Site clearing, soil excavation etc., lead to soil erosion. . Erosion rates may change during construction phase of a project when large areas of land may be cleared and left exposed. Methods like Universal Soil Loss Equation (USLE) are useful to make estimations of soil erosion
- ***Soil Permeability:*** Land disposal of wastewater, solidwaste / hazardous wastes, dredged material, oily wastes from boat maintenance etc., may lead to leaching into groundwater. The permeability characteristics are essential to design the lining of the soil for disposal of wastes. Also leaching characteristics of the site needs to be evaluated to assess impact on water resources and recharge areas and soil microorganisms.
- ***Land-use patterns***: Labour force affects the aesthetics due to construction of temporary hutment and disposal of solid wastes. However, assessment of whether the labour force belongs to the local region or needs to be brought in can be made, based on which area management can be planned and implemented.

- ***Hydrology***: Prediction of impact on hydrology can be made by assessing the projects water requirements during the construction and operation phases and determination of permissible safe yields, i.e, the maximum sustained withdrawal rate from an aquifer. Runoff from the site can also be evaluated using empirical equations and simple models

66.4 Impacts on biology/ecology

The productivity of a coastal area is enhanced by the presence of the mud flats, mangroves, coral reefs, lagoons and other ecologically sensitive species and a function of nature of tides, currents etc. Productivity can be evaluated by estimating the phytoplankton, zooplankton and fish population. The loss of biomass due to piling, dredging, land reclamation, etc can be evaluated by simple mathematical equations. Professional and scientific judgement can be used to estimate the impact of temperature, salinity, DO and suspended solids on ecology.

Tools to assist the expert in the prediction of impacts are:

- **Statistical estimates of bio-diversity such as the Shannon-Weavers Diversity Index or species richness indices from the rarefaction method or Jack-Knife estimates. These statistical estimates should be compared with other values for similar environments only;**
- **Biomass and energy pyramids that are aids to define the food chains and the health of the ecosystem. The baseline structure helps in the assessment of the impact of the abiotic environment on the ecosystem;**
- **Nutrient cycles that can help define potential impacts such as eutrophication, contribution to green house gases.**

Mathematical models have also been developed for ecological energetic or the study of the flow of energy within an ecosystem and ecological modelling for specialised ecosystem. If an EIA consultant uses these methods, a determination must be made to ensure appropriateness to the tropical coastal ecosystem of India.

66.5 Impact on socio-economics / socio culture

Construction activities provide temporary employment opportunities for skilled and unskilled labour. Some of the social impacts that need to be assessed are:

Socio-economics

- Additional employment opportunities to the locals and the improved infrastructure;

- Additional population increase (service sector) due to the project and data on tourist influx during peak season;
- Resettlement issues due to the displacement of indigenous population;
- Restriction on fishing due to constrained access to private beaches;
- Loss of rural areas and agricultural lands and exodus of indigenous population from agricultural profession into service sector;
- Increased cost of living for the locals due to competition from the tourist influx;
- High energy costs due to requirement of increased power supply demands

Socio-cultural

Qualitative assessment from professional experience needs to be made for the effects of:

- Change in lifestyle for local ethnic population with market economics.
- Possible increase in alcohol, drug abuse, prostitution, allied to major health risks

66.6 Summary of prediction

Predictions consist of estimating the impacts of the proposed project and overlaying the baseline on it, from which impacts of the project can be evaluated. Comparison with national standards for air, noise and water quality can be made from these estimates. Significance of impacts needs to be assessed with proposed environmental management plans and/or with best housekeeping practises.

However this summary must be compared with other sites where similar summaries were generated. The other method is to compare the impact magnitude against known standards. The drawback with this is that standards are not available for all cases. Given these constraints, the EIA consultant can choose to provide a matrix of adverse impacts and state their significance. Impacts need to be summarised in an EIA study to determine whether they are significant, manageable or insignificant.

67.0Significance of impacts

One method to determine impact significance is by consideration of the impact characteristic (Section 4.1.1) and the importance (weightage) attached to them.

Significance $= f\,\{\text{Impact characteristic, importance}\}$

The predicted impacts need to superimposed on the existing background concentrations and compared with standards. There may however be no appropriate technical standard for a social or a visual impact and resources that require sustainability. Significance in such cases must be derived from community preferences and can be discovered through public involvement or other special methods. (E.g. Delphi techniques).

The key basis for assessing impact significance are: level of public concern over health and safety, scientific and professional judgement, disturbance/destruction of valued ecological systems and degree of negative impact on social values and quality of life.

Significance can be determined based on ecological importance, social importance and environmental standards.

68.0 Example of Summary of Prediction

Issues considered for prediction[2]	*Results of Prediction*	*Impact Significance*
	Air quality Impacts	
Vehicular emissions during transportation of raw materials for 137 numbers/ day of additional vehicles	The increase in the concentration of NOx, CO and HC at a distance of 500m is negligible and the overall concentrations conform to NAAQS	Low
	Noise quality Impacts	
Piling operations	Noise levels are reduced to background levels within 50m from the source and conform to NAAQS. No noise sensitive receptors within 500m	Low
	Water quality Impacts	
Release of bilge, oily wastes and wastewaters from cruise liners	The baseline levels near the pier show signals of WQ standard violations.	The discharge needs to be monitored and regulated
	Land / Biology / benthic Ecology	
Ecological impacts of dredge dump disposal on land	Non toxic sediments shall not impact groundwater quality at the dump location No flora/ fauna at the dump location No benthos as dumping is not carried out in intertidal areas	Low
	Socio Economics	
Employment	Temporary employment during construction phase and employment for unskilled jobs during operations phase	Positive impact
	Net Significance	**Low and requires regular monitoring**

Environmental Management

69.0 INTRODUCTION

Poor tourism management can damage natural resources, which in turn shall adversely affect the tourism industry. In order to achieve sustainable tourism and economic growth, it is essential that strategic plans be developed at the planning level and environmental controls are implemented at the tourism site.

Broad areas, which need to be covered at the planning level, are:

- Standards for tourism resort ambience (density, building height, landscaping etc.) governed by the CRZ Notification, 1991 by the MoEF Annexure–II (Table 2.1);
- Site selection and site and building design including water and wastewater management systems, drainage etc;
- Management of construction activities; and
- Evaluation of supporting infrastructure such as transportation and road networks, waste collection and disposal etc. (State coastal development & management plans – e.g. CZMP)
- Carrying capacity studies before designating an area for tourism development.

Site-specific areas of environmental control are:

- Limiting the number of tourists or promoting off-season tourism, i.e., capacity management.
- Promotion of public transport or shuttle services during peak seasons to minimise large number of private vehicles and consequent congestion.
- Improvement of infrastructure like water, wastewater, solid waste and other such services to handle peak tourist requirements.
- Restriction on amount of water pumped from aquifers, installation of water recycling and rainwater harvesting systems.
- Designation of “no anchoring” areas in coral, sea grass beds, or other fragile habitats.
- Educating the tourists and tourist industries about environmentally sound practices.

69.1 Best Management Practice

Pollution prevention and control is required to mitigate or eliminate the impacts of tourism, since pollution prevention is more cost effective than repairing damage caused by uncontrolled tourism. Mitigation/planning measures shall be followed for minimising environmental impacts for each category of the tourism project during construction and operational stages of the project. Additionally, attitudes promoted and information shared with guests, help reduce impacts on the natural system.

Requirements for best management practice (BMP) at the planning level shall cover:

- Site and building design
- Construction / operations phase mitigation measures

Area of operations for which BMP have to be identified include:

- Facilities maintenance
- Recreation
- Waste management
- Water and energy usage
- Public/social interaction

70.0Site and building design

The objective of site management is to maintain the attributes of the site by managing the impacts through design improvements as suggested below.

- Integration of site and building designs with the environmental setting of the location.
- Provision of beach access to locals shall be planned.
- Construction on slopes shall be avoided in order to minimise/prevent erosion; Buildings shall be sufficiently away from the beach.
- Direct discharge into water bodies from drains, roadways and parking lots etc. shall be avoided. Roads shall be designed so as to reduce runoff from the site.
- Design and materials that improve conservation of energy shall be used
- Water conservation designs and strategies shall be followed. Use of permeable surfaces wherever possible shall be made. Rainwater harvesting measures shall be implemented.

71.0Construction & operation phase mitigation measures

The impacts of the various activities of the project and the specific measures that need to be implemented during construction and operation phases of the project are suggested in tables 7.1 to 7.5

Table 69.1 Transportation of raw materials

Potential Impacts	Mitigation	Implemented by	Timing
Generation of Noise	• **Periodic maintenance of vehicles shall be ensured**	Contractor	Construction
Generation of dust	• **Materials shall be covered with tarpaulin sheets during transport**	Contractor	Construction
Vehicular emissions	• **There shall be periodic emission check for vehicles**	Contractor	Construction

Table 69.2 Construction activities / fabrication and welding

Potential Impacts	Mitigation	Implemented by	Timing
Generation of Noise	• **Ear protection devices and helmets shall be provided for workers**	Contractor	Construction
Generation of dust	• **Concrete mixing plants shall be located atleast 500m away from dwellings/offices** • **Masks shall be provided for workers** • **Waste materials shall not be burnt**	Contractor	Construction
Equipment emissions	• **Equipment/ machinery shall be periodically checked for emission levels** • **Regular maintenance of equipment shall be done**	Contractor	Construction
Exploitation of water resources	• **Water shall be obtained only from approved locations**	Contractor	Construction
Increased turbid runoff	• **Stockpile of materials shall be located atleast 100m away from waterfront** • **Sediment runoff shall be intercepted by hay bales or detention trenches**	Contractor	Construction

Table 69.3 Labour Force

Potential Impacts	Mitigation	Implemented by	Timing

Generation of wastewater	• **Proper sanitary facilities shall be provided** • **Septic tanks/soak pits shall be provided for collection of toilet wastes** • **Ensure treatment of domestic sewage and treated effluent shall comply with standards**	Contractor	Construction / Operation
Exploitation of water resources	• **Water shall be obtained only from approved sources**	Contractor	Construction
Generation of solid waste	• **Solid wastes shall be collected in dustbins and dispose it in approved land fill sites and organic solidwastes can be composted.**	Contractor	Construction

Table 69.4 Marina development/Capital / Maintenance Dredging

Potential Impacts	Mitigation	Implemented by	Timing
Turbidity/ water quality deterioration	• **Confined method of dredging with turbidity reduction measures such as hopper dredging, or silt fences** • **Disposal shall be done in designated areas**	Contractor	Constructio n
Coastal erosion	• **Limited number of boats shall be used to limit wakes** • **Coastal vegetation shall be preserved/rehabilitated/regenerated**	Contractor	Constructio n
Generation of noise	• **Workers shall be provided with ear plugs**	Contractor	Constructio n
Emissions from dredging equipment	• **Emission check on equipment shall be done before every operation**	Contractor	Constructio n
Accumulation of anti-fouling agents shall harm shellfish and other marine life	• **Anti-fouling paints shall not be used** • **Boat maintenance shall be restricted to approved areas**	Proponent	Constructio n

Table 69.5 Boat operations/Cruise ships

Potential Impacts	Mitigation	Implemented by	Timing
Water quality impacts from discharge of oil and oil sludge, domestic refuse (raw sewage, plastics), engine room waste, wastewater, bilge water etc.	• **All liquids containing oil shall pass into the sea only via oil separation systems** • **Sludge shall not be discharged. The sludge and the separated oil residues are either to be incinerated on board in special furnaces or discharged to oil collection facilities** • **Adequate facilities for discharging oily residues shall be provided and effective supervision and monitoring of adherence to the regulations shall be done** • **Different types of refuse shall be collected in separate containers and temporarily stored till they are disposed to appropriate facilities on shore**	Proponent	Operation
Exhaust emissions	• **Exhausts shall be frequently cleaned** • **Use of fuel of approved quality** • **Correct adjustment and maintenance of engines and boilers shall be ensured**	Proponent	Operation
Destructin of coral, sea grass beds due to dropping of anchors.	• **Designation of "no anchoring" areas in fragile habitat areas, placement of stable mooring buoys in reef/lagoon areas** • **Distribution of maps of the area for identification of fragile areas.**	Proponent	Operation
Shoreline erosion from boat wakes and sediment disturbance from large boats	• **Control on boat speeds in narrow stretches** • **Designated areas for anchoring of large boats**	Proponent	Operation

72.0Facilities maintenance

Implementation of effective management systems can occur along every point in the supply chain comprising the sectors providing accommodation, transportation, travel agents, supplies and the tourists themselves. For example, hotels can exert influence on suppliers to provide products that minimize environmental impacts. Similarly travel agents can influence tourists through education and provision of options to reduce resource use. The following sections describe some specific measures for effective management.

Waste Management

Collection, treatment and removal of wastewater and solidwaste shall either be the responsibility of the tourism project proponent or shall be integrated in the local waste disposal plan. However, if the local Panchayat/municipalities are not equipped to handle such wastes, it is the responsibility of the project proponent to provide sewage treatment and solidwaste disposal facilities.

Issues to be considered while planning solidwaste handling can be:

- Segregation of different kinds of solidwastes
- Type of disposal (incineration, composting, landfill etc.)

Implementation of environmentally acceptable purchase policies, effective staff training, environmental management etc. is necessary for reducing the amount of wastes, recycling and treating, the responsibility of which lies with the project proponent. Some possible measures to reduce the amount of solidwaste are:

- Purchase of liquids in bulk, eliminating the supply of canned drinks, disposable bottles or packaged foodstuffs, plastic plates, cups, containers etc., use of linen / hand towels instead of paper napkins
- Recycling of organic wastes by composting
- Education of staff / tourists in environmental awareness

Management of effluents include:

- Designing the wastewater system to permit separation of grey water from sewage, which can be used in irrigation, green belt development and flush toilets.
- Eliminating the use of detergent containing phosphates.

Water conservation:

- Regular checks of plumbing fixtures to reduce leaks shall be carried out
- Low flow showerheads, low flush toilets etc., shall be used
- Recycling of water (laundry water and grey water for flushing toilets, watering lawns etc.) shall be practised
- Groundwater recharge measures such as rainwater harvesting, leaving parking lots unpaved etc. shall be adopted

Energy conservation

- Wherever possible, solar energy shall be utilised for water heating and exterior lighting.
- Routine maintenance of electrical appliances (refrigerators, air conditioners etc) shall be carried out
- Fluorescent lighting shall be used instead of incandescent bulbs
- Wherever possible, public areas shall be designed to be open spaces

Recreation facilities management

- Heavily used beaches shall have night cleanup for garbage.

- Jet skis or other motorised equipment shall not be operated in swimming areas
- Piers and moorings shall be placed with minimal or no obstruction to the coastal hydrodynamics
- Dune vegetation and seagrass shall not be removed from the beach
- Boat maintenance shall be done away from the seashore

72.1 Monitoring and EMP implementation

Monitoring is a tool to identify environmental damage and propose changes when a project is not meeting the environmental standards. Audits can be used to identify significant wastage of water and energy at sites with poor environmental practice Regular data collection can identify environmental deterioration and/or improvement.

Implementation of EMP can be done effectively by defining responsibilities for which the following points shall be taken into consideration

- A management representative for e.g., an Environmental Management Cell (EMC) head shall be made responsible for implementing and maintaining the Environmental Management System (EMS) who shall have clearly defined roles, responsibilities and authorities.
- An organization structure may be developed for implementing the EMP with responsibilities and authorities assigned.
- Job functions that could have an impact on the environment can be identified and job descriptions written for each of them
- Operating procedures may be prepared to define specific responsibilities and critical functions of each position in a single paragraph or a small series of bulleted points
- Training can be provided such that each person/operator understands his/her responsibilities and the extent of his/her authority, as well as general roles of others.

It must be recognised that it is not be feasible to employ personnel exclusively for EMP implementation and/or monitoring, or the EMC head cannot be solely responsible for all issues pertaining to environmental management. Environmental responsibilities shall form an integral part of each personnel's job. For this approach to be successful, employees have to understand exactly how their jobs impact the environment. While the EMC head is responsible for overall environmental management and quality, key personnel in the implementation of the Environmental Management Plans (EMP) are:

160. Managers, engineers' in-charge of various development activities (site engineer, estate managers, safety officers etc.);
161. Contractors, machinery / equipment operators or marina, boat operators etc;
162. Operators who maintain and test various sporting equipments and boats;

163. Maintenance staff.

For example, the estate manager could do routine monitoring of sporting equipment / boats using his judgement. The responsibility of advising the operator in maintaining the equipment should form an integral part of the estate manager’s job. Only in the event of non-compliance or due to reasons beyond the estate manager’s control will he report to the EMC/management to initiate appropriate action

For effective implementation of the EMP, it is the management’s direct responsibility to understand what resources are necessary for routine operations and special operations and to ensure that they are made available.

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Annexure A

SAMPLE EIA

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BASELINE STUDY DESIGN

The extent of baseline study requirement is a function of the project activities. A small-scale tourist facility may consist of a resort; a restaurant etc and use the existing infrastructure at the site. A large-scale facility may consist of resorts, cottages, swimming pools, multi-cuisine restaurants, amusement parks etc, which may require additional infrastructure such as DG sets for power generation, desalination plant for water supply etc.

A small-scale development requires only a limited amount of pre-project environmental assessment. While most of the data required for the analysis can be obtained as secondary information from the municipalities, town panchayats, town-planning authorities etc., a few parameters may be required to be analysed on-site depending on the project and environmental setting. The baseline study requirement is determined from the scoping process.

A sample EIA study for a small scale and a large-scale facility is described in the following sections to give a brief insight into the process.

SAMPLE EIA FOR LARGE SCALE BEACH RESORT

Table A-1 Baseline Study Design

Proposed facility	Project setting	Environmental setting	Resource requirement / waste generation	Parameter to be assessed
40 double bedroom, 8 single bedroom, Swimming pool, Parking facility, Landscaping, Internal access roads, Multi-cuisine restaurant, 20 single bedroom staff quarters for employees	Existing infrastructure such as roads, water supply, wastewater and solidwaste collection system etc.	Terrain, coastal features, vegetation, sand dunes, drainage pattern, slopes, land use, land cover etc. Sources of water supply / quality. Solidwaste disposal sites in the locality	200 cum of water / day 3500 kW / day 200 cum of wastewater 20 tons of solidwaste	Quantity/ quality (pH, DO, Suspended solids, TDS, Chlorides, Sulphates, Calcium, magnesium, iron, fecal coliforms) Soil type, permeability Specific fauna / vegetation Visual inspection for land use pattern, secondary data from revenue department, municipality, Town panchayat, Town planning authority
DG sets	Two numbers (one standby) of capacities 750 KVA; Available power from SEB_________	Sources of air pollution and noise generation. Present air quality & noise level status (comparison with NAAQS)	Peak diesel consumption 160litres/ hour	Air Quality (SPM, SO_2, NOx, HC) Noise sensitive receptors, noise levels Temperature, wind speed, predominant wind direction, monsoon & seasons

Proposed facility	Project setting	Environmental setting	Resource requirement / waste generation	Parameter to be assessed
Desalination plant	Intake and discharge locations. Process and Instrumentation details.	Presence of ecologically sensitive mangroves, corals, seagrass etc.	Capacity of desalination unit 300 cum/ day Details of additional facilities like settling tanks etc. Quantity of brine generated 200cum/ day.	Current speeds and directions, wave heights, tides Depth contours upto 30m Marine water quality such as temperature, Total suspended solids, pH, salinity, DO, BOD, chlorides, Biological characteristics of Phytoplankton, zooplankton Sediment quality,:benthic flora & fauna
Wastewater treatment facility	Process and Instrumentation details. Additional facilities like settling tanks, clarifiers, sludge drying beds exist.	Location of potable water sources in the vicinity Quality of treated effluent	Capacity of treatment unit 200cum/ day	Water quality of groundwater or any source in the plant's vicinity (pH, DO, Suspended solids, TDS, Chlorides, Sulphates, Calcium, nutirents, fecal coliforms)
Amusement parks	Existing infrastructure such as roads, water supply, wastewater and solidwaste collection system etc.	Terrain, coastal features, vegetation, sand dunes, drainage pattern, slopes, land use, land cover etc. Sources of water supply/ quality.	10 cum of water / day 50 kW / day 5 cum of wastewater 2 tons of solidwaste	Noise sensitive receptors, noise levels Landuse pattern Air Quality (SPM, SO_2, NOx, HC)

Proposed facility	Project setting	Environmental setting	Resource requirement / waste generation	Parameter to be assessed
Marina development	Existing infrastructure such as landing piers, jetties.	Coastal features, sand dunes	10 cum of water / day 10 kW / day	Quantity/ quality (pH, DO, Suspended solids, nutrients, faecal coliforms, oil & grease, PHC) Aesthetics, solid waste disposal locations
			5 cum of wastewater 2 tons of solidwaste	Air Quality (SPM, SO_2, NOx, HC) Noise sensitive receptors, noise levels

Summary of baseline

Baseline investigations on water quality, noise levels, ecology and socio-economic revealed the following:

- Ground water does not indicate any pollution
- Marine water quality meets the appropriate standards and does not indicate any pollution stress
- Air quality and noise levels conform to NAAQS
- There is dense vegetation in the project location. Rare or endemic species of fauna are not reported. There are some stunted mangroves located 5 Km south off the proposed site
- There are no sand dunes
- Traditional occupation of the locals are fishing and agriculture. Literacy levels are low and infrastructure is poor

Summary of prediction

- Construction phase impacts on air quality shall be negligible and limited to the project vicinity
- Local labour shall be used for construction so that there shall be no water demand or sanitation problems.
- Pier construction for marina development shall be done on piles and therefore there shall be no change to hydrodynamics. Boat repairs shall be carried out in designated areas and the aesthetics shall be maintained
- Water is obtained from municipal water supply. There shall be no groundwater withdrawal and therefore groundwater will not be affected. Additional water requirements shall be met from desalination plant. Modeling of the dishcarge of brine water indicates that the concentrations of brine shall return to background levels within 500 m of the discharge location.
- Feedwater for desalination plants shall be obtained from infiltration well to eliminate chemical pretreatment
- Desalination shall use Reverse Osmosis process which is considered to be energy efficient. Sludge, coagulants etc., from desalination plant shall not be disposed in coastal waters but transferred to a landfill site identified
- Wastewater treatment facility shall be designed for handling peak discharges. There shall be routine maintenance of the treatment facilities. Treated water shall be used for green belt development..
- Air quality modeling for DG set operation was carried out using Guassian dispersion models. The air quality issues associated with the facility operation would be negligible and within standards during wind speeds of 4m/s.. However, DG sets shall not be operated during periods of inversion or when wind speeds drop below 2m/s..
- The additional number of vehicles due to the facility shall be about 50 cars and 5-10 heavy vehicles/day. This will have a limited impact on the local traffic system and create congestion during peak seasons. Modeling of air quality and noise levels using Guassian models indicate that the pollution associated with the additional numbers of vehicles shall be incremental over the existing levels and conform to NAAQS

- There is no dredging or dumping. Also the discharge from desalination plant reaches background levels within 500m and therefore there shall not be any impact on stunted mangroves located 5 Km away.
- Solidwaste shall be segregated. Organic wastes shall be composted and others shall be incinerated.

Environmental Management Practice

- Twice the number of vegetative cover removed shall be planted before the commencement of construction
- Parking lots shall not be paved. Rainwater harvesting shall be done from rooftops and gently graded open areas.
- Liquids shall be procured in bulk. Canned items shall not be procured
- Plastic disposable cups / bottles shall not be used
- Locals shall be employed for jobs like gardening, cleaning etc.

Conclusions

- The project generates negligible pollution during construction phase from transportation of raw materials
- There shall be temporary employment for the locals during construction phase
- The facility requires an efficient environmental management system for regular monitoring of the wastewater treatment plant and DG set operation and shall cause an incremental impact on the existing environment which is within acceptable limits.

SAMPLE EIA FOR SMALL SCALE BEACH RESORT

Table A-2 Baseline Study Design

Proposed facility	Project setting	Environmental setting	Resource requirement / waste generation	Parameter to be assessed
20 double bedroom resort, Swimming pool, Parking facility, Landscaping, Multi-cuisine restaurant	Existing infrastructure such as roads, water supply, wastewater and solidwaste collection system etc.	Terrain, coastal features, vegetation, sand dunes, drainage pattern, slopes, land use, land cover etc. Sources of water supply / quality, Solidwaste disposal sites in the locality	50 cum of water / day 500 kW / day 30 cum of wastewater 4 tons of solidwaste	Quantity/ quality (pH, DO, Suspended solids, TDS, Chlorides, Sulphates, Calcium, magnesium, iron, fecal coliforms) Specific fauna / vegetation Visual inspection for land use pattern, secondary data from revenue department, municipality, Town panchayat, Town planning authority
Wastewater treatment facility	Process and Instrumentation details	Location of potable water sources in the vicinity Quality of treated effluent	Septic tank capacity 500 cum	Water quality of groundwater or any source in the plant's vicinity (pH, DO, Suspended solids, TDS, Chlorides, Sulphates, Calcium, nutirents, fecal coliforms)
Beach access	Umbrellas, lifeguard, refreshment kiosks.	Terrain, coastal features, vegetation, sand dunes	2 cum of water / day 5 kW / day 0.5 cum of wastewater 500 kg of solidwaste	Noise sensitive receptors, noise levels. Sand dunes

Summary of baseline

Baseline investigations on water quality, noise levels, ecology and socio-economic revealed the following:

- Ground water does not indicate any pollution
- Noise levels conform to NAAQS
- There is dense vegetation in the project location, but rare or endemic species.of flora or fauna are not reported
- There are no sand dunes
- Traditional occupation of the locals are fishing and agriculture. Literacy levels are low and infrastructure is poor

Summary of prediction

- Contruction phase impacts on air quality shall be negligible and limited to the project vicinity
- Local labour shall be used for construction so that there shall be no water demand or sanitation problems
- Water is obtained from municipal water supply. There shall be no groundwater withdrawal and therefore groundwater will not be affected.
- Wastewater from bathrooms and kitchen shall be collected separately and used for gardening purposes and grit removal. Decanted water from septic tank shall be used for green belt development after disinfection.
- There are no air quality problems associated with the facility operation. No air pollution from DG sets or other sources in the vicinity. The additional number of vehicles due to the facility shall be about 20 cars and 2-3 heavy vehicles/day, which shall have negligible impacts on air and noise quality
- Solidwaste shall be segregated. Organic wastes shall be composted and others shall be incinerated.

Environmental Management Practice

- Twice the number of vegetative cover removed shall be planted before the commencement of construction
- Parking lots shall not be paved. Rainwater harvesting shall be done from rooftops and gently graded open areas.
- Liquids shall be procured in bulk. Canned items shall not be procured
- Plastic disposable cups / bottles shall not be used
- Locals shall be employed for jobs like gardening, cleaning etc. Staff shall be provided accommodation in the nearby villages.

Conclusions

- The project generates negligible pollution during construction phase from transportation of raw materials
- There shall be temporary employment for the locals during construction phase
- The proposed facility shall not have any significant impact on the environment
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