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IL&FS | Environment

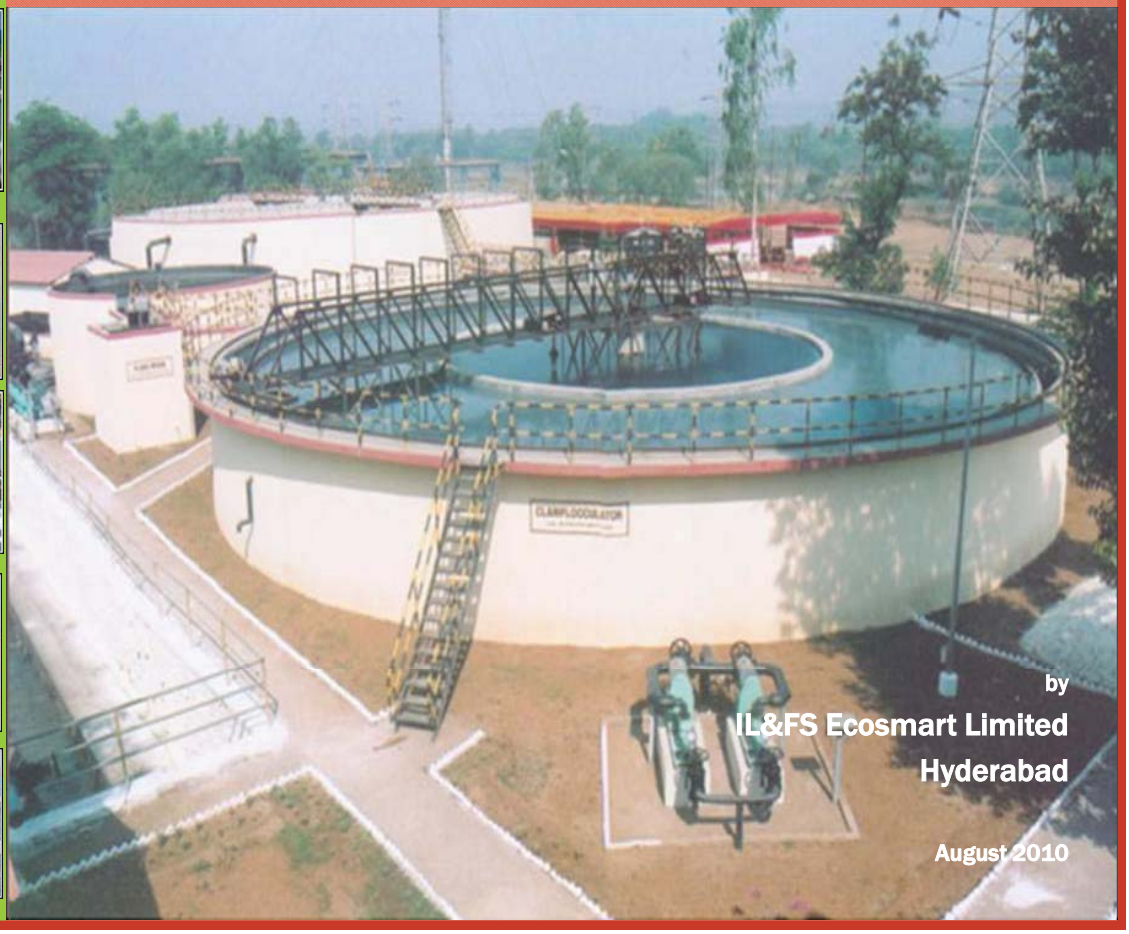
TECHNICAL EIA GUIDANCE MANUAL
FOR
COMMON EFFLUENT TREATMENT PLANTS

Prepared for

The Ministry of Environment and Forests
Government of India







by

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ACRONYMS

AAQ	Ambient Air Quality
BAT	Best Available Technology
BOD	Biological oxygen demand
BOO	Build-Own-Operate
BOT	Build-Operate-Transfer
CCA	Conventional Cost Accounting
CETP	Common Effluent Treatment Plant
CFE	Consent for Establishment
COD	Chemical Oxygen Demand
CRZ	Coastal Regulatory Zone
CSNL	Cashew Nut Shell Liquid
EAC	Expert Appraisal Committee
EBM	Environmental Baseline Monitoring
EcE	Economic-cum-Environmental
ECI	Environmental Condition Indicators
EIA	Environmental Impact Assessment
EIS	Environmental Information system
EPI	Environmental performance indicators
EMS	Environmental Management System
EMP	Environmental Management Plan
FCA	Full Cost Assessment
FSS	Fixed Suspended Solids
HAPs	Hazardous Air Pollutants
HDPE	High Density Poly Ethylene
HTL	High Tide Line
IL&FS	Infrastructure Leasing and Financial Services
LDAR	Leak Detection and Repair
LCA	Life Cycle Assessment
LTL	Low Tide Level
MEE	Multi-effect Evaporator
MoEF	Ministry of Environment & Forests
MSDS	Material Safety Data Sheets
O&M	Operation and Maintenance
QA/QC	Quality Assurance/Quality Control
QRA	Quantitative Risk Assessment
RO	Reverse Osmosis

RSPM	Respirable Suspended Particulate Matter
SBR	Sequencing Batch Reactor
SMEs	Small and Medium Entrepreneurs
SEAC	State Level Expert Appraisal Committee
SEIAA	State Environment Impact Assessment Authorities
SPCB	State Pollution Control Board
SPM	Suspended Particulate Matter
SS	Suspended Solids
TA	Technology assessment
TCA	Total Cost Assessment
TDS	Total Dissolved Solids
TEQM	Total Environmental Quality Movement
TGM	Technical EIA guidance manuals
UASB	Up flow Anaerobic Sludge Blanket
UTEIAA	Union Territory Level Environment Impact Assessment Authorities
UTPCC	Union Territory Pollution Control Committee
VEC	Valued Environmental Components
VSS	Volatile Suspended Solids
WBCSD	World Business Council on Sustainable Development

IL&FS | Environment

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Acknowledgement

The Notification issued on the prior environmental clearance process by the Ministry of Environment and Forests (MoEF) on September 14, 2006 delegated substantial powers to the State Level Environment Impact Assessment Authorities (SEIAA) to grant environmental clearance for certain categories of developmental activities/projects. It was felt that proper guidance to the stakeholders would enhance appreciation of environmental impacts of proposed projects and possible mitigation measures. Further, such a guidance would also help ensure that decision making authorities across different States and Union Territories could adopt similar considerations and norms with due weightage for site-specific considerations.

We feel privileged to be part of the interventions being spearheaded by Sh. Jairam Ramesh, Hon'ble Minister, MoEF, Government of India, to mainstream environmental considerations in the decision making process. IL&FS Ecosmart as part of this important initiative, prepared Technical EIA Guidance Manuals for 27 identified development activities. In view of the diversity of 27 developmental activities entrusted to IL&FS Ecosmart Ltd., in consultation with the MoEF, an expert Peer and Core Committee was constituted to review and finalize each of the draft Manuals. The Manuals prepared by IL&FS were technically reviewed and up-dated by the respective sector-specific expert resource persons.

The Manuals designed by the Expert Committee have benefitted from the advise and feedback received from MoEF. The Manuals are designed to provide readers with an in-depth understanding of the environmental clearance mechanism, developmental activity specific environmental impacts with possible mitigation measures, environmentally compliant manufacturing/ production processes and pollution control technologies, etc.

IL&FS Ecosmart hopes that these Manuals are a step forward to realize the MoEF's desired objective of enhancing functional efficiency and effectiveness in the environmental clearance process. We hope the stakeholders will find the Manuals useful.

We take this opportunity to convey our appreciation to the MoEF team under the leadership of Mr. J.M. Mauskar, Additional Secretary, for the technical inputs, guidance and support extended throughout the project period for successful completion of the project. The technical guidance and support extended by the Expert Peer and Core Committee under the Chairmanship of Dr. V. Rajagopalan, former Chairman, Central Pollution Control Board and inputs of the sector-specific resource persons are gratefully acknowledged.

(Mahesh Babu)

15th November 2010

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FOREWORD

The Ministry of Environment & Forests (MOEF) introduced the Environmental Impact Assessment (EIA) Notification 2006 on 14th September 2006, which not only reengineered the entire environment clearance (EC) process specified under the EIA Notification 1994, but also introduced a number of new developmental sectors which would require prior environmental clearance. The EIA Notification 2006 has notified a list of 39 developmental sectors which have been further categorised as A or B based on their capacity and likely environmental impacts. Category B projects have been further categorised as B1 and B2. The EIA Notification 2006 has further introduced a system of screening, scoping and appraisal and for the setting up of Environment Impact Assessment Authority (EIAA) at the Central level and State Level Environment Impact Assessment Authorities (SEIAAs) to grant environmental clearances at the Central and State level respectively. The Ministry of Environment & Forests is the Environment Impact Assessment Authority at the Central level and 25 State Level Environment Impact Assessment Authorities (SEIAAS) have been set up in the various States/UTs. The EIA Notification 2006 also stipulates the constitution of a multi-disciplinary Expert Appraisal Committee (EAC) at the Centre and State level Expert Appraisal Committees (SEACs) at State/UT Level for appraisal of Category A or B projects respectively and to recommend grant/rejection of environmental clearance to each project/activities falling under the various sectors to the EIAA/SEIAAs respectively.

Although the process of obtaining environmental clearance consisting of Screening, Scoping and Appraisal and for undertaking public consultation including the process of conduct of Public Hearing has been elaborated under the EIA Notification 2006, the Notification itself provides for bringing out guidelines from time to time on the EIA Notification 2006 and the EC process with a view to bringing clarity on the EC process for expediting environmental clearance. This need was further reinforced after the constitution of SEIAAs and SEACs in various States, who were assigned the task for the first time and for addressing the concerns of standardization of the quality of appraisal and in reducing inconsistencies between SEACs/SEIAAs in granting ECs for similar projects in different States.

The Technical Guidance Manual of **"Common Effluent Treatment Plants"** sector describes types of process and pollution control technologies, operational aspects of EIA with model TOR of that Sector, technological options and waste minimization techniques,

monitoring of environmental quality, post clearance monitoring protocol, related regulations, and procedure of obtaining EC if linked to other clearances for e.g., CRZ, etc.

The potential chemical water contamination, especially from new explored contaminants, has become a growing source of concern. Consequently direct potable reuse of reclaimed water is likely to remain an issue. In response to these increasing concerns, new technologies offering significantly higher removal rates are being designed and implemented. These technologies include pressure-driven membranes, carbon adsorption, advanced oxidation, ion exchange and air stripping systems. The technologies have come a long way. India's industrial competitiveness and environmental future depends on Industries such as Common Effluent Treatment Plants adopting energy and resource efficient technologies. Recycling and reuse of materials is critical.

To keep pace with changing technologies and needs of sustainable development, the manual would require regular updating in the future. The manual will be available on the MoEF website and we would appreciate receiving responses from stakeholders for further improvements.

I congratulate the entire team of IL&FS Ecosmart Ltd., experts from the sector who were involved in the preparation of the Manuals, Chairman and members of the Core and Peer Committees of various sectors and various Resource Persons whose inputs were indeed valuable in the preparation and finalization of the Manuals.

Jairam Ramesh

(Jairam Ramesh)

1. INTRODUCTION TO THE TECHNICAL EIA GUIDANCE MANUALS PROJECT

Environmental Impact Assessment (EIA) is a process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made. These studies integrate the environmental concerns of developmental activities in to the process of decision-making.

EIA has emerged as one of the successful policy innovations of the 20th Century in the process of ensuring sustained development. Today, EIA is formalized as a regulatory tool in more than 100 countries for effective integration of environmental concerns in the economic development process. The EIA process in India was made mandatory and was also given a legislative status through a Notification issued by the Ministry of Environment and Forests (MoEF) in January 1994. The Notification, however, covered only a few selected industrial developmental activities. While there are subsequent amendments, the Notification, issued on September 14, 2006 supersedes all the earlier Notifications, and has brought out structural changes in the clearance mechanism.

The basic tenets of this EIA Notification could be summarized into following:

- Pollution potential as the basis for prior environmental clearance based on pollution potential instead of investment criteria; and
- Decentralization of clearing powers to the State level/Union Territory (UT) level Authorities for certain developmental activities to make the prior environmental clearance process quicker, transparent and effective.

Devolution of the power to grant clearances at the state level for certain category of the developmental activities / projects is a step forward to fulfill the basic tenets of the re-engineering *i.e.*, quicker, transparent and effective process but many issues impede/hinder its functional efficiency. These issues could be in technical and operational as listed below:

Technical Issues

- Ensuring level playing ground to avoid arbitrariness in the decision-making process
- Classification of projects which do not require public hearing and detailed EIA (Category B2)
- Variations in drawing the Terms of Reference (ToR) for EIA studies for a given developmental activity across the States/UTs
- Varying developmental-activity-specific expertise requirement for EIA studies and their appraisal.
- Availability of adequate sectoral experts and variations in competency levels
- Inadequate data verification, cross checking tools and supporting institutional framework

- Meeting time targets without compromising with the quality of assessments/ reviews
- Varying knowledge and skill levels of regulators, consultants and experts
- Newly added developmental activities for prior environmental clearance, *etc*

Operational Issues

- State level /UT level EIA Authorities (SEIAA/UTEIAA) are formulated for the first time and many are functioning
- Varying roles and responsibilities of involved organizations
- Varying supporting institutional strengths across the States/UTs
- Varying manpower availability, *etc*.

1.1 Purpose

The purpose of developing these sector-specific technical EIA guidance manuals (TGMs) is to provide clear and concise information on EIA to all the stakeholders *i.e*., the project proponent, the consultant, the reviewer, and the public. TGMs are organized to cover the following:

Chapter 1 (Introduction): This chapter provides a brief introduction on the EIA, basic tenets of EIA Notification, technical & operational issues in the process of clearance, purpose of the TGMs, project implementation process and additional information.

Chapter 2 (Conceptual facets of an EIA): Provides an overall understanding to the conceptual aspects of control of pollution and EIA for the developmental projects. This basic understanding would set the readers at same level of understanding for proper interpretations and boundaries for identifying the environmental interactions of the developmental projects and their significance for taking measures of mitigation. This chapter covers the discussion on environment in EIA context *i.e.,* sustainable development, pollution control strategies, preventive environmental management tools, Objectives of EIA, types and basic principles of EIA, project cycle for common effluent treatment plant, understanding on type of environmental impacts and the criteria for the significance analysis.

Chapter 3 (Common Effluent Treatment Plant): The purpose of this chapter is to provide the reader precise information on all the relevant aspects of the industry, which is essential to realize the likely interaction of such developmental activities on the receiving environment. Besides, this Chapter gives a holistic understanding on the sources of pollution and the opportunities of the source control.

The specific coverage which provides precise information on the industry include (i) Introduction, (ii) Planning of CETPs - Categories of effluent generating industries, Qualitative/quantitative fluctuations of effluent, Waste minimization, Pre-treatment requirements, Segregation of effluent streams at the individual member industry, Conveyance system, Treatability and choice of technology, Modes of disposal, Cost analysis, (iii) Hazards and Concerns in Wastewater Treatment Facilities - Hazards, Major concerns, Hazardous air pollution, Exposure pathways and (iv) Summary of Applicable National Regulations - General description of major statutes, Inlet and treated effluent quality standards for CETP.

Chapter 4 (Operational aspects): The purpose of this chapter is to facilitate the stakeholders to extend clear guidance on coverage of legislative requirements, sequence

of procedures for obtaining the EIA clearance and each step-wise provisions and considerations.

The coverage of the Chapter include provisions in the EIA Notification regarding proposed industry, screening (criteria for categorization of B1 and B2, siting guidelines, *etc*.), scoping (pre-feasibility report, guidance for filling form 1, identification of valued environmental components, identification of impacts, *etc*.), arriving at terms of reference for EIA studies, impact assessment studies (EIA team, assessment of baseline quality of environment, impact prediction tools, significance of impacts), social impact assessment, risk assessment considerations, typical mitigation measures, designing considerations for environmental management plan, structure of EIA report for incorporation of study findings, process of public consultation, project appraisal, decision making process and post-clearance monitoring protocol.

Chapter 5 (Roles and responsibilities of various organizations involved in the process of prior environmental clearance): The purpose of this Chapter is to brief the stakeholders on the institutional mechanism and roles & responsibilities of the stakeholders involved in the process of prior environmental clearance. The Coverage of the Chapter include (i) roles and responsibilities of the stakeholders, (ii) organization specific functions, (iii) constitution, composition and decision making process of SEIAA and (iv) EAC & SEAC and (v) other conditions which may be considered.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue. Text within each section was researched from many sources, and was condensed from more detailed sources pertaining to specific topics.

The contents of the document are designed with a view to facilitate addressing of the relevant technical and operational issues as mentioned in the earlier section. Besides, facilitates various stakeholders involved in the EIA clearance process, *i.e*.

- Project proponents will be fully aware of the procedures, common ToR for EIA studies, timelines, monitoring needs, *etc*., in order to plan the projects/studies appropriately.
- Consultants across India will have similar understanding about a given sector, and also the procedure for conducting the EIA studies, so that the quality of the EIA reports gets improved and streamlined.
- Reviewers across the States/UTs will have the same understanding about an industrial and would be able to draw a benchmark to establish the significant impacts for the purpose of prescribing the ToR for EIA studies and also in the process of review and appraisal.
- Public who are concerned about new or expansion projects, use this manual to get a basic idea about the manufacturing/production details, rejects/wastes from the operations, choice of cleaner/control technologies, regulatory requirements, likely environmental and social concerns, mitigation measures, *etc*., in order to seek clarifications appropriately in the process of public consultation. The procedural clarity in the document will further strengthen them to understand the stages involved in clearance and roles and responsibilities of various organizations.
- In addition, these manuals would substantially ease the pressure on reviewers at the scoping stage and would bring in functional efficiency at the central and state levels.

1.2 Project Implementation

The Ministry of Environment & Forests (MoEF), Government of India took up the task of developing sector-specific TGMs for all the developmental activities listed in the re-engineered EIA Notification. The Infrastructure Leasing and Financial Services Ecosmart Limited (IL&FS Ecosmart), has been entrusted with the task of developing these manuals for 27 industrial and related sectors as mentioned in the Schedule attached to the EIA Notification issued on September 14, 2006. Common Effluent Treatment Plant (CETP) is one of these sectors, for which this manual is prepared.

The ability to design comprehensive EIA studies for specific industries depends on the knowledge of several interrelated topics. Therefore, it requires expert inputs from multiple dimensions *i.e.,* administrative, project management, technical, scientific, social, economic, risk *etc*., in order to comprehensively analyze the issues of concern and to draw logical interpretations. Thus, Ecosmart has designed a well-composed implementation framework to factor inputs of the experts and stakeholders in the process of finalization of these manuals.

The process of manual preparation involved collection & collation of the secondary available information, technical review by sectoral resource person and critical review & finalization by a competent Expert Committee composed of core and sectoral peer members.

The MoEF appreciates the efforts of Ecosmart, Expert Core and Peer Committee, resource persons and all those who have directly and indirectly contributed to this Manual.

1.3 Additonal Information

This TGM is brought out by the MoEF to provide clarity to all the stakeholders involved in of the 'prior environmental clearance' process. As such, the contents and clarifications given in this document do not withstand in case of a conflict with the statutory provisions of the Notifications and Executive Orders issued by the MoEF from time-to-time.

TGMs are not regulatory documents. Instead, these are the tools designed to assist in successful completion of an EIA. For the purposes of this project, the key elements considered under TGMs are: conceptual aspects of EIA; developmental activity-specific information; operational aspects; and roles and responsibilities of involved stakeholders.

This manual is prepared considering the Notification issued on September 14, 2006 and latest amendment as on 1st December 2009. For recent updates, if any, may please refer the website of the MoEF, Government of India *i.e.,* http://moef.nic.in/index.php.

2. CONCEPTUAL FACETS OF EIA

It is an imperative requirement to understand the basic concepts concerned to the pollution control and the environmental impact assessment in an overall objective of the sustainable development. This Chapter highlights the pollution control strategies and their tools besides the objectives, types & principles of EIA, type of impacts their significance analysis, in order to provide consistent understanding to the reader before assessing the development of activity-specific environmental concerns in Chapter 3 and identification & prediction of significant impacts in order to design mitigation measures as detailed in Chapter 4.

2.1 Environment in EIA Context

'Environment' in EIA context mainly focuses, but is not limited to physical, chemical, biological, geological, social, economical, and aesthetic dimensions along with their complex interactions, which affect individuals, communities and ultimately determines their forms, character, relationship, and survival. In EIA context, 'effect and 'impact' can often be used interchangeably. However, 'impact' is considered as a value judgment of the significance of an effect.

Sustainable development is built on three basic premises *i.e.*, economic growth, ecological balance and social progress. Economic growth achieved in a way that does not consider the environmental concerns will not be sustainable in the long run. Therefore, sustainable development needs careful integration of environmental, economic, and social needs in order to achieve both an increased standard of living in the short term, and a net gain or equilibrium among human, natural, and economic resources to support future generations in the long term.

"It is necessary to understand the links between environment and development in order to make choices for development that will be economically efficient, socially equitable and responsible, as well as environmentally sound."

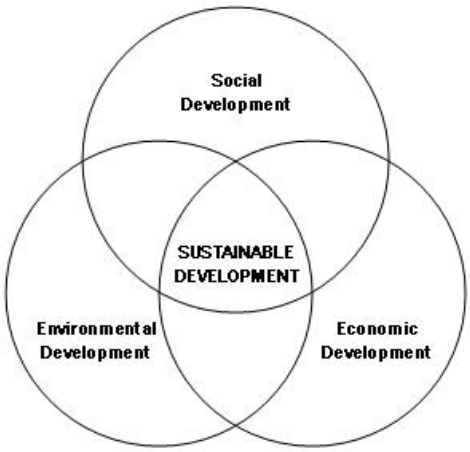

Figure 2-1: Inclusive Components of Sustainable Development

2.2 Pollution Control Strategies

Pollution control strategies can be broadly categorized in to preventive and reactive. The reactive strategy refers to the steps that may be applied once the wastes are generated or contamination of receiving environment takes place. The control technology or a combination of technologies to minimize the impact due to the process rejects/wastes varies with quantity and characteristics, desired control efficiency and economics.

Many combinations of techniques could be adopted for treatment of a specific waste or the contaminated receiving environment, but are often judged based on techno-economic feasibility. Therefore, the best alternative is to take all possible steps to avoid pollution itself. This preventive approach refers to a hierarchy that involves i) prevention & reduction; ii) recycling and re-use; iii) treatment; and iv) disposal, respectively.

Therefore, there is a need to shift the emphasis from the reactive to preventive strategy *i.e.,* to promote preventive environmental management. Preventive environmental management tools may be grouped into management based tools, process based tools and product based tools. A few of them are given below :

Management Based Tools	Process Based Tools	Product Based Tools
Environmental Management System (EMS) Environmental Performance Evaluation Environmental Audits Environmental Reporting and Communication Total Cost Accounting Law and Policy Trade and Environment Environmental Economics	Environmental Technology Assessment Toxic Use Reduction Best Operating Practices Environmentally Best Practice Best Available Technology (BAT) Waste Minimization Pollution Prevention Cleaner Production 4-R Concept Cleaner Technology Eco-efficiency	Industrial Ecology Extended Producers Responsibility Eco-labeling Design for Environment Life Cycle Assessment (LCA)

2.3 Tools for Preventive Environmental Management

These tools for preventive environmental management can be broadly classified in to following three groups.

- Tools for assessment and analysis - risk assessment, life cycle assessment, total cost assessment, environmental audit/statement, environmental benchmarking, environmental indicators
- Tools for action - environmental policy, market based economic instruments, innovative funding mechanism, EMS and ISO certification, total environmental quality movement, eco-labeling, cleaner production, eco-efficiency, industrial ecosystem or metabolism, voluntary agreements
- Tools for communication - state of environment, corporate environmental reporting

Specific tools under each group are discussed in next sections.

2.3.1 Tools for assessment and analysis

2.3.1.1 Risk assessment

Risk is associated with the frequency of failure and consequence effect. Predicting such situations and evaluation of risk is essential to take appropriate preventive measures. The major concern of the assessment is to identify the activities falling in a matrix of high & low frequencies at which the failures occur and the degree of its impact. The high frequency, low impact activities can be managed by regular maintenance *i.e*. Leak detection and repair (LDAR) programmes. Whereas, the low frequency, high impact activities (accidents) are of major concern in terms of risk assessment. As the frequency is low, often the required precautions are not realized or maintained. However, risk assessment identifies the areas of major concerns which require additional preventive measures: likely consequence distances considering domino effects, which will give the possible casualties and ecological loss in case of accidents. These magnitudes demand the attention for preventive and disaster management plans (DMP). Thus is an essential tool to ensure safety of operations.

2.3.1.2 Life cycle assessment

A broader approach followed to deal with environmental impacts during manufacturing is called LCA. This approach recognizes that environmental concerns are associated with every step of the processing w.r.t manufacturing of products and also examines environmental impacts of the product at all stages of project life cycle. LCA includes the product design, development, manufacturing, packaging, distribution, usage and disposal. LCA is concerned with reducing environmental impacts at all stages and considering the total picture rather than just one stage of the production process.

Industries /firms may apply this concept to minimize the costs incurred on the environmental conservation throughout the project life cycle.

2.3.1.3 Total cost assessment

Total cost assessment (TCA) is an enhanced financial analysis tool that is used to assess the profitability of alternative courses of action (*e.g*., raw material substitution to reduce the costs of managing the wastes generated by process; an energy retrofit to reduce the costs of energy consumption). This is particularly relevant for pollution prevention options. These options, because of their nature, often produce financial savings that are overlooked in conventional financial analysis, either because they are misallocated, uncertain, and hard to quantify, or occur more than three to five years after the initial investment. TCA includes all relevant costs and savings associated with an option so that it can compete for scarce capital resources fairly, on a level playing field. The assessments are often beneficial w.r.t the following:

- Identification of costly resource inefficiencies
- Financial analysis of environmental activities/projects such as investment in cleaner technologies
- Prioritization of environmental activities/projects
- Evaluation of product mix and product pricing
- Bench marking against the performance of other processes or against the competitors

A comparison of cost assessments is given below:

- Conventional cost accounting (CCA): Direct and indirect financial costs and Recognized contingent costs
- Total cost assessment (TCA): A broader range of direct, indirect, contingent and less quantifiable costs
- Full cost assessment (FCA): TCA and External social costs borne by society

2.3.1.4 Environmental audit/statement

Key objectives of an environmental audit include compliance verification, problems identification, environmental impact measurement, environmental performance measurement, conforming effectiveness of EMS, providing a database for corrective actions and future actions, developing company's environmental strategy, communication and formulating environmental policy.

The MoEF, Government of India (GoI) issued Notification on '*Environmental Statements*' (ES) in April, 1992 and further amended in April, 1993. As per the Notification, the industries are required to submit ES to the respective State Pollution Control Boards (SPCBs). ES is a pro-active tool for self-examination of the industry to reduce/minimize pollution by adopting process modifications, recycling and reusing of the resources. The regular submission of ES will indicate the systematic improvement in environmental pollution control being achieved by the industry. In other way, specific points in ES may be used as environmental performance indicators for relative comparison, implementation and to promote better practices.

2.3.1.5 Environmental benchmarking

Environmental performance and operational indicators could be used to navigate, manage and communicate significant aspects and give enough evidence of good environmental house keeping. Besides the existing prescribed standards, an insight to identify the performance indicators and prescribing schedule for systematic improvement in performance of these indicators will yield better results.

Relative indicators may be identified for different industrial sectors and be integrated in companies and organizations to monitor and manage the different environmental aspects of the company, to benchmark and compare two or more companies from the same sector. These could cover water consumption, wastewater generation, energy consumption, solid/hazardous waste generation, chemical consumption *etc*., per tonne of final product. Once these bench marks are developed, the industries which are below the may be guided and enforced to reach them while those which are better than the benchmark may be encouraged further by giving incentives, *etc*.

2.3.1.6 Environmental indicators

Indicators can be classified in to environmental performance indicators (EPI) and environmental condition indicators (ECI). The EPIs can be further divided into two categories *i.e*., operational performance indicators and management performance indicators.

The operational performance indicators are related to the process and other operational activities of the organization. These would typically address the issues of raw material

consumption, energy consumption, water consumption in the organization, quantities of waste water generated, other solid wastes & emissions generated from the organization, *etc*.

Management performance indicators are related to management efforts to influence environmental performance of organisational operations.

The environmental condition indicators provide information about the environment. These indicators provide information about the local, regional, national or global condition of the environment. This information helps an organisation to understand the environmental impacts of its activities and thus helps in taking decisions to improve the environmental performance.

Indicators are basically used to evaluate environmental performance against the set standards and thus indicate the direction in which to proceed. Selection of type of indicators for a firm or project depends upon its relevance, clarity and realistic cost of collection and its development.

2.3.2 Tools for action

2.3.2.1 Environmental policy

An environmental policy is a statement of an organization's overall aim and principles of action w.r.t. the environment, including compliance with all relevant regulatory requirements. It is a key tool in communicating environmental priorities of the organizations to all its employees. To ensure an organization's commitment towards a formulated environmental policy, it is essential for the top management be involved in the process of formulating the policy and setting priorities. Therefore, the first step is to get the commitment from the higher levels of management. The organization should then conduct an initial environmental review and draft an environmental policy. This draft should be discussed and approved by the board of directors and finally the approved environmental policy statement should then be communicated internally among all its employees and should also be made available to the public.

The Ministry of Environment & Forests, Government of India published the National Environment Policy, thus the individual firms while making their environmental policies may like to refer the national environment policy for synchronization

2.3.2.2 Market-based economic instruments

Market based instruments are regulations that encourage behavior through market signals rather than through explicit directives regarding pollution control levels. These policy instruments such as tradable permits, pollution charge, *etc.,* are often described as harnessing market forces. Market based instruments can be categorized in to the following four major categories, which are discussed below:

- **Pollution charge:** Charge system will assess a fee or tax on the amount of pollution a firm or source generates. It is worthwhile for the firm to reduce emissions to the point, where its marginal abatement cost is equal to the tax rate. Thus firms control pollution to different degrees *i.e*. High cost controllers – less; low-cost controllers-more. The charge system encourages the industries to reduce the pollutants further. The charges thus collected can form a fund for restoration of the environment.

Another form of pollution charge is a deposit refund system, where consumers pay a surcharge when purchasing a potentially polluting product, and receive a refund on return of the product after useful life span at appropriate centers. The concept of extended producers' responsibility brought in to avoid accumulation of dangerous products in the environment.

- **Tradable permits:** Under this system, firms that achieve the emission levels below their allotted level may sell the surplus permits. Similarly, the firms, which are required to spend more to attain the required degree of treatment/allotted levels, can purchase permits from others at lower costs and may be benefited.
- **Market barrier reductions:** Three known market barrier reduction types are as follows:
  - Market creation: Measures that facilitate the voluntary exchange of water rights and thus promote more efficient allocation of scarce water supplies
  - Liability concerns: Encourage firms to consider potential environmental damages of their decisions
  - Information programmes: Eco-labeling and energy efficiency product labeling requirements
- **Government subsidy reduction:** Subsidies are the mirror images of taxes and in theory, can provide incentive to address environmental problems. However, it has been reported that the subsidies encourage economically inefficient and environmentally unsound practices, and often leads to market distortions due to differences in the area. However, in the national interest, subsidies are important to sustain the expansion of production. In such cases, the subsidy may be comparable to the net social benefit.

2.3.2.3 Innovative funding mechanism

There are many forums under which the fund is made available for the issues which are of global/regional concern (GEF, OECD, Deutch green fund, *etc*.) *i.e*., climate change, Basal Convention and further fund sources are being explored for the persistent organic pollutants convention. Besides the global funding mechanism, there needs to be localized alternative mechanisms for boosting the investment in environmental pollution control. For example, in India the Government has established mechanism to fund the common effluent treatment plants, which are specifically serving the small and medium scale enterprises *i.e*., 25% share by the State Government, matching grants from the Central Government and surety for 25% soft loan. It means that the industries need to invest only 25% initially, thus encouraging for voluntary compliance.

There are some more options *i.e*., if the pollution tax/charge is imposed on the residual pollution being caused by the industries, municipalities, *etc*., fund will automatically be generated, which in turn, can be utilized back for funding the environmental improvement programmes. The emerging concept of build-operate-transfer (BOT) and build-own-operate (BOO) is an encouraging development, where there is a possibility to generate revenue by application of advanced technologies, for *e.g.,* the anaerobic treatment for municipal wastewater do generate methane gas which can be utilized for power generation, and the manure can be marketed, *etc*. There are many opportunities that can be explored. However, what is required is the paradigm shift and focused efforts.

2.3.2.4 EMS and ISO certification

EMS is that part of the overall management system, which includes organizational structure, responsibilities, practices, procedures, process and resources for determining and implementing the forms of overall aims, principles of action w.r.t the environment. It encompasses the totality of organizational, administrative and policy provisions to be taken by a firm to control its environmental influences. Common elements of an EMS are the identification of the environmental impacts and legal obligations, the development of a plan for management & improvement, the assignment of the responsibilities and monitoring of the performance.

2.3.2.5 Total environment quality movement

Quality is regarded as

- A product attribute that had to be set at an acceptable level and balanced against the cost
- Something delivered by technical systems engineered by experts rather than the organization as a whole
- Assured primarily through the findings and correction of mistakes at the end of the production process

One expression of the total environment quality management (TEQM) is a system of control called Kaizen. The principles of Kaizen are

- Goal must be continuous improvement of quality instead of acceptable quality
- Responsibility of quality shall be shared by all members of an organization
- Efforts should be focused on improving the whole process and design of products

With some modifications, TEQM approach can be applied in improvement of corporate environmental performance in both process and product areas.

2.3.2.6 Eco-labeling

Eco-labeling is the practice of supplying information on the environmental characteristics of a product or service to the general public. These labeling schemes can be grouped into three types:

- Type I: Multiple criteria base; third party (Govt. or non-commercial private organizations) programme claims overall environmental preferability
- Type II: Specific attribute of a product; often issued by a company/industrial association
- Type III: Agreed set of indices; provide quantified information; self declaration

Among the above, Type I are more reliable because they are established by a third party and consider the environmental impacts of a product from cradle to grave. However, the labeling program will only be effective if linked with complementary program of consumer education and up on restriction of umbrella claims by the producers.

2.3.2.7 Cleaner production

Cleaner production is one of the tools, which has lot of bearing on environmental pollution control. It is also seen that the approach is changing with time *i.e*., dumping-to-control-to-recycle-to-prevention. Promotion of cleaner production principles involves an insight into the production processes not only to get desired yield but also to optimize on raw material consumption *i.e.* resource conservation and implications of the waste treatment and disposal.

2.3.2.8 4-R concept

The concept endorses utilization of wastes as a by-product to the extent possible *i.e*. Re-cycle, Recover, Re-use and Recharge. Recycling refers to using wastes/by-products in the process again as a raw material to maximize production. Recovery refers to engineering means such as solvent extraction, distillation, precipitation, *etc*., to separate the useful constituents of wastes, so that this recovered material can be used. Re-use refers to the utilization of waste from one process as a raw material to other. Recharging is an option in which the natural systems are used for renovation of waste for further use.

2.3.2.9 Eco-efficiency

The world business council on Sustainable Development (WBCSD) defines eco-efficiency as "the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with earth's carrying capacity". The business implements the eco-efficiency on four levels *i.e*. optimized processes, recycling of wastes, eco-innovation and new services. Fussler (1995) defined six dimensions of eco efficiency, which are given below to understand/examine the system.

- **Mass**: There is an opportunity to significantly reduce mass burdens (raw materials, fuels, utilities consumed during the life cycle)
- **Reduce energy use**: The opportunity is to redesign the product or its use to provide significant energy savings
- **Reduce environmental toxins**: This is a concern to the environmental quality and human health. The opportunity here is to significantly control the dispersion of toxic elements
- **Recycle when practical**: Designing for recyclability is important
- **Working with nature**: Materials are borrowed and returned to the nature without negatively affecting the balance of the ecosystem
- **Make it last longer**: It relates to useful life and functions of products. Increasing the functionality of products also increases their eco efficiency

The competitiveness among the companies and long-term survival will continue and the successful implementation of eco-efficiency will contribute to their success. There is a need to shift towards responsible consumerism equal to the efficiency gains made by corporations – doing more with less.

2.3.2.10 Industrial ecosystem or metabolism

Eco-industrial development is a new paradigm for achieving excellence in business and environmental performance. It opens up innovative new avenues for managing business and conducting economic development by creating linkages among local 'resources', including businesses, non-profit groups, governments, unions, educational institutions, and communities. They can creatively foster the dynamic and responsible growth. Antiquated business strategies based on isolated enterprises are no longer responsive enough to market, environmental and community requirements.

Sustainable eco-industrial development looks systematically at development, business and environment, attempting to stretch the boundaries of current practice - on one level. It is as directly practical as making right connections between the wastes and resources needed for production and at the other level, it is a whole new way of thinking about doing business and interacting with communities. At a most basic level, it is each organization seeking higher performance within itself. However, most eco-industrial activity is moving to a new level by increasing the inter connections between the companies.

Strategic partnership, networked manufacturing and performed supplier arrangements are all the examples of ways used by the businesses to ensure growth, contain costs and to reach out for new opportunities.

For most businesses, the two essentials for success are the responsive markets and access to cost-effective, quality resources for production or delivering services. In absence of these two factors, virtually every other incentive becomes a minor consideration.

Transportation issues are important at two levels, the ability to get goods to market in an expeditious way is essential to success in this day of just in time inventories. The use of least impact transportation with due consideration of speed and cost supports business success and addresses the concerned community.

Eco-industrial development works because it consciously mixes a range of targeted strategies shaped to the contours of the local community. Most importantly, it works because the communities want nothing less than the best possible in or near their neighborhood. For companies, it provides a path towards significantly higher operating results and positive market presence. For our environment, it provides great hope that the waste will be transformed into valued product and that the stewardship will be a joint pledge of both businesses and communities.

2.3.2.11 Eco-industrial park

An eco-industrial park is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environment and resource issues including energy, water and raw materials. By working together, the community of businesses seeks a collective benefit that is greater than some of the individual benefits which could be optimized by improving individual performance. The goal of an eco-industrial park is to improve economic performance of the participating companies by minimizing their environmental impacts.

2.3.2.12 Voluntary agreements

Voluntary environmental agreements among the industries, government, public representatives, NGOs and other concerned towards attaining certain future demands of the environment are reported to be successful. Such agreements may be used as a tool where Government would like to make the standards stringent in future (phase-wise-stringent). These may be used when conditions are temporary and require timely replacements. Also these may be used as supplementary/ complimentary in implementation of the regulation. The agreements may include:

- Target objectives (emission limit values/standards)
- Performance objectives (operating procedures)
- R&D activities – Government and industry may have agreement to establish better control technologies.
- Monitoring & reporting of the agreement conditions by other agents (NGOs, public participants, civil authority, *etc*.)

In India, the MoEF, has organized such programme popularly known as the corporate responsibility for environment protection (CREP) considering identified 17 categories of high pollution potential industrial sectors. Publication in this regard, is available with the Central Pollution Control Board (CPCB).

2.3.3 Tools for communication

2.3.3.1 State of environment

The Government of India has brought out the state of environment report for entire country and similar reports are available for many of the states. These reports are published at regular intervals to record trends and to identify the required interventions at various levels. These reports consider the internationally accepted DPSIR framework for the presentation of the information. DPSIR refers to:

- D – Driving forces – causes of concern *i.e*., industries, transportation, *etc*.
- P – Pressures – pollutants emanating from driving forces *i.e*., emission
- S – State – quality of environment *i.e.,* air, water & soil quality
- I – Impact – Impact on health, ecosystem, materials, biodiversity, economic damage *etc*.
- R – Responses – action for cleaner production, policies (including standards/guidelines), targets, *etc*.

Environment reports including the above elements give a comprehensive picture of specific target area in order to take appropriate measures for improvement. Such reports capture the concerns which could be considered in EIAs.

2.3.3.2 Corporate environmental reporting

Corporate environmental reports (CERs) are only one form of environmental reporting defined as publicly available, stand alone reports, issued voluntarily by the industries on their environmental activities. CER is just a means of environmental improvement and greater accountability, not an end in itself.

Three categories of environmental disclosure are:

- Involuntary disclosure: Without its permission and against its will (env. campaign, press, *etc*.)
- Mandatory disclosure: As required by law
- Voluntary disclosure: The disclosure of information on a voluntary basis

2.4 Objectives of EIA

Objectives of EIA include the following:

- To ensure environmental considerations are explicitly addressed and incorporated into the development decision-making process
- To anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of development proposals
- To protect the productivity and capacity of natural systems and the ecological processes which maintain their functions
- To promote development that is sustainable and optimizes resource use as well as management opportunities

2.5 Types of EIA

Environmental assessments could be classified into four types *i.e*. strategic environmental assessment, regional EIA, sectoral EIA and project level EIA. These are discussed below:

Strategic environmental assessment

Strategic environmental assessment (SEA) refers to systematic analysis of the environmental effects of development policies, plans, programmes and other proposed strategic actions. SEA represents a proactive approach to integrating environmental considerations into the higher levels of decision-making – beyond the project level, when major alternatives are still open.

Regional EIA

EIA in the context of regional planning integrates environmental concerns into development planning for a geographic region, normally at the sub-country level. Such an approach is referred to as the economic-cum-environmental (EcE) development planning. This approach facilitates adequate integration of economic development with management of renewable natural resources within the carrying capacity limitation to achieve sustainable development. It fulfills the need for macro-level environmental integration, which the project-oriented EIA is unable to address effectively. Regional EIA addresses the environmental impacts of regional development plans and thus, the context for project-level EIA of the subsequent projects, within the region. In addition, if environmental effects are considered at regional level, then cumulative environmental effects of all the projects within the region can be accounted.

Sectoral EIA

Instead of project-level-EIA, an EIA should take place in the context of regional and sectoral level planning. Once sectoral level development plans have the integrated sectoral environmental concerns addressed, the scope of project-level EIA will be quite minimal. Sectoral EIA helps in addressing specific environmental problems that may be encountered in planning and implementing sectoral development projects.

Project level EIA

Project level EIA refers to the developmental activity in isolation and the impacts that it exerts on the receiving environment. Thus, it may not effectively integrate the cumulative effects of the development in a region.

From the above discussion, it is clear that EIA shall be integrated at all the levels *i.e.* strategic, regional, sectoral and the project level. Whereas, the strategic EIA is a structural change in the way the things are evaluated for decision-making, the regional EIA refers to substantial information processing and drawing complex inferences. The project-level EIA is relatively simple and reaches to meaningful conclusions. Therefore in India, the project-level EIA studies take place on a large scale and are being considered. However, in the re-engineered Notification, provisions have been incorporated for giving a single clearance for the entire industrial estate for *e.g.*, Leather parks, pharma cities *etc*., which is a step towards the regional approach.

As we progress and the resource planning concepts emerge in our decision-making process, the integration of overall regional issues will become part of the impact assessment studies.

2.6 Basic EIA Principles

By integrating the environmental impacts of the development activities and their mitigation early in the project planning cycle, the benefits of EIA could be realized in all stages of a project, from exploration and planning, through construction, operations, decommissioning, and beyond site closure.

A properly-conducted-EIA also lessens conflicts by promoting community participation, informing decision makers, and also helps in laying the base for environmentally sound projects. An EIA should meet at least three core values:

- Integrity: The EIA process should be fair, objective, unbiased and balanced
- Utility: The EIA process should provide balanced, credible information for decision-making
- Sustainability: The EIA process should result in environmental safeguards

Ideally an EIA process should be:

- Purposive - should inform decision makers and result in appropriate levels of environmental protection and community well-being.
- Rigorous - should apply ‘best practicable’ science, employing methodologies and techniques appropriate to address the problems being investigated.

- Practical - should result in providing information and outputs which assist with problem solving and are acceptable to and able to be implemented by proponents.
- Relevant- should provide sufficient, reliable and usable information for development planning and decision making.
- Cost-effective - should impose minimum cost burdens in terms of time and finance on proponents and participants consistent with meeting accepted requirements and objectives of EIA.
- Efficient -.should achieve the objectives of EIA within the limits of available information, time, resources and methodology.
- Focused - should concentrate on significant environmental effects and key issues; *i.e.*, the matters that need to be taken into account in making decisions.
- Adaptive - should be adjusted to the realities, issues and circumstances of the proposals under review without compromising the integrity of the process, and be iterative, incorporating lessons learned throughout the project life cycle.
- Participative - should provide appropriate opportunities to inform and involve the interested and affected publics, and their inputs and concerns should be addressed explicitly in the documentation and decision making.
- Inter-disciplinary - should ensure that appropriate techniques and experts in relevant bio-physical and socio-economic disciplines are employed, including use of traditional knowledge as relevant.
- Credible - should be carried out with professionalism, rigor, fairness, objectivity, impartiality and balance, and be subject to independent checks and verification.
- Integrated - should address the interrelationships of social, economic and biophysical aspects.
- Transparent - should have clear, easily understood requirements for EIA content; ensure public access to information; identify the factors that are to be taken into account in decision making; and acknowledge limitations and difficulties.
- Systematic - should result in full consideration of all relevant information on the affected environment, of proposed alternatives and their impacts, and of the measures necessary to monitor and investigate residual effects.

2.7 Project Cycle

The generic project cycle including that of CETP has six main stages:

1. Project concept
2. Pre-feasibility
3. Feasibility
4. Design and engineering
5. Implementation
6. Monitoring and evaluation.

It is important to consider the environmental factors on an equal basis with technical and economic factors throughout the project planning, assessment and implementation phases. Environmental considerations should be introduced at the earliest in the project cycle and must be an integral part of the project pre-feasibility and feasibility stage. If the EIA environmental considerations are given due respect in site selection process by the project proponent, the subsequent stages of the environmental clearance process would get

simplified and would also facilitate easy compliance to the mitigation measures through out the project life cycle.

A project's feasibility study should include a detailed assessment of significant impacts and the EIA include a detailed prediction and quantification of impacts and delineation of Environmental Management Plan (EMP). Findings of the EIA study should preferably be incorporated in the project design stage so that the project is studied, the site alternatives are required and necessary changes, if required, are incorporated in the project design stage. This practice will also help the management in assessing the negative impacts and in designing cost-effective remedial measures. In general, EIA enhances the project quality and improves the project planning process.

2.8 Environmental Impacts

Environmental impacts resulting from proposed actions can be grouped into following categories:

- Beneficial or detrimental
- Naturally reversible or irreversible
- Repairable via management practices or irreparable
- Short term or long term
- Temporary or continuous
- Occurring during construction phase or operational phase
- Local, regional, national or global
- Accidental or planned (recognized before hand)
- Direct (primary) or Indirect (secondary)
- Cumulative or single

The category of impact as stated above, and the significance will facilitate the expert appraisal committee (EAC)/State level EAC (SEAC) to take a view on the ToR for EIA studies, as well as in decision making process about the developmental activity.

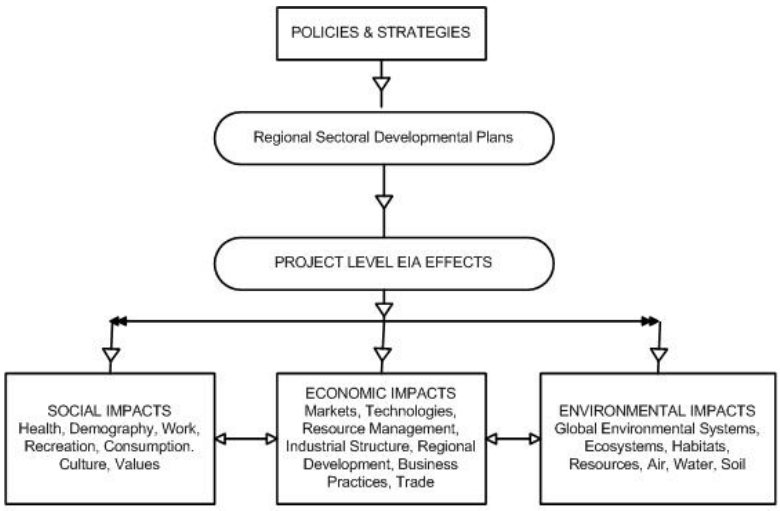

Figure 2-2: Types of Impacts

The nature of impacts could fall within three broad classifications *i.e.,* namely direct, indirect and cumulative, based on the characteristics of impacts. The assessment of direct, indirect and cumulative impacts should not be considered in isolation or

considered as separate stages in the EIA. Ideally, the assessment of such impacts should form an integral part of all stages of the EIA. The TGM does not recommend a single method to assess the types of impacts, but suggests a practical framework/approach that can be adapted and combined to suit a particular project and the nature of impacts.

2.8.1 Direct impacts

Direct impacts occur through direct interaction of an activity with an environmental, social, or economic component. For example, discharge of effluent from the Effluent Treatment Plant (ETP) into a river may lead to a decline in water quality in terms of high biochemical oxygen demand (BOD) or dissolved oxygen (DO) or rise of water toxins or rise of Total Dissolved Solids (TDS), *etc*.

2.8.2 Indirect impacts

Indirect impacts on the environment are those which are not a direct result of the project, often produced away from or as a result of a complex impact pathway. The indirect impacts are also known as secondary or even tertiary impacts. For example, ambient air SO_2 rise due to stack emissions may deposit on land as SO_4 and cause acidic soils. Another example of indirect impact is the decline in water quality due to rise in temperature of water bodies receiving cooling water discharge from the nearby industry. This, in turn, may lead to a secondary indirect impact on aquatic flora in that water body and may further cause reduction in fish population. Reduction in fishing harvests, affecting the incomes of fishermen is a third level impact. Such impacts are characterized as socio-economic (third level) impacts. The indirect impacts may also include growth-inducing impacts and other effects related to induced changes to the pattern of land use or additional road network, population density or growth rate (*e.g.* around a CETP project). In the process, air, water and other natural systems including the ecosystem may also be affected. Many indirect impacts may also be positive such as greening of the area; improved recreational, health and educational facilities; employment generation and enhanced economic activity of a region.

2.8.3 Cumulative impacts

Cumulative impact consists of an impact that is created as a result of the combination of the project evaluated in the EIA together with other projects in the same vicinity causing related impacts. These impacts occur when the incremental impact of the project is combined with the cumulative effects of other past, present and reasonably foreseeable future projects. Figure 2-3 depicts the same. Respective EAC may exercise their discretion on a case-by-case basis for considering the cumulative impacts.

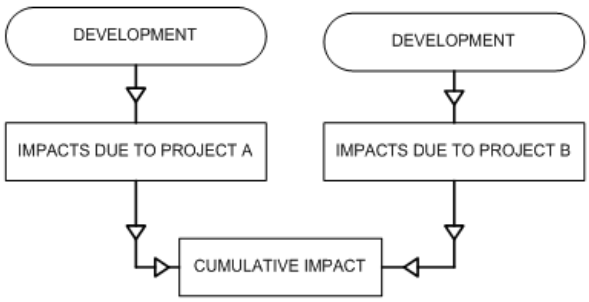

Figure 2-3: Cumulative Impact

2.8.4 Induced impact

The cumulative impacts can be due to induced actions of projects and activities that may occur if the action under assessment is implemented such as growth-inducing impacts and other effects related to induced changes to the pattern of future land use or additional road network, population density or growth rate (*e.g.* excess growth may be induced in the zone of influence around a CETP project, and in the process causing additional effects on air, water and other natural ecosystems). Induced actions may not be officially announced or be part of any official announcement/plan. Increase in workforce and nearby communities contributes to this effect.

They usually have no direct relationship with the action under assessment, and represent the growth-inducing potential of an action. New roads leading from those constructed for a project, increased recreational activities (*e.g.*, hunting, fishing), and construction of new service facilities are examples of induced actions.

However, the cumulative impacts due to induced development or third level or even secondary indirect impacts are difficult to be quantified. Because of higher levels of uncertainties, these impacts cannot normally be assessed over a long time horizon. An EIA practitioner usually can only guess as to what such induced impacts may be and the possible extent of their implications on the environmental factors. Respective EAC may exercise their discretion on a case-by-case basis for considering the induced impacts.

2.9 Significance of Impacts

This TGM establishes the significance of impacts first and proceeds to delineate the associated mitigation measures. So the significance here reflects the 'worst-case scenario' before mitigation is applied, and therefore provides an understanding of what may happen if mitigation fails or is not as effective as predicted. For establishing significance of different impacts, understanding the responses and interaction of the environment system is essential. Hence, the impact interactions and pathways are to be understood and established first. Such an understanding will help in the assessment process to quantify the impact as accurately as possible. Complex interactions, particularly in case of certain indirect or cumulative impacts, may give rise to non-linear responses which are often difficult to understand and therefore their significance is difficult to assess. It is hence understood that indirect or cumulative impacts are more complex than the direct impacts. Currently the impact assessments are limited to direct impacts. In case mitigation measures are delineated before determining significance of the effect, the significance represents the residual effects.

However, the ultimate objective of an EIA is to achieve sustainable development. The development process shall invariably cause some residual impacts even after implementing an EMP effectively. Environmentalists today are faced with a vital, not-easy-to-answer question—"What is the tolerable level of environmental impact within the sustainable development framework?" As such, it has been recognized that every ecosystem has a threshold for absorbing deterioration and a certain capacity for self-regeneration. These thresholds based on concept of carrying capacity are as follows:

- Waste emissions from a project should be within the assimilative capacity of the local environment to absorb without unacceptable degradation of its future waste absorptive capacity or other important services.

- Harvest rates of renewable resource inputs should be within the regenerative capacity of the natural system that generates them; depletion rates of non-renewable inputs should be equal to the rate at which renewable substitutes are developed by human invention and investment.

The aim of this model is to curb over-consumption and unacceptable environmental degradation. But because of limitation in available scientific basis, this definition provides only general guidelines for determining the sustainable use of inputs and outputs. To establish the level of significance for each identified impact, a three-stage analysis may be referred:

- First, an impact is qualified as being either negative or positive.
- Second, the nature of impacts such as direct, indirect, or cumulative is determined using the impact network
- Third, a scale is used to determine the severity of the effect; for example, an impact is of low, medium, or high significance.

It is not sufficient to simply state the significance of the effect. This determination must be justified, coherent and documented, notably by a determination methodology, which must be described in the methodology section of the report. There are many recognized methodologies to determine the significance of effects.

2.9.1 Criteria/methodology to determine the significance of the identified impacts

The criteria can be determined by answering some questions regarding the factors affecting the significance. This will help the EIA stakeholders, the practitioner, in particular, to determine the significance of the identified impacts eventually. Typical examples of such factors include the following:

- Exceeding threshold Limit: Significance may increase if a threshold is exceeded. *e.g.*, particulate matter emissions exceed the permissible threshold.
- Effectiveness of mitigation: Significance may increase as the effectiveness of mitigation measures decreases. *e.g.*, control technologies, which may not assure consistent compliance to the requirements.
- Size of study area: Significance may increase as the zone of effects increases
- Incremental contribution of Effects from Action under Review: Significance may increase as the relative contribution of an action increases.
- Relative contribution of effects of other actions: Significance may decrease as the significance of nearby larger actions increase.
- Relative rarity of species: Significance may increase as species becomes increasingly rare or threatened.
- Significance of local effects: Significance may increase as the significance of local effects is high.
- Magnitude of change relative to natural background variability: Significance may decrease if effects are within natural assimilative capacity or variability.
- Creation of induced actions: Significance may increase as induced activities also highly significant.

- Degree of existing disturbance: Significance may increase if the surrounding environment is pristine.

For determining significance of impacts, it is important to remember that secondary and higher order effects can also occur as a result of a primary interaction between a project activity and the local environment. Wherever a primary effect is identified, the practitioner should always think if secondary or tertiary effects on other aspects of the environment could also arise.

The EIA should also consider the effects that could arise from the project due to induced developments, which take place as a consequence of the project. For *e.g.,* Population density and associated infrastructure and jobs for people attracted to the area by the project. It also requires consideration of cumulative effects that could arise from a combination of the effects due to other projects with those of other existing or planned developments in the surrounding area. So the necessity to formulate a qualitative checklist is suggested to test significance, in general.

3. ABOUT COMMON EFFLUENT TREATMENT PLANTS INCLUDING BEST PRACTICES AND POLLUTION CONTROL TECHNOLOGIES

3.1 Introduction

In order to minimize environmental pollution due to the small and medium-scale industries, cleaner production technologies and formation of waste minimization circles are being encouraged in India. Besides, collective treatment at a centralized facility, known as the CETP is considered as a viable treatment solution, to overcome the constraints associated with effluent treatment in small to medium enterprises.

Till 1990, only one CETP at Jeedimetla, Hyderabad was in operation. In 1991, the Ministry of Environment & Forests (MoEF), Government of India initiated an innovative financial support scheme for CETPs to ensure the growth of the small and medium entrepreneurs (SMEs) in an environmentally compatible manner. The provision of the scheme for fund support is as follows:

- State Government subsidy- 25% of the project capital cost
- Central government matching grants-25%
- Loans from financial institutions- 30% of the project capital cost, and
- Contribution from the SMEs- 20% of the project capital cost

While this scheme is designed for an initial period of 10 years, considering the need was extended further. Besides, the MoEF, the Ministry of Commerce and other funding schemes supported establishment of new CETPs and augmentation of the existing ones.

The concept of CETP was adopted to achieve end-of-the-pipe treatment of combined wastewater to avail the benefit of scale of operation. In addition, the CETP also facilitates in reduction of number of discharge points in an industrial estate for better enforcement and also to make the skilled man power available for proper treatment of effluent.

A total of 130 CETPs have come-up in the country, either established or in the process of establishment, to cater to the needs of the industrial clusters/group of industries of which, 91 CETPs are in operation. The status of zone-wise CETPs in the country is given in Table: 3-1.

Table 3-1: Zone-wise Status of CETPs in India

Zone	Number of CETPs
Northern Zone (UP – 3, Haryana – 1, Punjab –2, Delhi – 10 complete, 2under construction, 3 kept in abeyance	16
Western Zone (Gujarat – 19, Maharashtra – 12)	31
Eastern Zone (WB-1)	1

Zone	Number of CETPs
Central Zone (Rajasthan – 5, MP- 1)	6
South Zone (T.N – 33, AP – 2, Karnataka – 2)	37

Source: CPCB (Year 2006)

Advantages of CETP

- facilitates 'economy of scale' in waste treatment, thereby reducing the cost of pollution abatement for individual SMEs
- addresses the 'lack of space' issue – CETP can be planned in advance to ensure that adequate space is available including plans for expansion in future
- homogenization of wastewater
- relatively better hydraulic stability
- professional control over treatment can be affordable
- facilitates small scale units, which often can not internalize the externalities due to control of pollution
- eliminates multiple discharges in the area, provides opportunity for better enforcement *i.e.*, proper treatment and disposal
- provides opportunity to improve the recycling and reuse possibilities
- facilitates better organization of treated effluent and sludge disposal *etc*.

Problems and constraints

Consistency in compliance to the prescribed standards by the CETPs is constrained by many reasons, such as:

- operating on 'one-size-fits-all-basis'
- lack of access to capital investments, working capitals, specialized technical skills, inconsistent effluent quality from member industries
- improper management of treatment units at common facility
- varied nature and scale of the industries, along with the addition of industries in a haphazard manner, without proper planning
- no provision to tackle the fluctuations in the pollution load and quantities, at individual member industries
- no separate treatment units to deal with hazardous and toxic effluents, *etc*.

CETPs serving similar kind of industries will have greater operational ease due to their similar nature of characteristics, which will also facilitate in choosing the right treatment scheme with greater certainty. Whereas, the CETPs serving effluents from heterogeneous industries require greater knowledge and skill for consistent compliance to the prescribed standards.

3.2 Planning of CETPs

Establishment of CETP requires a proper planning in order to avoid the shortfalls as discussed in previous Section. Sequence of steps in planning for CETPs is shown in Figure 3-1.

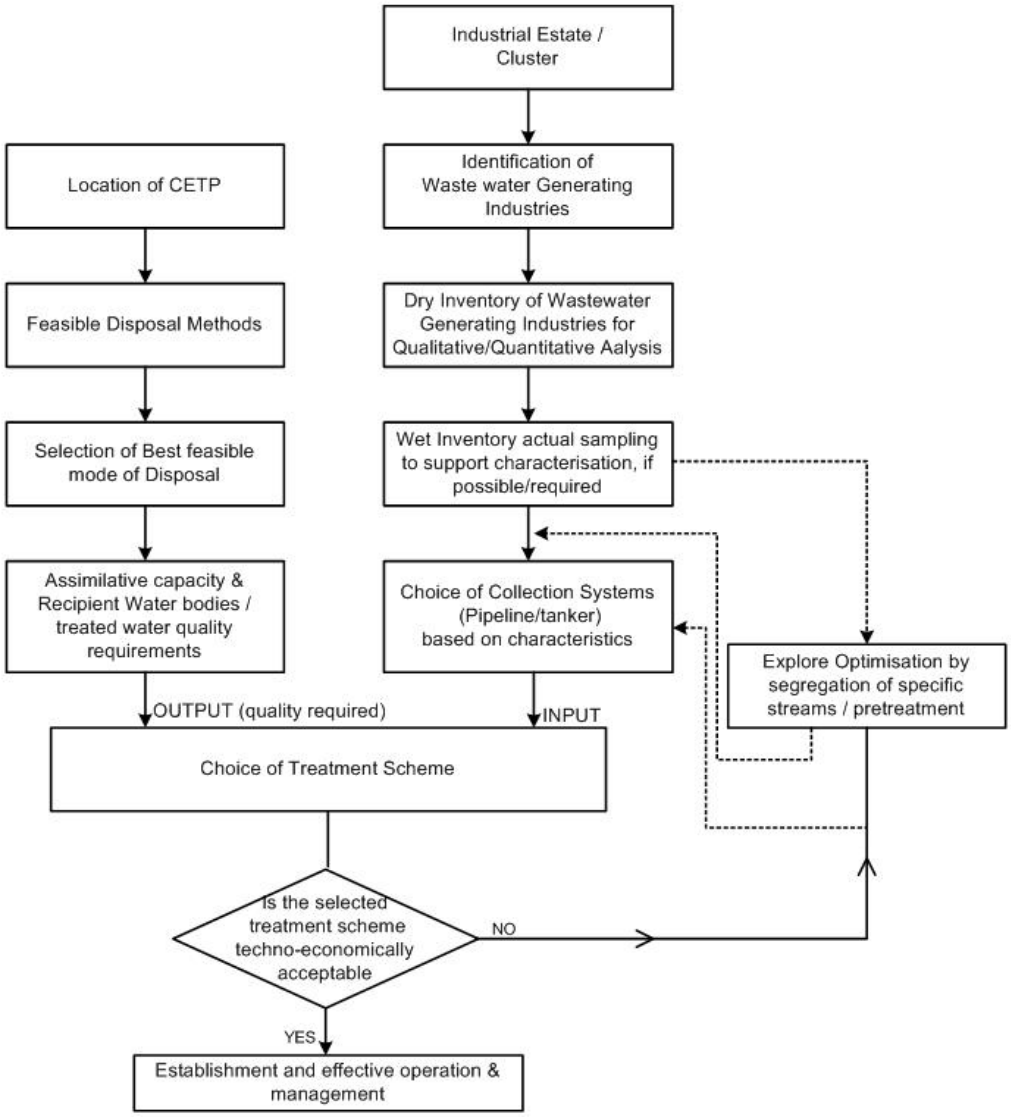

Figure 3-1: Planning Process of a CETP

Factors, which influence the proper planning and operation of the CETPs include following:

i) categories of effluent generating member industries
ii) qualitative/quantitative fluctuations of effluent (equalization/ homogenization / modules)
iii) pre-treatment requirements
iv) segregation of effluent streams at individual member industry
v) collection and monitoring mechanism
vi) treatability choice of technology and bio degradability, interferences
vii) mode of disposal; and
viii) charging system

Each of the above factors is discussed in subsequent sections.

3.2.1 Categories of effluent generating industries

Treatability of mixed effluent streams generated from various types of industries is a complex issue in respect providing a treatment scheme and for its operation. CETPs can be classified based on the combination of industries that it serves *i.e.*

- those serving homogenous industries (textiles, tanneries, *etc*.) – all member industries falls in same industry sector and involves in similar operations; and
- those serving heterogeneous industries including chemical industries

For homogeneous industries, the quantitative and qualitative fluctuations may be in the predictable range due to similar process operations, the heterogeneous industries demand a greater flexibility with respect to the treatment units to handle wide range of such fluctuations. As such, a detailed inventory of the member industries is an essential first step in the process of planning a CETP to understand the nature of operations and likely constituents of the effluent.

Wastewater inventory

Before proposing a new CETP, a wastewater inventory has to be developed. This process involves:

- identifying the potential users of CETP, their type and number of industries in the geographic area
- identifying the type (organic/inorganic/toxic) and volume of wastewater generation likely to generate (concentrated/dilute, *etc*.)
- estimating future waste loads on CETP – helps in designing the plant capacity on a modular basis
- identifying treatment options – examining the compatibility and identifying the treatment options
- evaluating cleaner technologies – recommending changes in the raw material, manufacturing process, reducing waste generation, *etc*., in individual member industries, in order to facilitate smooth functioning of CETPs

The inventory may be broadly classified into dry inventory; and wet inventory (involves sampling), and are discussed as follows:

Dry inventory: The dry inventory refers to the collection of information through questionnaire survey w.r.t. raw materials used, intermediates and final products, water use profile, wastewater generation, likely characteristics, proposed pre-treatment *etc*. While forwarding the questionnaire, industry may furnish the use of specific chemicals which are normally less or non-biodegradable and are likely to interfere with biological treatment system. Once the data is compiled, an interaction meet with prospective industries will facilitate the acquisition of remaining information/data gaps, if any, including specific characteristics, volumes, frequency of discharges, product change patterns, predictable/ unpredictable volumes, *etc*., which also facilitates a comparison with similar kind of industries, where possible, as a reliability check.

Wet inventory: Grab and composite samples are collected (from the existing units) and depending on the analysis of the results, the pollution loads are arrived.

The treatment of industrial wastewaters to meet the ultimate discharge standards for given specific mode of disposal, often requires segregation of wastewater streams at source (individual industry level); and grouping of the streams based on their compatibility and in consultation with the CETP management, in order to stream line the treatment schemes and their operation to the desired efficiencies.

Wet inventory specifically aims at the wastewater streams which can not be mixed with the conventional biological treatment and to specifically design the additional treatment requirements either at central facility or at the individual unit based on techno-economic considerations.

Most of the CETPs, which are located in and around metros/cities, are availing sewage for either enhancing treatability or dilution - more often both. (Specifically facilitates in respect of COD and TDS).

The emerging treatment technologies and combination of treatment options offer flexibility to treat various pollutants of higher concentration. Therefore, CETP inlet standards shall be based on the designed inlet concentrations. Retro-fitting centralized treatment facilities for additional specific pollutants such as ammonical nitrogen treatment, is a prudent option often used, than control many individual member industries.

3.2.2 Qualitative/quantitative fluctuations of effluent

Quantitative fluctuations specify the volume of equalization tank. Besides, modular design of effluent treatment plant (ETP) is an important aspect for proper handling of varying hydraulic load (frequent product changes-corresponding hydraulic loads, *etc*.).

Qualitative fluctuations specify/correct the capacity of holding/equalization tanks to homogenize the influent characteristics or to avoid shock loads.

A. Quantity of effluent

The effluent quantity can be assessed based on the product details furnished by the individual industry with a comparison from literature values or from the water balance submitted by individual industry to SPCB in their consent application. While arriving at the size of the CETP w.r.t. flow, the various unit operations considered shall be sized and layout is prepared to add additional units in future depending on the projected growth rate of the specific (type/nature) industries in the region.

B. Flow rate

Flow rate is important in determining the size of CETP. Minimum and maximum flows should be computed as they decide the hydraulic computations and the size of pipe distribution. Anticipated future increase should also be incorporated. Temporal flow variations require use of equalization ponds to allow a constant flow rate through downstream processes. Mixing of wastewaters including sewage often helps in reducing concentration of the pollutants on treatment processes.

C. Effluent characteristics

Analysis of effluent characteristics to determine the units in a treatment process scheme is a critical step. Effluent characteristics, which are of importance in the design of CETP can be grouped into physical and chemical characteristics.

i. Physical characteristics of the effluent

- Temperature – Observation of temperature of effluents is useful in indicating the solubility of oxygen which affects oxygen transfer capacity of aeration equipments and rate of biological activity.
- Colour and odour – Indicates the colloidal portion and need for specific treatments chemical/membrane units.
- Total and volatile suspended solids - Total solids include both the suspended solids and the dissolved solids which are obtained by separating the solid and liquid phase by evaporation.
  - Suspended solids are a combination of settleable solids and non-settleable solids, which are usually determined by filtering a wastewater sample through a glass fiber filter contained in a Gooch crucible or through a membrane filter. Settleable solids are those which usually settle in sedimentation tanks during a normal detention period. This fraction is determined by measuring the volume of sludge in the bottom of an Imhoff cone after one hour of settling.
  - Solids remaining after evaporation or filtration are dried, weighed, and then ignited. The loss of weight by ignition at 500°C±50 °C is a measure of the volatile solids, which are classed as organic material. The remaining solids are the fixed solids, which are considered as inorganic (mineral) matter. The suspended solids associated with volatile fraction are termed volatile suspended solids (VSS), and the suspended solids associated with the mineral fraction are termed fixed suspended solids (FSS).

ii. Chemical characteristics of effluents

- pH - The biological treatment units at CETP are sensitive to pH of the effluent. Thus, it is of high importance. Besides, acidic effluents cause corrosion related problems.
- Carbonaceous substrates - Carbonaceous constituents are measured by BOD, COD or TOC analysis. While the BOD has been the common parameter to characterize carbonaceous material in wastewater, COD is becoming more common in most current comprehensive computer simulation design models.
  - The BOD test gives a measure of oxygen utilized by bacteria during the oxidation of organic material contained in a wastewater sample. The test is based on the premise that all the biodegradable organic material contained in the wastewater sample will be oxidized to CO_2 and H_2O, using molecular oxygen as the electron acceptor. Hence, it is a direct measure of oxygen requirements and an indirect measure of biodegradable organic matter.
  - The COD test is based on the principle that most organic compounds are oxidized to CO_2 and H_2O by strong oxidizing agents under acidic conditions. COD will always be equal or higher than BOD, as the test is under strong oxidizing agent, which oxidizes to greater extent, including inorganics.
  - Total organic carbon (TOC): The total carbon analyzer allows a total soluble carbon analysis to be made directly on an aqueous sample. In many cases, TOC can be correlated with COD and occasionally with BOD values. As the time

required for carbon analysis is generally short, such co-relations are extremely helpful for efficient control of day-to-day operations of treatment plant.

- Toxic metals and compounds - Some heavy metals and compounds such as chromium, copper, *etc*., will determine the precipitation of biological treatment. Various considerations will determine the choice of treatment.

3.2.3 Waste minimization

An important aspect of waste management is waste minimization. In other words, rather than attempting to treat the wastes as they are produced, maximum efforts can be made in avoiding, minimizing and/or using the byproducts. The basic principles of waste minimization considering the order of acceptability are as follows.

- Avoiding or eliminating the production of waste – can be carried out by choosing an alternative process when designing a production unit.
- Reduction and minimization of waste within the industry – can be achieved by considering all the processes and activities which may lead to production of waste.

3.2.4 Pre-treatment requirements

Initially, CETPs were mere sinks of raw effluents from the industries and suffered lack of discipline in pre-treatment at the industries, scientific understanding of complex characteristics of collection, segregation and corresponding treatability studies of waste streams, particularly where varieties of products were manufactured in member industries. Therefore, inlet effluent standards were brought in with an understanding that suspended solids and biodegradable matter will be removed at CETP facilities.

Any biological system warrants consistency in influent quality. Therefore, additional pre-treatment facilities may be established at CETP premise or individual industries may be asked to send only those effluents, which can be treated at the CETP. In any case, the effluent from the individual industries shall meet the requirement of the collection system protection specifications (pipeline/tankers). Therefore, in case of heterogeneous industrial complexes, pre-treatment is a more reliable relief, in operation & maintenance (O&M) of CETP. But poor managerial and monitoring control, in the initial stages of establishment of CETPs, lead to exploitation of common facilities by the member industries, resulting in poor performance of CETPs.

Pre-treatment standards - Effluent from industrial processes requires some form of pre-treatment prior to sending the effluents for further treatment at CETP. This is mainly required when wastewater is carried through gravity lines to minimize corrosion & clogging; and to prevent reductions in biological treatment process efficiency due to toxic constituents.

Pre-treatment standards for sulphides, sulphates and pH are concerned with preventing corrosion of concrete parts in gravity pipes and also the anaerobic conditions leading to the formation of hydrogen sulphide leading to the fire accidents. Limits for the discharge of oil, grease, grit and heavy sediments are prescribed in order to prevent clogging of pipelines. Limits to heavy metals and toxic organics would ensure proper performance of biological treatment and minimize accumulation of contaminants in residual sludge.

Standards are prescribed for inlet effluent quality as well as treated effluent quality for CETPs. The inlet effluent standards are given in the table 3-2.

Table 3-2: Inlet Effluent Quality Standards for CETPs

Parameter	Concentration
pH	5.5 - 9.0
Temperature (^oC)	45.0
Oil and grease	20.0
Cyanide (as CN)	2.0
Ammoniacal nitrogen(as N)	50.0
Phenolic compounds (as C_6H_5OH)	5.0
Hexavalent Chromium	2.0
Total chromium	2.0
Copper	3.0
Nickel	3.0
Zinc	15.0
Lead	1.0
Arsenic	0.2
Mercury	0.01
Cadmium	1.0
Selenium	0.05
Fluoride	15.0
Boron	2.0
Radioactive Materials	
Alfa emitters, Hc/ml	10^{-7}
Beta emitters, Hc/ml	10^{-8}

Source: Guidelines for management, operation and maintenance of common effluent treatment plants, CPCB publications, programme objective series: problems/81/2001-2002

Note:

1. These standards apply to the small-scale industries, i.e. total discharge up to 25 kld
2. For each CETP and its constituent units, the state Board will prescribe standards as per the local needs and conditions; these can be more stringent than those prescribed above. However, in case of clusters of units, the State Board with the concurrence of CPCB in writing may prescribe suitable limits.

3.2.5 Segregation of effluent streams at the individual member industry

Effluent streams could be broadly segregated for combining appropriately, based on their suitability for a specific treatment choice. A typical model approach for segregation of streams is given in Figure 3-2 and choice of treatment options based on the segregation streams is discussed in section 3.2.7.2.

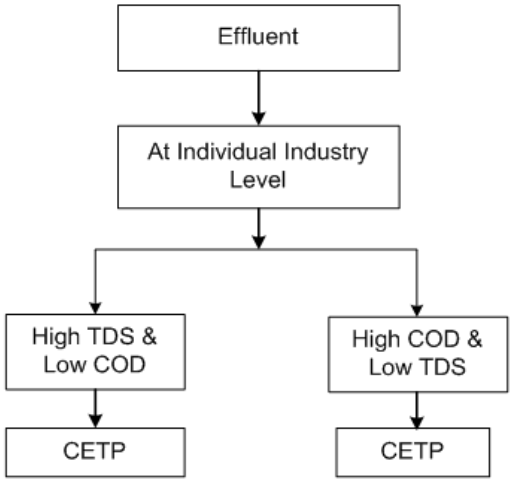

Figure 3-2: Categories of Effluent Streams

3.2.5.1 Segregation of effluent streams in synthetic organic chemical industry

When the member industries of CETP comprise chemical industries or multiple industrial categories, the complexity w.r.t the O&M is high and thus demands specific skills. It has been largely felt that the member industries need to have qualitative assessment of their effluent streams and must segregate the effluent generated into the following streams:

- highly inorganic streams (TDS)
- highly concentrated effluents/non-degradable/toxics
- mixed (organic & inorganic) streams

As discussed earlier, the treatment envisaged at CETP is primarily for the separation of suspended solids and organic matter through biological treatment systems (pre-treatment standards refer to just this expectation). Therefore, only those streams which can be treated at CETPs may be sent and others require specific treatment at the individual industry level. In other words, additional treatment either at CETP or at individual member industries is required. An example of effluent segregation and corresponding treatment in a synthetic organic chemical unit is shown in Figure 3-3.

If such segregation is not practiced at the individual-member-industry-level, effluent treatment at common treatment facilities gets complicated with only primary and secondary (biological) treatment facilities (general condition of effluent standards for CETP inlet).

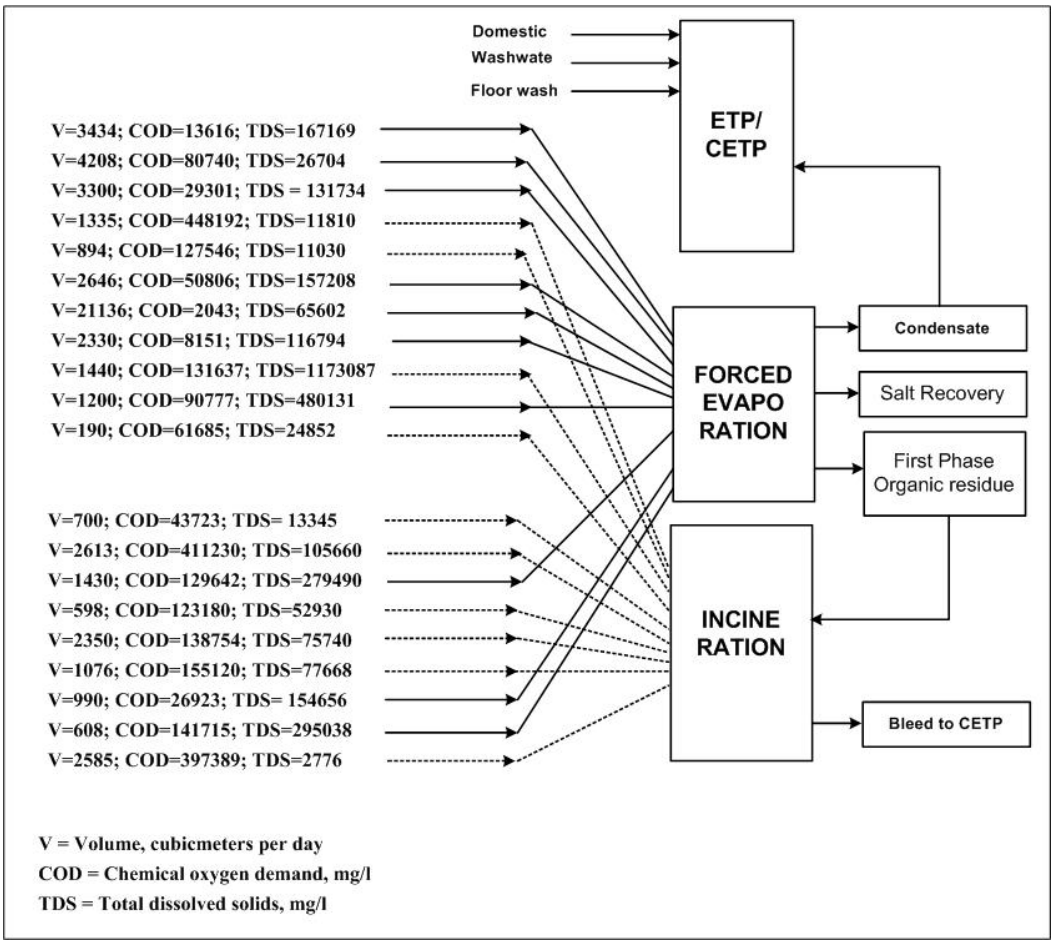

Figure 3-3: Effluent stream-specific choice of treatment: A model case study

3.2.5.2 Segregation of effluent streams in tanneries

CETPs serving tanneries are unable to comply with the TDS standard of 2100 milligrams per litre (mg/l) with existing treatment units in the CETP. In general, only double-stage biological treatment system is provided if the industries are involved in processing of leather/skin/hide from raw to finish. If the processing is from semi-synthetic to synthetic, single-stage biological treatment units are provided. With these treatment systems, TDS could not be brought down to the prescribed standard. The diagram shown below illustrates the cause for consistent violation w.r.t. the TDS parameter.

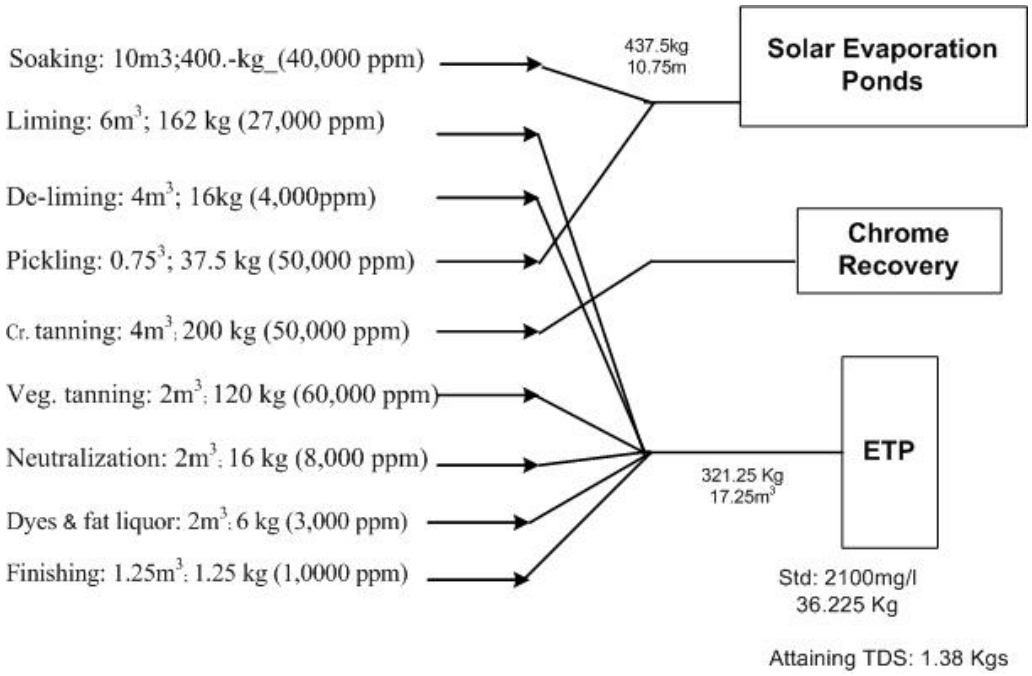

Figure 3-4: Sources and Treatment of TDS in Tanneries

In general, wastewater from soaking and pickling is collected separately and sent to the solar evaporation ponds. In case of chrome tanning, the wastewater is sent to the chrome recovery and then sent to the solar evaporation ponds. All other wastewater streams are sent to the ETP/CETPs. The diagram is constructed based on the prevailing concentrations and volume of wastewater per tonne of hides/skin processing. The diagram reveals that for each tonne of hides/skin processing, about 100 kilograms (kg) of TDS is in excess of what is desired through the standard. Therefore, the options would be to explore cleaner technologies in the member industries and/or providing terminal TDS separation technologies. The influencing factors include following:

- segregation of soak, pickle and chrome liquors at source
- adopted waste minimization / cleaner technologies at member industries (desalting, enzymatic unhairing, green flushing, use of better quality chemicals *etc*., Reycling/ reuse of wash liquor after liming/de-liming, counter current soaking *etc*.)
- pre-treatment for floating and readily settleable solids
- capacity utilization of CETPs – mostly under loaded
- treatment units
- physico-chemical treatment- quality of lime and alum
- type and efficiency of equipment used in treatment (ejectors vs. floating aerators, fixed vs. diffused aeration system; sludge dewatering by chamber filter press vs. sludge drying beds)
- O&M of CETP – tanners themselves - personnel, power, chemical, *etc*.
- skilled manpower

3.2.5.3 Segregation of effluent streams in Textile Industry

The wet operations in textile units include scouring, bleaching and dyeing processes. As these processes involve handling of considerable amounts of salts, the effluent exert high TDS besides organics. CETPs carry out physico-chemical treatment using lime, ferrous sulphate, and polyelectrolyte for colour removal and thus generating sizeable quantities of lime sludge. Thus, the colour is removed but neither TDS nor BOD is removed.

Effluent from textile industries can be classified into two sets, *i.e.*, dye-bath effluent (in general 10% of the total quantity of effluents) and other washings. Considering this distinct qualitative variation, following scheme is adopted for recovery of salts, water and management of rejects by evaporation to achieve zero discharge. The schemes adopted include, nano-filtration for recovery of salts (colour-free sodium chloride [NaCl] with more or less same concentration of the feed) from the dye-bath effluents; recovery of water from the effluent and rejects management by the multiple effective evaporator (MEE).

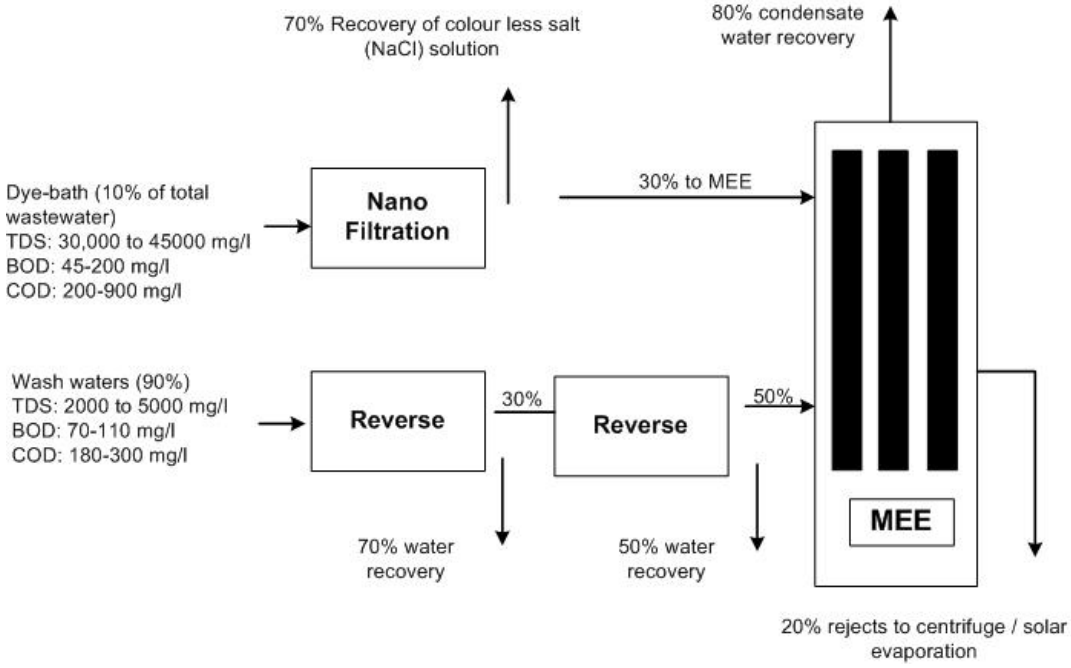

Figure 3-5: Wastewater Characteristics-Specific Treatment Options

3.2.6 Conveyance system

Conveyance system plays an essential role in cost-effectiveness of the treatment besides ease in plant operations. Prevailing modes of collection of effluents from individual industries to CETP are as follows

- Tankers
- Pipes
- Open channels
- Combination of the above

Each of the above modes of transport has some advantages and disadvantages. The choice of the conveyance system shall be based on topography of the area, nature of effluent to be conveyed, location of treatment plant in the area and the cost.

The collection and transportation system is one which cannot be easily and economically expanded at a later stage (unlike treatment and disposal system). Therefore, the collection system has to be provided with adequate spare capacity to meet future requirements. On the other hand, if collection system is erected in early stages of development (provided with extra capacity for future requirements), lot of money gets blocked without much return. Secondly, since the system would be over designed with respect to the present flow, settling of suspended solids may occur within the piping systems. In such situations, conveyance of effluent by tankers may be a better choice. At many places, topography of the area may permit use of only tanker conveyance system.

Tankers

If the industrial estate is in early stage of development and accommodates mostly small scale industries, tankers are probably the best alternative. Moreover, over short distances a tanker system may be cheaper than other systems. The design elements of this tanker system include selection of container material which suits all types of wastes to be transported, choosing types and sizes of vehicles that are suitable for the transport routes, choosing the number of vehicles and developing safe operating procedures for handling hazardous materials. Tankers are more reliable in terms of ensuring the quality, but causes traffic and related impacts, long waiting of tankers till the effluent quality conforms to the influent quality, illegal disposals, *etc*.

Piping system

This option would be feasible in case of homogeneous member industries. Transfer of pre-treated wastewater by underground piping network from individual industry is practical when participating firms are located close to the CETP. Piping system is especially suitable where all the individual units are located close to each other or when the industrial estate is completely developed and fully occupied with industrial units.

Design of the piping system for CETP requires attention to the sulphide and sulphate content in the inlet effluent in order to prevent corrosion of pipes. Selection of pipes and joints must be done considering the anticipated pressure of influent flow and properties.

In case of gravity pipelines, provision of manholes of suitable size at every 30 metre (m) interval and at directional changes will help in cleaning / maintenance.

However, in this system, each individual industry has to make provision for storage of pre-treated effluents in their premises with sufficient detention time and locking arrangement.

Open channel system

Open channel system is vulnerable for rainwater entry and may impose excessive loadings on treatment plant during rainy season. Open channels covered with concrete generally turn out to be economical as compared to sewers.

A combination of these three systems may be adopted in actual practice depending on local conditions *e.g*., open channel with factory premises, tanker conveyance up to terminal pumping station and terminal pumping station to CETP by pumping system.

If the industrial estate is divided into many phases or blocks, individual collection system and collection sump can be designed for each phase or block. The wastewater can then be pumped from these collection tanks to a main tank for onward conveyance.

Final design of a collection network takes into consideration the topography, undulations, road alignments, flow characteristics, groundwater table, infiltration, flushing requirements, appurtenances, *etc*.

3.2.7 Treatability and choice of technology

3.2.7.1 Treatability

Treatability studies are conducted to facilitate in characterizing the physical, chemical and biological nature of the liquid waste streams of interest and devise effective, economical ways to treat and manage such wastewater to meet the regulatory criteria for safe disposal and for reuse.

Based on the stream-wise chemical composition, and the data provided by the member industries, CETP promoter/ operator has to conduct the treatability studies to determine the specific treatment and recycling technologies as well as to arrive at the capital and operational costs.

Objectives of the treatability studies include:

- converting the chemical composition of the wastewaters into environmental parameters to understand the nature of the effluent.
- conceptualizing the possible treatment schemes by conducting lab-scale studies to support the hypothesis in respect of the conceptual treatment scheme and also to arrive the operating parameters.

3.2.7.2 Choice of technologies

Based on characteristics, the appropriate technologies can be identified to arrive at the probable combination of treatment technologies in a treatment scheme. One such guidance matrix is as follows:

Table 3-3: Wastewater Characteristics – Specific Treatment Options

Combination	Quality of Effluent	Treatment options
High TDS, and high COD and equivalently high BOD	Waste is not easily biodegradable but toxic	▪ Thermal decomposition (based on calorific value) ▪ Chemical oxidation by hydrogen peroxide, ozone *etc*. ▪ Evaporation + secured landfill
High TDS, High COD and high difference between COD and BOD	May be toxic; not suitable for biological treatment; mostly inorganic salts	▪ Chemical treatment (recovery, precipitation *etc*.) ▪ Evaporation + secured landfill of evaporated residue

Combination	Quality of Effluent	Treatment options
High TDS, high BOD and low difference between COD & BOD	Highly organic effluent fully biodegradable	▪ Anaerobic + Aerobic treatment ▪ If quantity is less, incineration (based on calorific value) + secure landfill of incineration ash
High TDS, low BOD and low BOD & COD difference	Only inorganic salts, no need for biological treatment	▪ Solar evaporation ▪ Forced evaporation (after separation of volatile organic matter) ▪ Membrane technologies
Low TDS, and high COD and equivalently high BOD	Highly organic effluent, may not be easily biodegradable	▪ Thermal decomposition ▪ Chemical oxidation by hydrogen peroxide or ozone or sodium hypo-chlorite *etc*. ▪ Chemical + biological treatment
Low TDS, High COD and high difference between COD and BOD	Highly inorganic effluent, not suitable for biological treatment	▪ Chemical recovery ▪ Chemical oxidation + biological treatment
Low TDS, high BOD and low difference between COD & BOD	Organic effluent, fully biodegradable	▪ Anaerobic + aerobic treatment
Low TDS, low BOD and low BOD & COD difference	Low organic and low inorganic effluent	▪ Recycle and reuse (after preliminary treatment)

The approach to provide effluent treatment at low cost is an important factor to be considered and depends on appropriate designs which are diverse in nature and scale of operations. Typically for small scale units, low capital investment, and lower O&M costs for treatment, are the prime factors. Considering these factors,

- mechanical and chemical processes are more preferable to reduce the suspended solid concentration in effluents before biological treatment
- UASB (one of the anaerobic techniques) with less hydraulic retention and less space requirement can be one of the possible options.
- in order to obviate the need of excessive civil work at CETP in making huge equalization and settling units, the member units can be provided with settling and neutralization of their individual waste.
- to minimize the electrical cost, the possibility of substituting bio-energy should be explored to the extent possible.
- proper management of sludge with its nutritive value would mobilize resources to substitute the operational cost, especially from secondary biological treatment.
- to reduce down-time for maintenance during design of the plant, less manpower with high technical skills would be an added advantage.

3.2.7.3 Vulnerability to shock loads

The general practice is to receive wastewater in neutral state as there will not be any problem in the receiving section. Alternately, if planned at the design stage to receive acidic wastes and provide for neutralization, the sump should be provided with acid resistant bricks and not tiles; also they should provide brick on edge preferably in two lengths in a zigzag position so that no two joints come at one point. It is advisable to use CSNL liquid for joining to have longer life. In case of highly alkaline wastes, the concrete or metal surfaces should be coated with coal tar epoxy or better with FRP with mat reinforcement. Further, it is always advisable to use caustic for reducing the pH and dilute sulphuric acid for increasing the pH for ease and safety of storage, handling and operations, if they do not pose problem in subsequent treatment units and/or in compliance.

To avoid the shock loads, key characteristics of wastewater must be considered in designing CETPs which include flow rate, physical, chemical, and biological characteristics of the wastewater. Wastewater flow, commonly expressed as cubic metres per day ($m^{3/}$day), determines the size of the CETP. Minimum and maximum flow rates should be estimated as precisely as possible because they affect hydraulic computations and sizing of channels and distribution pipes. Design flows should also incorporate anticipated future upgrades. Large temporal flow variations (*e.g.*, inflow/infiltration response to rainfall) may require use of equalization tanks to allow a constant or nearly constant flow rate through the downstream treatment processes. Benefit of equalization tanks is to reduce the effect of toxic shock on treatment processes caused by accidental releases of toxic substances. This reduction is accomplished by blending wastewater with lower concentrations in the equalization tank.

3.2.7.4 Wastewater treatment

Industrial wastewater operations can range from pre-treatment to full-scale treatment processes. In a typical pre-treatment facility, process and/or sanitary wastewater and/or stormwater runoff is collected, equalized, and/or neutralized and then discharged to a wastewater treatment plant with specific characteristics like TDS, COD, NH4 – N, *etc*., where it is then typically treated further.

Wastewater treatment can be divided into four/five major categories or steps based on design, and O&M:

- Segregation at source of generation as explained earlier Sections.
- Preliminary treatment - It involves a number of unit processes to eliminate undesirable characteristics of wastewater. Processes include use of screen, grit chambers for removal of sand and large particles, communitors for grinding of coarse solids, pre-aeration for odour control and removal of oil and grease.
- Primary treatment- It involves removal of settable solids prior to biological treatment. The general treatment units include: flash mixer + flocculator + sedimentation
- Secondary treatment- It involves purification of wastewater primarily with dissolved organic matter by microbial action. A number of processes are available but the ones that are mainly used are anaerobic and /or aerobic treatment methods.
- Tertiary treatment - This mainly includes physical and chemical treatment processes that can be used after the biological treatment to meet the treatment objectives.

Design of the actual treatment system for a CETP involves selection of alternative processes based on the requirement/ability of individual treatment processes to remove specific waste constituents.

Various technologies available for treating industrial wastewater are given in the following table.

Table 3-4: Industrial Wastewater Treatment Schemes

	PRECISE DESCRIPTION
Preliminary Treatment	
Screening	▪ It is adopted to remove floating matter and shall be provided at the intake point
Grit Removal	▪ Used when WWTP has to deal with rainwater which normally entrains a considerable amount of sand
Oil and grease removal	▪ Oil and grease are skimmed-off by passing the waste water through skimming tank. This process can be rendered more efficient by dissolved air flotation or vacuum flotation
Primary Treatment	
Equalization	▪ Applicable for wastewaters having different characteristics at different intervals of time and where uniform treatment is required ▪ Each unit volume of waste is mixed thoroughly with other unit volumes of other wastes to produce homogeneous and equalized effluent ▪ Gives better mixing of different unit volumes of effluents
Neutralization	▪ Applicable for highly acidic and highly alkaline effluents ▪ Acidic effluents may be neutralized by treatment with lime or lime slurry or caustic soda ▪ Alkaline waste may be neutralized by treatment with acids
Sedimentation	▪ Separation of suspended particles by gravitational settling and floating material ▪ Clarifies collected rainwater from solid content (sand or dust) ▪ Clarifies wastewater from inert contents (sand or comparable particles) ▪ Clarifies wastewater from reaction material (emulsified metal compounds, polymers and their monomers) ▪ Separates heavy metals or other dissolved components after preceding flocculation process ▪ Removes suspended solids in the primary clarifier ▪ Removes biological sludge in secondary clarifier of a biological WWTP
Secondary Treatment	
Aerobic Treatment	

	PRECISE DESCRIPTION
Activated Sludge Process	▪ Applicable to all biodegradable industrial wastewater streams. ▪ The effluent from primary treatment processes are collected in aeration tank and are aerated with mechanical devices such as fixed/ floating/diffused aeration/ oxygen injection *etc*.
Aerated Lagoons	▪ The effluent from primary treatment processes are collected in lagoons and are aerated with mechanical devices such as floating/ fixed aerators.
Trickling Filters/Bio filters	▪ In the trickling or percolating filter process the microorganisms are attached to a highly permeable medium through which the waste water is trickled – or percolated ▪ Trickling filters are effectively used for the treatment of industrial waste water ▪ Used to treat urban and some industrial wastewater ▪ Used when effluent is highly loaded with COD ▪ Used to upgrade an existing activated sludge plant
Sequential Batch Reactors (SBR)	▪ The operation is in sequence of "fill , aerate , settle and waste sludge and draw treated waste water but not with secondary clarifier
Sub merged Aerobic Fixed Film reactor	▪ This technology utilizes an aerobic fixed film process that is a combination of submerged attached growth and activated sludge process. This system is designed to be installed into a two compartment, where the first compartment provides majority of BOD removal, and the second compartment polishes the BOD. Rigid block-type media is submerged within the treatment module, providing surface area for microbial growth.
Membrane Bioreactor	▪ Treats municipal and industrial waste water ▪ It is particularly suitable for effluents with high COD and /or ammoniacal nitrogen loads ; envisaging recycling of waste water, stringent discharge regulations, sensitive receiving water bodies, sludges which are hard to settle, upgrading existing plants, compact installations
Anaerobic Treatment	
▪ Used only as Pretreatment for waste water which is characterized by high organic load (>2 g/l) ▪ Applicable mostly for effluents of high BOD loads	
Anaerobic Contact Reactor (ACR)	▪ Anaerobic contact process (ACP) waste water is mixed with recycled sludge and digested in a sealed reactor, the waste water / sludge mixture externally separated (sedimentation, or vacuum fine screening flotation) and the supernatant discharged for further downstream treatment.
Up flow Anaerobic Sludge Blanket (UASB)	▪ In the UASB process, waste water is introduced at the bottom of the reactor, from where it flows upward through a sludge blanket composed of biologically formed granules or particles.
Fixed-bed Reactor	▪ In the fixed-bed or anaerobic filter process, waste water flows upward or downward (depending on the solids content of the influent) through a column with various types of solid media on

	PRECISE DESCRIPTION
	which anaerobic micro-organisms grow and are retained
Biological Removal of Sulphur Compounds / Heavy Metals	
▪ Much lower solubility of metal sulphides compared to their hydroxides ▪ Applicable to all waste water streams that contain a considerable amount of sulphate	
Tertiary Treatment	
Sand Filters	▪ Removes undissolved pollutants such as suspended solids, undissolved phosphate and attached organics ▪ Flexible for modifications in basic design structure to accommodate site specific criteria.
Carbon Filters	▪ activated carbon adsorbs organics ▪ Flexible for modifications in basic design structure to accommodate site specific criteria.
Micro Filtration	▪ Applied when a solid free waste water for downstream facilities is desired such as reverse osmosis or complete removal of hazardous contaminants ▪ Used in metal particle recovery ▪ Used in metal plating waste water treatment ▪ Used in sludge separation after activated sludge process in a central biological WWTP, replacing secondary clarifier
Ultra Filtration	▪ Removes pollutants such as proteins and other macromolecular compounds and toxic non-degradable components ▪ Separates heavy metals after complexation or precipitation ▪ Separates components not readily degradable in sewage treatment effluents which are subsequently recycled to the biological stage ▪ It is a pretreatment step prior to reverse osmosis or ion exchange ▪ Removes SS along with attached COD as a polishing step and avoiding secondary clarification
Retention ponds	▪ Used to avoid hydraulic overload of downstream facilities ▪ Separates solid pollutants (such as sediment, organic matter, dissolved metal compounds and nutrients) from rainwater ▪ Applied to industrial sites with highly contaminated surfaces
NanoFiltration	▪ Applied to remove larger organic molecules and multivalent ions in order to recycle and reuse the waste water or reduce its volume ▪ Increase the concentration of contaminants to such an extent that subsequent destruction processes are feasible
Reverse Osmosis (RO)	▪ Separates water and dissolved constituents down to ionic species ▪ It is applied when a high purity water is required ▪ The segregated water phase is recycled and reused such as desalination, final removal of degradable components if biological treatment is not available, heavy metals, toxic components and segregation of pollutants with the aim of concentrating or further processing

	PRECISE DESCRIPTION
	▪ It is often used in combination with post treatment techniques for the permeate
Ion Exchange	▪ Applied to remove unwanted ionic and ionisable species from waste water ▪ Its greatest value lies in recovery potential ▪ It recovers rinse water and process chemicals ▪ Examples: ▪ Heavy metal ions – cationic or anionic, *e.g.* Cr3+ or cadmium and its compounds, with low feed concentrations ▪ Ionisable inorganic compounds, such as H_3BO_3 ▪ Soluble, ionic or ionisable organic compounds, *e.g.* carboxylic acids, sulphonic acids, some phenols, amines as acid salt, quaternary amines, alkylsulphates and organic mercury can be removed. ▪ Ion Exchange is the removal of undesired or hazardous ionic constituents of waste water and their replacement by more acceptable ions from an ion exchange resin, where they are temporarily retained and afterwards released into a regeneration or backwashing liquid.
Evaporation	▪ It is applicable to remove or concentrate inorganics

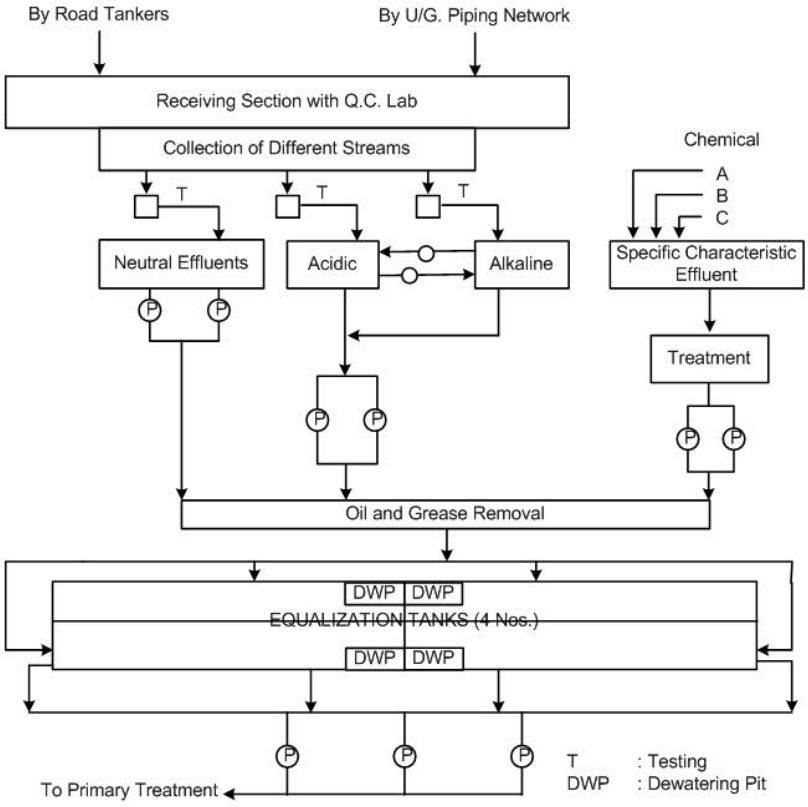

Figure 3-6: Typical Collection and Preliminary Treatment at CETP

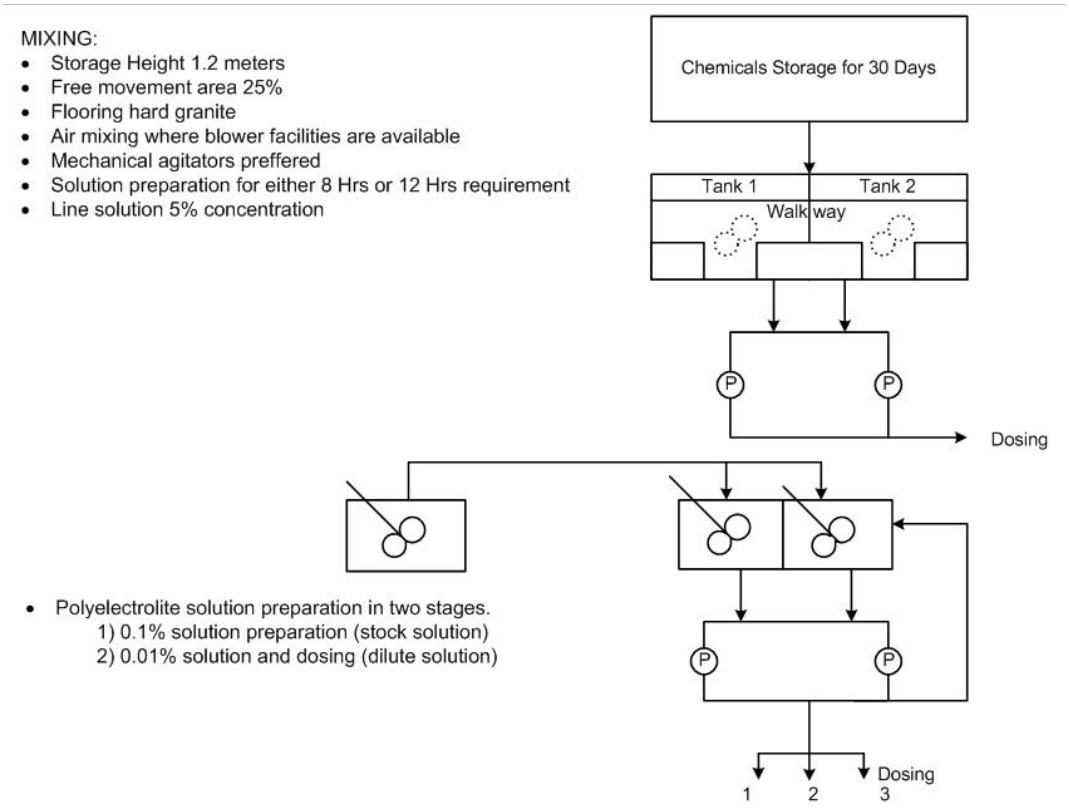

Figure 3-7: Typical Chemical Dosing Process Flowchart

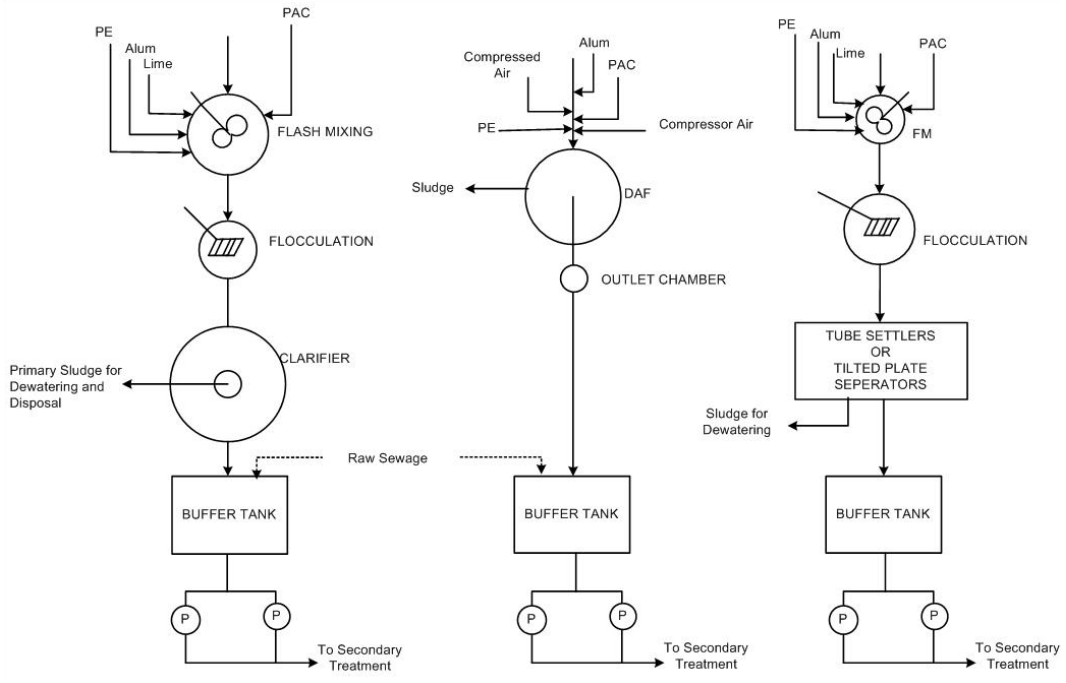

Figure 3-8: Typical Primary Treatment Flowchart

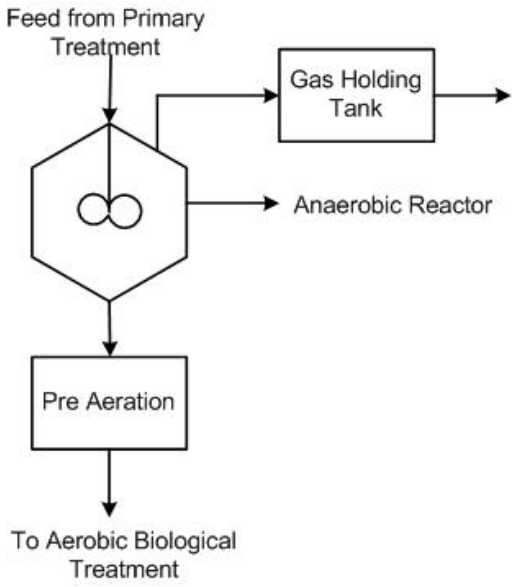

Figure 3-9: Anaerobic Treatment Flowchart

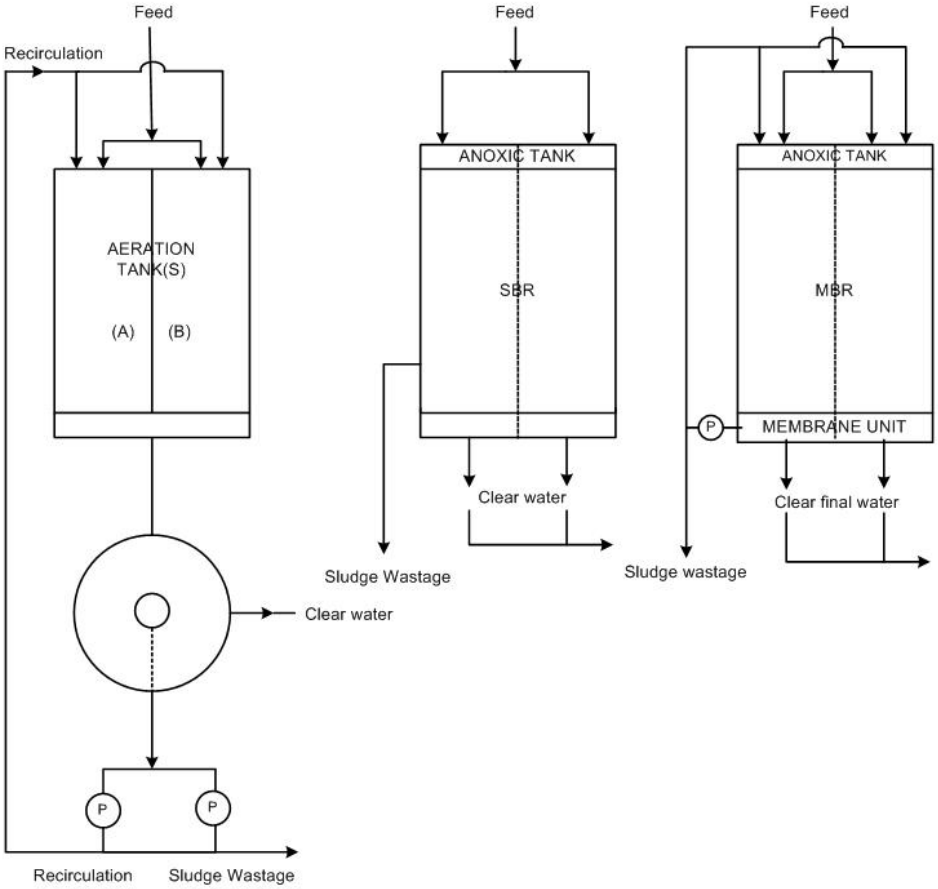

Figure 3-10: Typical Biological Treatment Flowchart

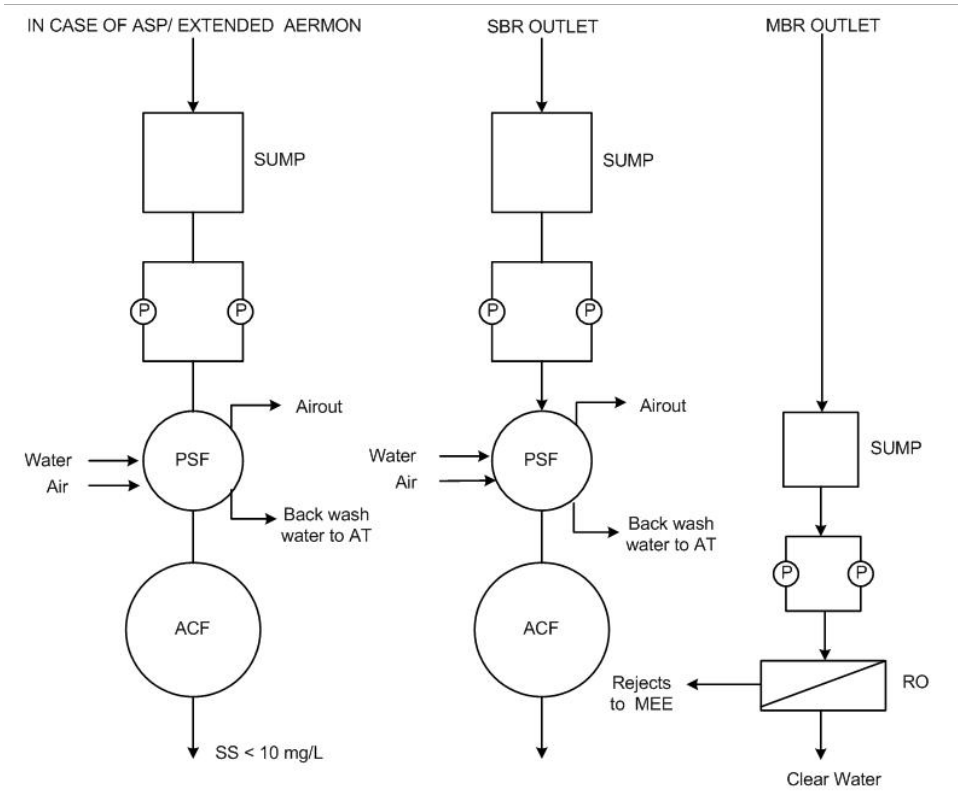

Figure 3-11: Typical Tertiary Treatment

PSF- Pressurized Solution Feed, ACF- Activated Carbon Filters, RO-Reverse Osmosis
MEE- Multiple Effect Evaporator

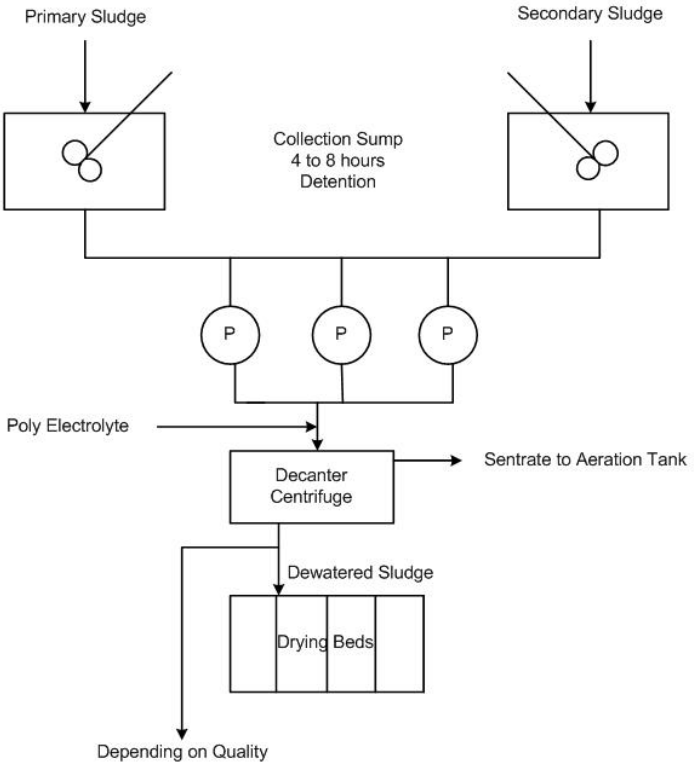

Figure 3-12: Typical Sludge Handling Flowchart

3.2.8 Modes of disposal

Disposal of treated effluents from a CETP can be done in the following modes:

- Surface water bodies
- On land for irrigation
- Marine outfall
- Public sewers

Local conditions, topography *etc*., of a given location, determines the cost-effective disposal option. Disposal mode-specific treated effluent standards are available *i.e*. for discharge into surface water bodies, for on land treatment and for marine disposal. For discharge into public sewers, the general standards for discharge of effluents may be referred.

Disposal of Sludge

Availing of CETP sludge for agricultural use is acceptable, only when it is free from hazardous constituents. The primary sludge in general due to its constituents, falls under the purview of regulatory provisions, for proper disposal into TSDF. The secondary sludge from biological treatment predominantly contains nutrients, thus could be availed as manure, especially for dry land or forest disposal at controlled rates, as long as the concentrations of the constituents are within the acceptable ranges. This has to be studied on a case-to-case basis and with the permission from the regulatory bodies. Both primary and secondary sludge will have to be dewatered to reduce the amount of sludge. Any sludge suspected of still containing hazardous material will be disposed of in proper TSDF, after required analysis and if further required, needs stabilization prior to land disposal.

3.2.9 Cost analysis

- Cost estimates (capital and O&M) for all the treatment options and annual estimates may be assessed. In general, treatment costs would include regular collection and treatment charges. To ensure financial flow and stability, certain portion of the equity shall be collected from the member industry, as a non-refundable membership charge. Often a regulatory mechanism shall be established to check the defaulting member industries in respect of payment. The attributes to be considered for cost calculations include following:

A) Capital Cost

- Land
- Process know-how
- Equipment and electrical
- Civil including administrative building and process units and internal roads and / or approaches
- Stand-by DG Sets
- Piping (preferably High Density Poly Ethylene (HDPE) of suitable pressure rating)
- Instrumentation (plant) such as
  - flow meters (at entry, to Aeration tanks and outlet)
  - D.O. meters in aeration tanks
  - TOC meter
  - TDS meter
  - VOC meter, *etc*., as required by SPCB

- Laboratory equipment for analysis including instrumental analysis
- Piping in the industrial estate or for tankers

B) Operational Cost

- Power (state electricity Board and Diesel for stand-by DG Sets)
- Fresh drinking water / bore water for chemical solution preparation
- Transportation charges of effluent if planned to collect by gravity after collection of sample and analysis or road tankers
- Sewage water charges (if provided)
- Plant maintenance and repairs
  - Mechanical
  - Electrical
  - Instruments
- Sludge disposal charges
- Laboratory chemicals and glassware
- Plant process chemicals (consumables) like lime, alum, poly electrolyte, *etc*.
- Effluent and sludge analysis charges by external agency once in 6 months by a MoEF approved laboratory for comparison with in-house analysis
- Electrical spares
- Mechanical spares
- Consultancy charges (if required)
- R&D activity expenditure

C) Administrative and others

- Salaries and benefits
- Overtime
- Auditors charges
- Bonus, medical and other benefits

3.3 Hazards and Concerns in Wastewater Treatment Facilities

3.3.1 Hazards

Several hazards may endanger the treatment plant, health and safety of workers and may cause danger to the surrounding environment. These hazards are as follows and discussed in the following sections.

- Natural hazards
  - Floods
  - Earthquakes
  - Lightening
- Accidental hazards
  - Fire & explosion hazards
  - Electricity
  - Slips, trips and falls at work
- Chemical hazards
- Biological hazards
- Ergonomic and psychological hazards

3.3.1.1 Natural hazards

Floods

Flooding can cause serious problems for CETPs. During high floods, the plant may be inundated with water as CETPs are usually located in low lying areas for easy flow of water under gravity to the plant. Also, there might be the risk of stormwater flooding in case of the structures built underground often partially below the flood water levels. Therefore, an analysis has to be made on flood water levels, peak hourly wastewater flow rates, hydraulic capacity of the works and effluent pumping systems. Water levels and flow rates in the works shall be controlled by proper systems. During flooding the most common problems are as follows.

- Power outage – Use of generators in emergency situations avoiding by passing
- Lift pump failures – Inspection and servicing the lift pumps at regular intervals to operate at peak efficiency as flow begins to rise. Availability of spare replacement parts on hand in emergency situations
- Treatment system problem

Earthquakes

CETPs are faced with extensive damage during the earthquakes. Also, the workers may result in fatal injuries. Therefore preventive measures shall be taken before, during and after earthquake.

Lightning

Electrical energy from lightning will flow out in all directions of lowest electrical impedance to equalize the electrical potential. This energy may strike things on the ground at high risk and water pipes area real good path which can damage electronic equipment. Ensure that the building is well grounded and every conductive path is bonded to the ground system.

3.3.1.2 Accidental hazards

Enclosed CETPs

Enclosed CETPs may cause problems associated with condensation, corrosion, temperature control and odour emission. These problems can be alleviated by controlling toxic, flammable gases and bio-aerosols. In particular, if ventilation is provided to dilute hydrogen sulphide emissions and hazardous air pollutants to acceptable levels, then it ensures that further measures to control these problems are unnecessary. However, in some circumstances, additional ventilation may be required.

Fire and explosion hazards

Burns and explosions are mainly due to chemicals in the workplace. Flammable and explosive chemicals lead to major accidental hazards. Therefore, to prevent fires and explosions, special precautions must be taken before handling, sorting or transporting these chemicals.

Flammable substances may be accidentally ignited by the following sources:

- Direct flames because of matches, cigarettes, soldering, welding or cutting torches,
- Heat radiation from all sources of heat emitting radiation which may ignite a flammable material at a distance
- Electrical sparks produced from electrical current in a number of ways such as electric arc welding, power supplies (sockets, switches, sliding contacts), electric motors, ignition systems of internal combustion engines, lightening, generation of static electricity between two non-conducting materials (belts on a pulley, rubber tyres on the ground or liquids pumped or pores through pipes).

Fire fighting equipments must be used to control and/or extinguish these fires and explosions. There are two types of fire fighting equipments – fixed and portable. Type of flooring, leaks proof dykes, alarms at appropriate locations are significant factors to be considered during fire fighting.

In case of enclosed works, the fire could spread rapidly endangering the lives of the workers, damaging the treatment plant and the structures. The spread of fire and smoke can be prevented by:

- selection of surface materials with low rates of surface spread of flame and low rates of heat production
- choosing elements of the structure with specified minimum periods of fire resistance
- use of non-combustible materials, wherever possible
- compartmentalization of building into units of restricted floor area and capacity
- protection of openings from doors, pipes, water channels. Ventilation ducts, flues between compartments
- restricting the spread of fire through hidden voids in the building
- specifying construction methods for external walls and roofs and the separation between buildings
- special measures to protect spaces connecting compartments

Electricity

Fatalities can arise due to electric shocks, burns and when contacted with overhead or underground power cables. Non-fatal shocks can cause severe and permanent injuries. Shocks from faulty equipments may lead to falls from ladders, scaffolds or any other platforms. Poor electrical installations and faulty electrical appliances can lead to fires which may also cause death or injury to others. Careful planning and straightforward precautions can avoid these accidents.

Risk assessment should be carried out in order to identify the needs in handling these hazards. Risk assessment shall include:

- Identifying the possible hazards
- The Receptors who would be harmed because of the hazards
- Adequacy of the existing precautionary measures
- Reviewing and revising the assessment from time to time
- Identifying the greater risk of damage
- Testing the electrical appliances regularly

After completion of risk assessment, following findings can be used for reducing the risks.

- Safe installation of electrical appliances at standards
- Use of safe and suitable equipments for the working environment
- Provision for safety devices for detecting faults
- Preventive maintenance by testing the equipments and visual inspection
- Safe working conditions
- Considering underground power cables
- Overhead power lines

Slips, trips and falls at work

These are the most common causes of non-fatal injuries at work but may cost workers heavily. Slip and trip hazards can be reduced through good health and safety arrangements of the workers/employers. The actions brought as a result of these injuries can be extremely damaging to business, especially where the public is involved. There should be adequate information on appropriate use of the safety equipments provided. A good management system for health and safety shall include:

- planning for minimizing or removing risks by identifying the risk areas
- organization setup with responsibilities to ensure safe working conditions
- control on working practices and processes by record keeping and maintenance to ensure good health and safety
- monitoring and reviewing the reports regularly based on experience and improving the existing conditions.
- good working practices by choosing suitable floor surfaces, lighting levels, provision for footwear, removing obstructions, warn signs, *etc*.

3.3.1.3 Chemical hazards

Sources of chemical hazards can be exposure to chemicals and toxic effects of chemicals.

Exposure to chemicals

The heaviest exposure to some chemicals often occurs during industrial activities. The four main exposure routes where chemicals enter the body are through inhalation (breathing), absorption (skin or eye), ingestion (swallowing, eating), transplacental transfer (across the placenta of the pregnant women to the foetus). Most of the chemicals in the workplace have the potential to be dispersed into the air as dust, droplets or as gas or vapor or inhalation. The most important routes of exposure in the workplace leading to systemic effects are inhalation and skin absorption. Also, ingestion is a potential source through contaminated food or drink in the workplace.

Toxic effects of chemicals

The toxicity in chemicals may poison the body of the person exposed. The toxic chemical exposure may lead to acute, chronic, reversible, irreversible, local, systematic and synergism effect. The toxicity of chemicals can be classified as corrosive, irritant, sensitizer, asphyxiant, carcinogen, mutagen, teratogen and fetotoxicant.

To avoid these toxic risk assessment should be carried out which involves identification of hazard based on chemicals of concern, adverse effects, target populations, risk characterization, assessing, exposure and estimating the risk.

Safe use of chemicals

The safety of a chemical in the context of human health is the extent to which a chemical may be used in the amount necessary for the intended purpose with a minimum risk of adverse health effects. Therefore it is important to answer the statements like "is this chemical safe?" or "is there any safety level when using this chemical?"

Prevention and control of chemical hazards

- **Identification of hazard** – workers are required to know the possible health effects of chemicals, other substances, work processes and health and safety procedures
- **Evaluation of hazard and risk** - employers, manufacturers and suppliers of chemical products are required to
  - Develop material safety data sheets (MSDS) for all the chemicals used in the workplace
  - Ensure whether chemical products clearly indicate their harmful effects and provide guidance on how to use the products as safely as possible
  - Instruct workers on labels and MSDS
  - Workers should have the right to refuse to work with chemicals which does not have safety information about the chemical
- To prevent, control or eliminate the risk – all the workers are required to implement effective safety procedures for protection against chemical hazards agreed jointly by employer and workers through
  - Regular inspections with standard checklists for particular chemicals and chemical processes
  - Investigations of workers complaints
  - Use of accident and sickness records
  - Regular survey of workers health
  - Environmental and biological monitoring
  - Assessment of government inspectors/consultants reports
  - Investigation of causes of accidents and their prevention
  - Development of as workplace chemical register
- **Controlling the hazard through specific actions** – the most effective way is to remove the chemical entirely and replace it with less hazardous chemical, wherever possible. Similarly, dangerous processes can also be substituted to avoid the production of toxic intermediates.
- **Engineering controls** – In case, the chemical hazard cannot be removed from the workplace by substitution then the best solution is to physically enclose the hazard to prevent it from coming into contact with either workers or the environment. Dilute or local exhaust ventilation systems can be used to remove contaminated air from the workplace.

3.3.1.4 Biological hazards

Exposure to wastewater may result in number of illnesses when entered into the body. Some of these illnesses are:

- Gastroenteritis – Cramping stomach pain, diarrhea and vomiting

- Weil's disease – Flu like illness with persistent and severe headache, transmitted by rat urine. Damage to liver, kidneys and blood.
- Hepatitis – Inflammation of the liver and jaundice
- Occupational Asthma - Attacks of breathlessness, chest tightness and wheezing and produced by inhalation of living or dead organisms
- Infection to skin or eyes
- Rarely allergic alveolitis (inflammation of the lung) with fever, breathlessness, dry cough and aching muscles and joints.

As the micro-organisms are inherent in wastewater they cannot be removed or eliminated. However, exposure to wastewater can be minimized to avoid these biological hazards. The following measures can be taken to reduce risk of infection and illness:

- awareness on risks through instructions, training and supervision
- use of personal protective equipment such as water proof gloves, footwear, eye and respiratory protection, face visors, *etc*.
- workers should be of 20 to 50 years age group and must not have asthma and tuberculosis
- provide the workers with adequate welfare facilities such as clean water, soaps, disposable paper towels, showers, *etc*.
- inspection and maintenance of safety equipments
- provision for adequate first aid facilities
- effective arrangements for monitoring health and safety

3.3.1.5 Ergonomic and psychological hazards

These hazards can be raised due to stress during work. Some of the problems which may lead to stress are:

- boring job
- repetitive job
- too little or too much work to do
- too little time
- too little or too much training for the job
- selecting right person to fit into the task
- poor relationship with others
- bullying, racial or sexual harassment
- inflexible work schedules
- poor physical working conditions
- lack of communication and consultation
- lack of support for individuals to develop their skills
- lack of control over work activities
- negative work culture

These hazards can be minimized by following measures:

- clarity in defined objectives and responsibilities of an individual linked to business objectives
- selection of appropriate person for the assigned tasks
- prioritizing the jobs

- training the individuals based on interpersonal skills and increasing the scope of work for the trained
- increase the variety of tasks
- rearrange people between the jobs in order not to get bored with the single task
- working in group to improve the performance
- setting up of an effective system to prevent and stop harassments
- working in shifts to ensure flexible working hours
- provision for regular health checkups
- provision for adequate control measures
- opportunity to contribute individual ideas in planning and organizing the jobs
- introducing clear business objectives, good communications and employee involvement particularly during period of change
- any individual should be honest and respect others
- support the individuals to develop their skills

3.3.2 Major concerns

3.3.2.1 Mercury

Mercury is usually found in three different areas of CETP – in the equipment, as an ingredient in chemicals and as a contaminant in treatment chemicals. Safety guidelines shall be followed while handling mercury.

There will be possibility of the chemical getting contaminated with mercury in the liquid flow of the stream. To prevent this environmental contamination mercury analysis of the product should be carried out by the chemical supplier and certification should be taken that the product is mercury free.

It is important to handle mercury and mercury containing devices carefully. To avoid mercury contamination following tips can be followed.

- use of mercury in uncarpeted and well ventilated areas
- there should be a room reserved for mercury use only
- provide troughs on smooth surfaced tables and benches to collect mercury spills
- workers handling mercury should wear mercury vapor respirators and protective clothing, gloves, disposable gowns and shoe coverings
- prohibiting smoking and eating in or near exposed areas
- training the workers on dangers and precautions for handling and disposing mercury
- clean and calibrate all mercury containing equipment to the specification of the manufacturer
- properly document and label containers containing mercury in addition to having MSDS
- in case of spills, use emergency spill and containment plan
- avoid chemicals which react with mercury (Ex. chlorine dioxide, nitric acid, nitrates, ethylene oxide, chlorine and methylazide)
- ensure that mercury is away from biological waste or anything else that will be incinerated since incineration puts mercury vapor into the air.

3.3.2.2 Endotoxins

Many respiratory health effects related to workers in wastewater facility expose to large doses of endotoxins. These endotoxins are produced by bacteria, especially gram-negative bacteria during growth, division or death. Daily exposure to these bacteria may not be healthy. Exposure to endotoxins may lead to fever, cough, shortness of breath, headache, nose and throat irritation, nausea, chest tightness, acute airway flow restriction and inflammation. Even low doses of endotoxins may cause changes in body temperature, metabolism, hematological (blood making), immune and endocrine systems of the body.

As endotoxins are prevalent in wastewater it is difficult to control them. However, following measures can be taken to prevent its exposure.

- minimizing the uncontrolled flow of wastewater in populated areas
- cleaning up of any releases
- ventilation to draw aerosolized water away from breathing zone of the employee
- use of special filtration systems to collect airborne droplets
- wearing respirators equipped with a dust, mist and fume cartridge

Air sampling is carried out to know the endotoxin concentrations. Sampling for endotoxins may also include placement of sampling water and dust in endotoxin-free containers. No enforceable standards have been established to date in the world including India. Therefore water exposure results have to be compared to guidelines based on challenge studies and field studies. One study conducted by a leading authority on endotoxins, Dr. Ragnar Rylander, establishes a 'no-effect-level' less than 10 milligrams per cubic metre (mg/m^3). The following table indicates the expected health effects when exposed to the listed concentration.

Table 3-5: Disease Type Concentration

Disease Type	Concentration ($\mu g/m^3$)
Airway inflammation	10
Systemic effects	100
Toxic pneumonitis (toxic inflammation of the lungs)	200

Source: Guidelines for Health and Safety of Workers in Wastewater Treatment Facilities, CPCB, MoEF, October, 2001
Note:
1 $\mu g/m^3$ Endotoxin is approximately equal to 10 to 15 Endotoxin units (EU)

3.3.3 Hazardous air pollution

Solvents in huge quantities are used in pharmaceutical, chemical, dyes & dye intermediate units. The recovery and reuse of these solvents in such units is very poor because of the indigenous technology, equipment adds to pollution load in CETP. This may lead to problem of hazardous air pollutants (HAPs).

CETP is considered as one of the major sources of HAP emissions. HAPs have adverse health impacts of methylene chloride and benzene in animals and human beings respectively.

HAPs entering CETP can be biodegraded, adhere to sludge, volatile to air or pass through to receiving waters. During the process of effluent treatment in CETP, HAPs are emitted. Apart from various components of CETP, effluent collection systems may cause HAP emissions. These primary HAPs (xylenes, methylene chloride, toluene, ethyl benzene, chloroform, tetra chloroethylene, benzene and nepthalene) would be emitted from ETPs when the compounds are present in the influent in sufficient concentrations and treatment units are uncontrolled for air emissions. These HAPs may be shifted from one medium to another medium (liquid to air to sludge to liquid) or destroyed through bio-degradation. In addition, volatization of HAP may occur in effluent collection and transportation system prior to reaching CETP.

Control of HAPs

HAP can be controlled either by add-on controls or pre-treatment. CETP may have covers on their existing treatment units either

- vented using a high ventilation rate – does not suppress HAPs
- vented using a low ventilation rate – suppresses HAPs but suppressed HAPs emissions are likely to re-occur in the next physical process in the effluent treatment
- not vented

The covers are vented to odour control devices such as scrubbers and granulated activated carbon (GAC) absorption units. These scrubbers will reduce HAP-emission concentrations to 95 %. Also, bio-filtration is used to adsorb to HAPs.

Member industries of a CETP shall control the concentrations of HAPs; if uncontrolled, the HAPs may cause treatment process inhibition (adversely affecting the bio-treatment of organisms) or present a safety/health hazard to CETP workers. SPCBs/UTPCCs (Union Territory Pollution Control Committee) may prescribe emission standards to CETP companies regarding concentration of HAPs in effluent and sludge.

In case of enclosed works HAP emissions can be controlled by:

- controlling the quantities of toxic or flammable materials discharged into the pipelines/rising main sewers.
- discouraging the formation of toxic gases within the pipelines and rising main sewers
- isolating the end of pipelines, rising mains, sewers from treatment works building
- selecting unit operations and operating practices that minimize the emissions within the treatment works
- preventing emissions from the works by enclosure and operation at negative pressure
- containing emission sources wherever possible
- apply local ventilation measures wherever possible
- restricting the spread of emissions through the works by compartmentalization
- applying general ventilation to dilute emissions to acceptable levels
- treat ventilation air before discharge and
- disperse treated air to dilute it to acceptable concentrations outside the plant

In case the CETP is not equipped with closed vent system and control devices, it should have facilities to minimize the HAP emissions. If a CETP has a potential to emit 10

tonnes per year T/yr or more of any single HAP compound or 25 T/yr or greater of any combination of HAP compounds, then the CETP becomes a major source of HAP emission and has to be dealt with.

3.3.4 Exposure pathways

Exposure pathway is the path due to which exposure of the receptor takes place. "Exposure" has been defined as contact with a chemical or physical agent. It is the process by which an organism acquires a dose (Suter, 1993). The estimation of exposure of a target organism requires an exposure scenario that answers to four questions (Suter, 1993):

- given the output of fate models (see section 4.2.2 on mass balance equation for water quality), which media (ecosystem components) are significantly contaminated?
- to which contaminated media are the target organisms exposed?
- how are they exposed (pathways and rates of exposure)?
- given an initial exposure, will the organism modify its behavior to modify exposure pathways or rates (attraction or avoidance)?

For environmental risk management there are three major risk factors and exposure pathway is one of the three factors. To determine whether risk management actions are warranted, the following assessment approach should be applied to establish whether the three risk factors of 'contaminants', 'receptors', and 'exposure pathways' co-exist, or are likely to co-exist, at the project site after the operational phase of the proposed development.

- **Contaminant(s):** Presence of pollutants and toxic gases in the waste in any environmental media above permissible concentrations
- **Receptor(s):** Actual or likely contact of humans, wildlife, plants, and other living organisms with the contaminants of concern
- **Exposure Pathway(s):** A combination of the route of migration of the contaminant from its point of release (*e.g.*, leaching into potable groundwater) and exposure routes

Table 3-6 identifies some of the major exposure pathways.

Table 3-6: Exposure Pathways

Media	Pathways	Comment
Air (Carbon emissions)	Respiration	Assuming accurate fate model estimates, exposure is relatively predictable based on assumption of homogenous distribution in air
Water (Leachate)	Near by surface water bodies and ground water	Assuming accurate fate model estimates, exposure is relatively predictable based on assumption of homogenous distribution in water
Soil (Solid waste dump)	Benthic animals absorb chemicals, respire pore water or food or food from the water column. Plants rooted in the sediment may take up material from	Processes are very complicated and usually simplifying assumptions are required

Media	Pathways	Comment
	sediments, surface water and air	
Soil (solids, pore water and pore air)	Organisms in soils may absorb material from soil, pore water, pore air, ingest soil, soil – associated food.	Processes are very complicated and usually simplifying assumptions are required.
Ingested food and water	Consumption by fish and wildlife	Assume the test animal consumption rates in laboratory for a given availability of food or water are the same as those occurring naturally in the environment.
Multimedia	More than one of the above pathways	It is often possible to assume one pathway is dominant. In some cases, it will be necessary to estimate the combined dosage.

Emissions from the solid waste (gaseous, solid & hazardous as well as liquid effluents) can cause damage to human health, aquatic and terrestrial ecology as well as material due to various exposure routes (pathways). For example, adverse effects of solid waste open dump on human health can derive from the direct impact of noxious gases on the organism and/or their indirect impact via the food chain and changes in the environment. Especially in connection with high levels of fine particulates, noxious gases like methane, CO_2, SO_2 and NOx can lead to respiratory diseases. The duration of exposure is decisive. Injurious heavy metals (*e.g.*, lead, mercury and cadmium) can enter the food chain and, hence, the human organism by way of drinking water and vegetable and animal products. Climatic changes such as warming and acidification of surface waters, forest depletion, *etc*., can occur due to acid rain and/or the greenhouse effect of methane and CO_2 and other trace gases can have long-term detrimental effects on human health. Similarly important are the effects of climatic changes on agriculture and forestry (and thus on people's standard of living), *e.g.*, large-scale shifts of cultivation to other regions and/or deterioration of crop yields due to climate change impacts.

3.4 Summary of Applicable National Regulations

3.4.1 General description of major statutes

A comprehensive list of all the laws, rules, regulations, decrees and other legal instruments applicable to CETP is attached as **Annexure I**.

3.4.2 General standards for discharge of environmental pollutants

List of general standards for discharge of environmental pollutants as per CPCB is given in **Annexure II**.

3.4.3 Inlet and treated effluent quality standards for CETP

According to CPCB, inlet and treated effluent quality standards that shall be maintained for CETP is as given in the following tables.

Table 3-7: Inlet effluent quality standards for CETP

S. No	Parameter	Concentration in mg/l
1	pH	5.5 – 9.0
2	Temperature ^{o}C	45
3	Oil & Grease	20
4	Phenolic Compounds (as C_6H_5OH)	5.0
5	Ammonical Nitrogen (as N)	50
6	Cyanide (as CN)	2.0
7	Chromium Hexavalent (as Cr_{6+})	2.0
8	Chromium (Total) (as Cr)	2.0
9	Copper (as Cu)	3.0
10	Lead (as Pb)	1.0
11	Nickel (as Ni)	3.0
12	Zinc (as Zn)	15
13	Arsenic (as As)	0.2
14	Mercury (as Hg)	0.01
15	Cadmium (as Cd)	1.0
16	Selenium (as Se)	0.05
17	Fluoride (as F)	15
18	Boron (as B)	2.0
19	Radioactive Materials	
19	Alpha emitters, Hc/ml	10-7
20	Beta emitters, He/ml	10-8

Note:

1. These standards apply to small-scale industries i.e. total discharge up to 25 KLD.

2. For each CETP and its constituent units, the State Board will prescribe standards as per the local needs and conditions; these can be more stringent than those prescribed above. However in case the cluster of units, the State Board with the concurrence of CPCB in writing may prescribe suitable limits.

Table 3-8: Treated Effluent Quality of Common Effluent Treatment Plant Concentration in mg/l except pH and Temperature

S. No	Parameter	Into inland surface waters	On land for Irrigation	Into Marine Coastal areas
		(a)	(b)	(c)
1	pH	5.5 – 9.0	5.5 – 9.0	5.5 – 9.0
2	BOD_5 20^{o}C	30	100	100

S. No	Parameter	Into inland surface waters	On land for Irrigation	Into Marine Coastal areas
3	Oil & Grease	10	10	20
4	Temperature ^{o}C	Shall no exceed 40^{o}C in any section of the stream within 15 meters down-stream from the effluent outlet	-	45^{o}C at the point of discharge
5	Suspended Solids	100	200	(a) For process wastewaters -100 (b) For cooling water effluents 10% above total suspended matter of effluent cooling water
6	Dissolved Solids (inorganic)	2100	2100	-
7	Total residual Chlorine	1.0	-	1.0
8	Ammonical nitrogen (as N)	50	-	50
9	Total Kjeldahl nitrogen (as N)	100	-	100
10	Chemical Oxygen Demand (COD)	250	-	250
11	Arsenic (as As)	0.2	0.2	0.2
12	Mercury (as Hg)	0.01	-	0.01
13	Lead (as Pb)	0.1	-	0.1
14	Cadmium (as Cd)	1.0	-	2.0
		(a)	(b)	(c)
15	Total Chromium (as Cr)	2.0	-	2.0
16	Copper (as Cu)	3.0	-	3.0
17	Zinc (as Zn)	5.0	-	15
18	Selenium (as Se)	0.05	-	0.05
19	Nickel (as Ni)	3.0	-	5.0
20	Boron (as B)	2.0	2.0	-
21	Percent Sodium	-	60	-
22	Cyanide (as CN)	0.2	0.2	0.2
23	Chloride (as Cl)	1000	600	-
24	Fluoride (as F)	2.0	-	15

S. No	Parameter	Into inland surface waters	On land for Irrigation	Into Marine Coastal areas
25	Sulphate (SO_4)	1000	1000	-
26	Sulphide (as S)	2.8	-	5.0
27	Pesticides	Absent	Absent	Absent
28	Phenolic Compound (as C_6H_5OH)	1.0	-	5.0

Note:

All efforts should be made to remove color and unpleasant odor as far as possible.

4. OPERATIONAL ASPECTS OF EIA

Prior environmental clearance process has been revised in the Notification issued on 14th September, 2006 into following four major stages *i.e.*, screening, scoping, public consultation and appraisal. Each stage has certain procedures to be followed. This section deals with all the procedural and technical guidance for conducting objective-oriented EIA studies, its review and decision-making. Besides, the Notification also classifies projects into Category A and Category B, which require prior environmental clearance from the MoEF and SEIAA/UTEIAA respectively.

Consistency with other requirements

- Clearance from other regulatory bodies is not a prerequisite for obtaining the prior environmental clearance and all such clearances will be treated as parallel statutory requirements
- Consent for establishment (CFE) and prior environmental clearance are two different legal requirements, a project proponent should acquire. Therefore, these two activities can be initiated and proceeded with simultaneously.
- If a project falls within the purview of Coastal Regulatory Zone (CRZ) and EIA Notifications, then the project proponent is required to take separate clearances from the concerned Authorities.
- Rehabilitation and Resettlement (R&R) issues need not be dealt under the EIA Notification as other statutory bodies deal with these issues. However, socio-economic studies may be considered while taking environmental decisions.

4.1 Coverage of CETPs under the Purview of Notification

All new CETP projects including expansion and modernization require prior environmental clearance. Based on pollution potential, these projects irrespective of the capacities are classified into Category B

The Notification covers treatment plants which serve different industries not in the same premises for common/combined wastewater. The Notification excludes ETPs serving different production units within the same individual industry premises, which are integrated to operation.

Besides there are general conditions, when it applies, a Category B project will be treated as Category A project. These conditions are discussed in subsequent sections.

It also covers sludge handling, discharging pipeline and disposal point studies.

It covers combined wastewater treatment plants *i.e.*, CETPs accepting sewage also along with industrial effluents for better treatability. For clarity, any treatment plant having more than 10% of industrial contributions by volume shall be treated as a combined treatment plant.

The sequence of steps in the process of prior environmental clearance for Category B and Category A projects are shown in Figure 4.1 and Figure 4.2 respectively. Each stage in the process of prior environmental clearance for the CETP is discussed in subsequent sections. The timelines indicated against each stage are the maximum permissible time lines set in the Notification for said task. In case the said task is not cleared/objected by the concerned Authority, within the specified time, said task is deemed to be cleared, in accordance to the proposal submitted by the proponent.

In case of Expansion or Modernization of the developmental Activity:

- Any developmental activity, which has an EIA clearance (existing project), when undergoes expansion or modernization (change in process or technology) with increase in production capacity or any change in product mix beyond the list of products cleared in the issued clearance is required to submit new application for EIA clearance.
- Any developmental activity, which is listed in Schedule of the EIA Notification and due to expansion of its total capacity, if falls under the purview of either Category B or Category A, then such developmental activity requires clearance from respective authorities.

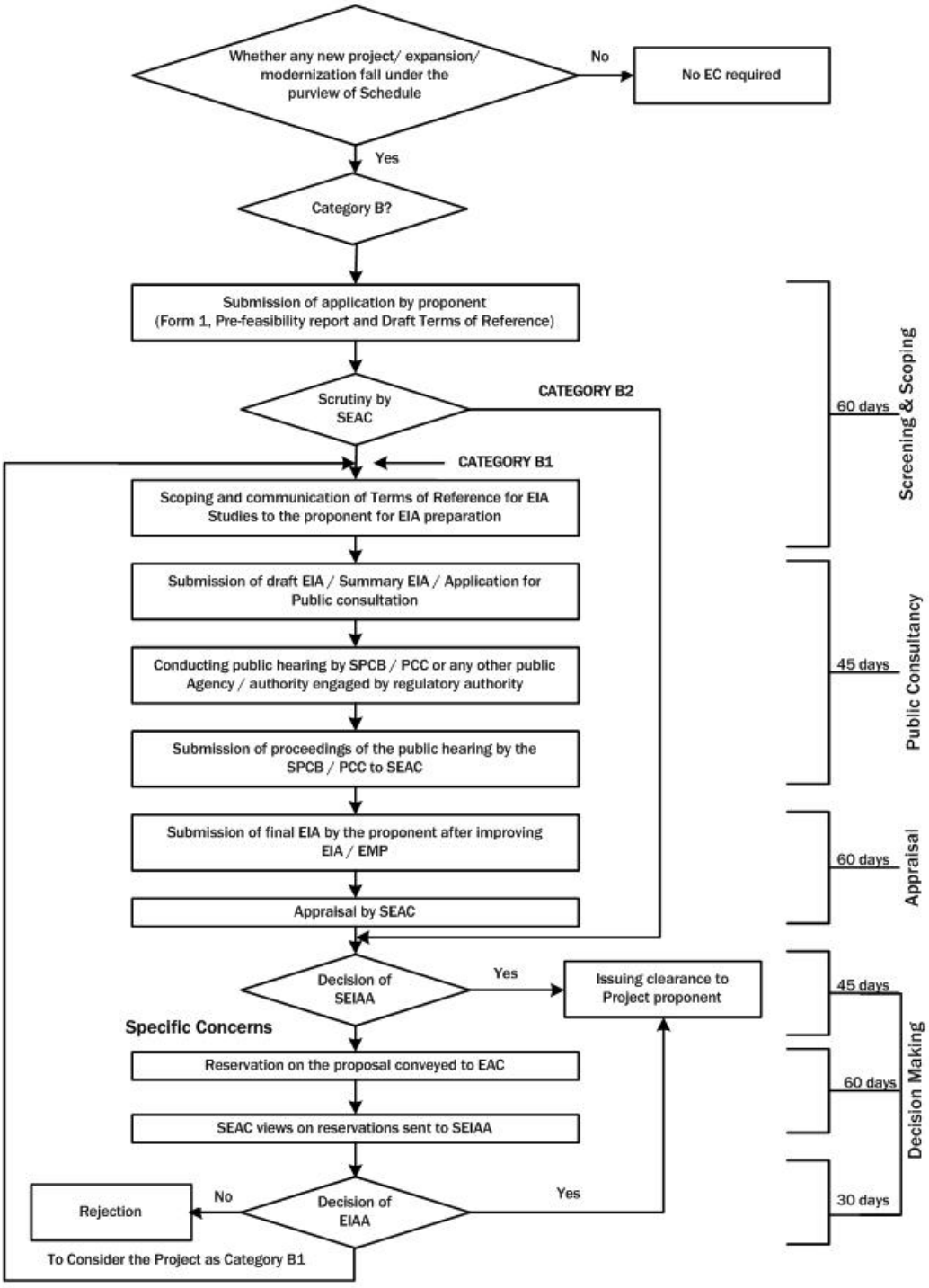

Figure 4-1: Prior Environmental Clearance Process for Activities Falling Under Category B

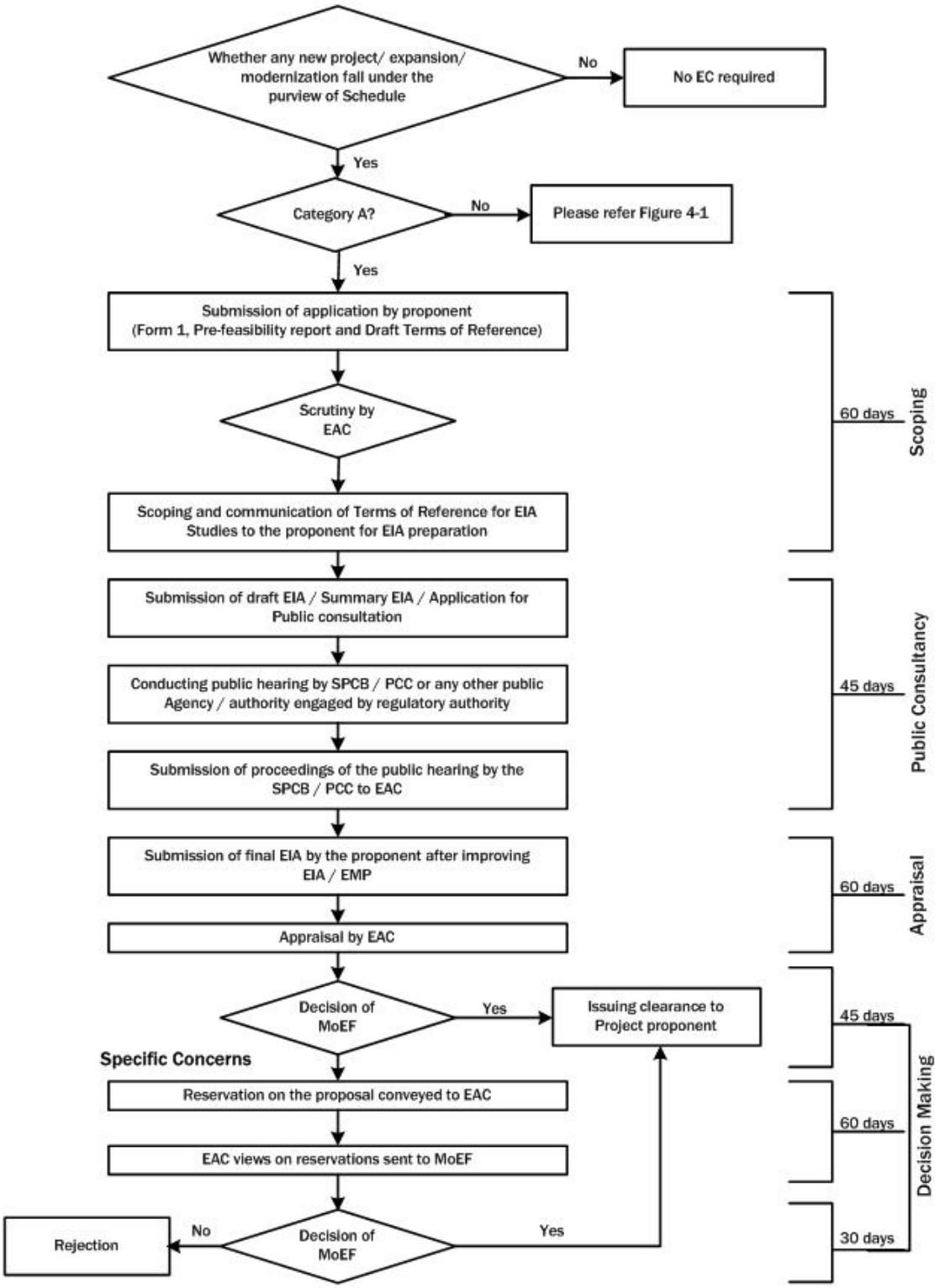

Figure 4-2: Prior Environmental Clearance Process for Activities Falling Under Category A

4.2 Screening

Screening of the project shall be performed at the initial stage of the project development so that proponents are aware of their obligations before deciding on the budget, project design and execution plan.

This stage is applicable only for Category 'B' developmental activity *i.e.,* if the general condition mentioned in the Notification is applicable to a Category B project, it will be considered as a Category A project. Besides, screening also refers to the classification of Category B projects into either Category B1 or Category B2. Category B1 projects require to follow all the stages applicable for a Category A projects, but are processed at the SEIAAs/UTEIAAs. Category B2 projects, on the other hand, do not require either EIA or public consultation.

As per the Notification, classification of Category B projects falls under the purview of the SEAC. This manual provides certain guidelines to the stakeholders for classification of Category B1 and Category B2.

4.2.1 Applicable conditions for Category B projects

General condition:

- Any CETP project that is usually falling under Category B will be treated as Category A, if located in whole, or in part within 10 km from the boundary of:
  - Protected areas notified under the Wild Life (Protection) Act, 1972
  - Critically polluted areas as notified by the CPCB from time to time
  - Eco-sensitive areas as notified under Section 3 of the E(P) Act, 1986, such as Mahabaleshwar Panchgani, Matheran, Panchmarhi, Dahanu, Doon valley and
  - Inter-State boundaries and international boundaries— provided that the requirement regarding distance of 10 km of the inter-state boundaries can be reduced or completely done away with by an agreement between the respective States/UTs sharing the common boundary in case the activity does not fall within 10 km of the areas mentioned above
- The SEIAA shall base its decision on the recommendations of a State/UT level EAC for the purpose of environmental clearance
- In absence of a duly constituted SEIAA or SEAC, a Category B project shall be appraised at the Central level *i.e.*, at the MoEF
- The EAC at the State/UT level shall screen the projects or activities in Category B. SEAC shall meet at least once every month
- If any Category B CETP project/activity, after proposed expansion of capacity/ production or fuel change, falls under the purview of Category A in terms of production capacity, then clearance is required from the Central Government.

4.2.2 Criteria for classification of Category B1 and B2 projects

The classification of Category B projects into Category B1 or B2 will be determined based on whether or not the project or activity requires further environmental studies for preparation of an EIA for its appraisal prior to the grant of environmental clearance. The necessity of which will be decided, depending upon the nature and location specificity of

the project by the SEAC after scrutiny of the applications seeking environmental clearance for Category B projects/activities.

CETP projects in case of new industrial estates may be treated as parallel projects for consideration instead of inclusion in the entire industrial estate for the purpose of clearance, to offer the flexibility and to optimize the time in establishing the CETP, if desired by the proponents.

All Category B1 projects require EIA studies and public consultation whereas, Category B2 projects do not require EIA studies and public consultation.

4.2.3 Application for prior environmental clearance

- The project proponent, after identifying the site and carrying out a pre-feasibility study, is required to apply for the prior environmental clearance in Form 1 given in **Annexure III.** The proponent has to submit filled in Form 1 along with pre-feasibility report and draft ToR for EIA studies to the concerned Authority *i.e.,* MoEF, Government of India for Category A projects and SEIAA in case of Category B projects. Subsequent sections can be referred for the information on how to fill Form 1, contents of pre-feasibility report and draft ToR for CETP.
- Prior environmental clearance is required before starting any construction work, or preparation of land on the identified site/project or activity by the project management, except for securing the land.
- If the application is made for a specific developmental activity, which has an inherent area development component as a part of its project proposal and the same project also attracts the construction and area development provisions under 8a and 8b of the Schedule, then the project will be seen as a developmental activity other than 8a and 8b of the Schedule.

4.2.4 Siting guidelines

These are the guidelines, stakeholders may consider while siting the developmental projects, to minimize the possible associated environmental impacts. In some situations, adhering to these guidelines is difficult and unwarranted. Therefore these guidelines may be kept in the background, as far as possible, while taking the decisions.

Areas preferably be avoided

While siting industries, care should be taken to minimize the adverse impact of the industries on immediate neighborhood as well as distant places. Some of the natural life sustaining systems and some specific landuses are sensitive to industrial impacts because of the nature and extent of fragility. With a view to protect such sites, the industries may maintain the following distances, as far as possible from the specific areas listed:

- Ecologically and/or otherwise sensitive areas: Preferably 5 km; depending on the geo-climatic conditions the requisite distance shall have to be increased by the appropriate agency.
- Coastal Areas: Preferably ½ km from high tide line (HTL).
- Flood plain of the riverine system: Preferably ½ km from flood plain or modified flood plain affected by dam in the upstream or by flood control systems.

- Transport/communication system: Preferably ½ km from highway and railway.
- Major settlements (3,00,000 population): Distance from settlements is difficult to maintain because of urban sprawl. At the time of siting of the industry, if the notified limit of any major settlement is found to be within 20 km from the project boundary, the spatial direction of growth of the settlement for at least a decade must be assessed. Subsequently, the industry shall be sited at least 10 km from the projected growth boundary of the settlement
- Critically polluted areas are identified by MoEF from time-to-time. Current list of critically polluted areas is given in **Annexure IV**.

Note:

Ecological and/or otherwise sensitive areas include (i) Religious and Historic Places; (ii) Archaeological Monuments (e.g. identified zone around Taj Mahal); (iii) Scenic Areas; (iv) Hill Resorts; (v) Beach Resorts; (vi) Health Resorts; (vii) Coastal Areas rich in Corals, Mangroves, Breeding Grounds of Specific Species; (viii) Estuaries rich in Mangroves, Breeding grounds of Specific Species; (ix) Gulf Areas; (x) Biosphere Reserves; (xi) National Parks and Sanctuaries; (xii) Natural lakes, Swamps; (xiii) Seismic Zones; (xiv) Tribal Settlements; (xv) Areas of Scientific and Geological Interest; (xvi) Defence Installations, specially those of security importance and sensitive to pollution; (xvii) Border Areas (International) and (xviii) Airports.
Pre-requisite: State and Central Governments are required to identify such areas on a priority basis.

General siting factors

In any particular selected site, the following factors must also be recognized:

- No forest land shall be converted into non-forest activity for the sustenance of the industry (Ref: Forest Conversation Act, 1980).
- No prime agricultural land shall be converted into industrial site.
- Within the acquired site the industry must locate itself at the lowest location to remain obscure from general sight.
- Land acquired shall be sufficiently large to provide space for appropriate green cover including green belt around the battery limit of the industry.
- Enough space should be provided for storage of recyclable solid wastes so that these could be available for possible reuse.
- Layout of the industry that may come up in the area must conform to the landscape of the area without affecting the scenic features of that place.
- Associated township of the industry may be created at a space having physiographic barrier between the industry and the township.

4.3 Scoping for EIA Studies

Scoping exercise is taken up soon after the project contours are defined. The primary purpose of scoping is to identify concerns and issues which may affect the project decisions. Besides, scoping defines the requirements and boundaries of an EIA study.

Scoping refers to the process by which EAC in case of Category 'A' projects or activities, and the SEAC in case of Category 'B1' projects, including applications for expansion and/or modernization of existing projects, determines the ToR for EIA studies addressing all relevant environmental concerns for preparation of an EIA report for a particular project.

- Project proponent shall submit application to the concerned Authority. The application (Form 1 as given in **Annexure III**) shall be attached with pre-feasibility report and proposed ToR for EIA studies. The proposed sequence to arrive at the draft ToR is discussed below:
  - Pre-feasibility report summarizes the project details and also the likely environmental concerns based on secondary information, which will be availed for filling Form 1.
  - From pre-feasibility report and Form 1, valued environmental components (VECs) may be identified for a given project (receiving environment/social components, which are likely to get affected due to the project operations/activities).
  - Once the project details from the pre-feasibility report and Form 1; and VECs are identified, a matrix establishing the interactions which can lead to the effects/impacts could be developed (qualitative analysis).
  - For each identified possible effect in the matrix, significance analysis could be conducted to identify the impacts, which needs to be studied further (quantitative analysis) in subsequent EIA studies. All such points find a mention in the draft ToR to be proposed by the project proponent. The draft ToR shall include applicable baseline parameters (refer **Annexure VII**) and impact prediction tools (refer **Annexure IX**) proposed to be applied.
  - The information to be provided in pre-feasibility report, guidelines for filling Form 1 and guidelines for developing draft ToR is summarized in subsequent sections.
  - Authority consults the respective EAC/SEAC to reply to the proponent. The EAC/SEAC concerned, reviews the application form, pre-feasibility report and proposed draft ToR by the proponent and makes necessary additions/deletions to make it a comprehensive ToR that suits the statutory requirements for conducting EIA studies.
- The concerned EAC/SEAC may formulate a sub-committee for a site visit if considered necessary. The sub-committee will act up on receiving a written approval from the Chairperson of EAC/SEAC concerned. Project proponent shall facilitate such site visits of the sub-committees.
- EAC/SEAC shall provide an opportunity to the project proponent for presentation and discussions on the proposed project and related issues as well as the proposed ToR for EIA studies. If the State Government desires to present their views on any specific project, they can depute an officer for the same at the scoping stage to EAC, as an invitee but not as a member of EAC. However, non-appearance of the project proponent before EAC/SEAC at any stage will not be a ground for rejection of the application for the prior environmental clearance.
- If a new or expansion project is proposed in problem area as identified by the CPCB, then the MoEF may invite a representative of SEIAA to the EAC to present its views, if any at the stage of scoping..
- The final set of ToR for EIA studies shall be conveyed to the proponent by the EAC/SEAC within sixty days of the receipt of Form 1 and pre-feasibility report. If the finalized ToR for EIA studies is not conveyed to the proponent within sixty days

of the receipt of Form 1, the ToR suggested by the proponent shall be deemed as final and will be approved for EIA studies.

- Final ToR for EIA studies shall be displayed on websites of the MoEF/SEIAA.
- Applications for prior environmental clearance may be rejected by the concerned Authority based on the recommendation of the concerned EAC/SEAC at this stage itself. In case of such rejection, the decision along with the reasons for the same shall be communicated to the proponent in writing within sixty days of the receipt of the application.
- The final EIA report and other relevant documents submitted by the applicant shall be scrutinized by the concerned Authority with strict reference to the approved ToR for EIA studies.

4.3.1 Pre-feasibility report

The pre-feasibility report should include, but may not limited to highlight the proposed project information, considering the environmental sensitivities of the selected site, influent wastewater, technology options (based on alternatives analysis), wastewater availability, interconnectivity with other STP treated wastewater, system reliability, efficiency, availability, flexibility for vulnerable shock loads to opt for combinations of different chemical characteristics of wastewater. Information required in the pre-feasibility report varies from case-to-case even in the same sector depending upon the local environmental setting within which the plant is located/proposed. However, the environmental information to be furnished in the pre-feasibility report may include:

I. Executive Summary

II. **Project details**: Project description, including in particular:

- a description of the physical characteristics of the whole project and the landuse requirements during the construction and operational phases
- details of raw materials, including the intermediates, for instance, chemicals used, description of the main characteristics of the wastewater, the treatment processes, nature and quantity of the wastewater generated, *etc*.
- an estimate, by type and quantity, of expected residues and emissions (air, noise, vibration , *etc*.) resulting from the operation of the proposed CETP.

III. Site selection based on least possible impacts

- An outline of the main alternatives studied by the developer and an indication of the main reasons for this choice, taking into account the environmental effects.

IV. Anticipated impacts based on project operations on receiving environment

- A description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors.
- A description of the likely significant effects of the proposed project on the environment resulting from:
  - existence of the project
  - use of natural resources – specific consumptions

- emission of pollutants, creation of nuisances and elimination of waste and
- Project proponent's description of the forecasting methods used to assess the effects on environment.

V. Proposed broad mitigation measures which would effectively be internalized as project components to have environmental and social acceptance of the proposed site.

- A description of key measures envisaged to prevent, reduce and where possible offset any significant adverse effects on environment
- A non-technical summary of information provided under the above headings.
- An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the project proponent in compiling the required information.

Some pre-feasibility reports are based on various studies and data collection. These reports address in detail the concerns as technical & economical; analysis and detailed feasibility level design of equipment, process optimization, transportation of products, financial, social and environmental investigations, cost estimates with detailed bill of quantities (BOQ). The components identified here focus on the requirements of scoping for EIA study. Points which may be covered in pre-feasibility report are listed in **Annexure V**.

4.3.2 Guidance for filling information in Form 1

The information given in specifically designed pre-feasibility report for this developmental activity may also be availed for filling Form 1.

Form 1 is designed to help users identify the likely significant environmental effects of proposed projects right at the scoping stage. There are two stages for providing information under two columns:

- First - identifying the relevant project activities from the list given in column 2 of Form 1. Start with the checklist of questions set out below and complete Column 3 by answering:
  - Yes - if the activity is likely to occur during implementation of the project;
  - No - if it is not expected to occur;
  - May be - if it is uncertain at this stage whether it will occur or not.
- Second – Each activity for which the answer in Column 3 is "Yes" the next step is to refer to the fourth column which quantifies the volume of activity which could be judged as significant impact on the local environmental characteristics, and identify the areas that could be affected by that activity during construction /operation / decommissioning of the project. Form 1 requires information within 15 km around the project, whereas actual study area for EIA will be as prescribed by respective EAC/SEAC. Project proponent will need information about the surrounding VECs in order to complete this Form 1.

4.3.3 Identification of appropriate valued environmental components

VECs are the components of natural resources and human world that are considered valuable and are likely to be affected by the project activities. Value may be attributed for economic, social, environmental, aesthetic or ethical reasons. VECs represent the investigative focal point for further EIA process. The indirect and/or cumulative effects

can be concerned with indirect, additive or even synergistic effects due to other projects or activities or even induced developments on the same environmental components as would be considered direct effects. But such impacts tend to involve larger scale VECs such as within entire region, river basins or watersheds; and, broad social and economic VECs such as quality of life and the regional economy. Once VECs are identified, appropriate indicators are selected for EIA on respective VECs.

4.3.4 Methods for identification of impacts

There are various factors which influence the approach adopted for the assessment of direct, indirect, cumulative impacts, *etc*. for a particular project. The method should be practical and suitable for the project given the data, time and financial resources available. However, the method adopted should be able to provide a meaningful conclusion from which it would be possible to develop, where necessary, mitigation measures and monitoring. Key points to consider when choosing the method(s) include:

- Nature of the impact(s)
- Availability and quality of data
- Availability of resources (time, finance and staff)

The method chosen should not be complex, but should aim at presenting the results in a way that can be easily understood by the developer, decision maker and the public. A comparative analysis of major impact identification methods is given in Table 4-1.

Table 4-1: Advantages and Disadvantages of Impact Identification Methods

	Description	Advantages	Disadvantages
Checklists	▪ Annotate the environmental features that need to be addressed when identifying the impacts of activities in the project	▪ Simple to understand and use ▪ Good for site selection and priority setting ▪ Simple ranking and weighting	▪ Do not distinguish between direct and indirect impacts ▪ Do not link action and impact ▪ The process of incorporating values can be controversial
Matrices	▪ Identify the interaction between project activities (along one axis) and environmental characteristics (along other axis) using a grid like table ▪ Entries are made in the cells which highlights impact severity in the form of symbols or numbers or descriptive comments	▪ Link action to impact ▪ Good method for displaying EIA results	▪ Difficult to distinguish direct and indirect impacts ▪ Significant potential for double-counting of impacts
Networks	▪ Illustrate cause effect relationship of project activities and environmental characteristics ▪ Useful in identifying	▪ Links action to impact ▪ Useful in simplified form for checking for	▪ Can become very complex if used beyond simplified version

	Description	Advantages	Disadvantages
	secondary impacts ▪ Useful for establishing impact hypothesis and other structured science based approaches to EIA	second order impacts ▪ Handles direct and indirect impacts	
Overlays	▪ Map the impacts spatially and displays them pictorially ▪ Useful for comparing site and planning alternatives for routing linear developments ▪ Can address cumulative effects ▪ Information incentive	▪ Easy to understand ▪ Good to display method ▪ Good siting tool	▪ Addresses only direct impacts ▪ Does not address impact duration or probability
GIS	▪ Maps the impacts spatially and display them pictorially ▪ Useful for comparing site and planning alternatives for routing linear developments ▪ Can address cumulative effects ▪ Information incentive	▪ Easy to understand ▪ Good to display method ▪ Good siting tool ▪ Excellent for impact identification and analysis	▪ Do not address impact duration or probability ▪ Heavy reliance on knowledge and data ▪ Often complex and expensive
Expert System	▪ Assist diagnosis, problem solving and decision making ▪ Collects inputs from user by answering systematically developed questions to identify impacts and determine their mitigability and significance ▪ Information intensive, high investment methods of analysis	▪ Excellent for impact identification and analysis ▪ Good for experimenting	▪ Heavy reliance on knowledge and data ▪ Often complex and expensive

The project team made an attempt to construct an impact matrix considering major project activities (generic operations) and stage-specific likely impacts which is given in Table 4-2.

While the impact matrix is project-specific, Table 4-2 may facilitate the stakeholders in identifying a set of components and phase-specific project activities for determination of likely impactsLocation-specific concerns may vary from case-to-case. Therefore, the components even without likely impacts are also retained in the matrix for the location-specific reference.

Table 4-2: Matrix of Impacts

			PHASE I			PHASE II			PHASE III														
			Pre Construction			Construction/ Establishment			Operation and Maintenance														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
ENVIRONMENT	COMPONENT	Project Activity / Parameter/ Factor	Land Acquirement	Site Clearing/Leveling	Burning of wastes, refuse and cleared vegetation	Civil works such as earth moving and building of structures including temporary structures	Heavy Equipment operations	Laying of pipeline for collection of wastewater as well as disposal of treated wastewaters	Wastewaters collection					Treatment						Disposal				
									Tanker		Pipeline													
									Traffic related	Spills / leaks	Unauthorized disposal	Leak, corrosion, break	Maintenance/pump flow status/power supply	Adequacy of treatment units including holding tank capacity	Better operating practicing and management system	Stormwater network	Temporary storage and handling of sludge	Laboratory operations	Safety and health protection measures	Reuse/recycle	Surface water bodies	Land applications	Marine	Sewer
PHYSICAL	Soil	Erosion Risks																			*			
		Soil Quality /Contamination		*						*	*	*	*	*			*					*		
	Resources	Fuels/ Electricity		*			*		*															
		Construction material- stone, aggregates				*																		
		Land especially undeveloped or agricultural land		*																				
	Water	Interpretation or alteration of river beds																						
		Alteration of aquifers																			*			
		Water quality/ Contamination								*	*	*	*	*	*	*		*			*		*	*
	Air	Air quality			*	*	*				*				*									*

			PHASE I			PHASE II			PHASE III														
			Pre Construction			Construction/ Establishment			Operation and Maintenance														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
		Noise		*		*	*																	
BIOLOGICAL	Terrestrial fauna	Effect on grass & flowers		*						*	*	*										*		
		Effect on trees & shrubs		*																		*		
		Effect on farmland		*												*						*		
		Endangered species		*																				
		Fragmentation of terrestrial habitats		*																				
		Disturbance of habitats by noise or vibration		*																				
		Reduction of Biodiversity		*																				
	Aquatic biota	Habitat removal																					*	
		Contamination of habitats																*			*		*	
		Reduction of aquatic biota																*			*		*	
SOCIAL	Economy	Creation of new economic activities	*						*											*				
		Commercial value of properties	*					*			*	*	*											
		Conflict due to negotiation and/ compensation payments	*					*		*	*	*	*		*									
		Generation of temporary and permanent jobs				*														*				
		Effect on crops		*							*	*				*					*			
		Reduction of farmland productivity		*							*													

			PHASE I			PHASE II			PHASE III														
			Pre Construction			Construction/ Establishment			Operation and Maintenance														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
		Income for the state and private sector	*																				
		Savings for consumers & private consumers				*																	
		Savings in foreign currency for the state													*			*					
	Education	Training in new technologies																	*				
	Public order	Political Conflicts	*					*															
		Unrest, Demonstrations & Social conflicts	*					*		*	*	*	*	*	*	*					*	*	*	*
	Infrastructure and services	Conflicts with projects of urban, commercial or Industrial development	*				*	*															
	Health	Accidents caused by					*				*												
		Temporary				*	*	*			*		*						*		*			
		Chronic										*										*		
		Acute									*					*								
	Cultural	Land use	*	*		*		*															
		Recreation		*	*	*																	
		Aesthetics and human interest		*	*	*		*		*	*	*	*								*	*	*	

Note:

1. The above table represents a model for likely impacts, which will have to be arrived case-to-case basis considering VECs and significance analysis (Ref Section 2.9).
2. Project activities are shown as indicative. However, in Form 1 (application for EIA Clearance), for any question for which answer is 'Yes', then the corresponding activity shall reflect in project activities. Similarly 'parameters'/'factors' will also be changed within a component in order to reflect the target species of prime concern in the receiving local environment.

4.3.5 Testing the significance of impacts

The following set of conditions may be used as the checklist for testing the significance of the impacts and also to provide information in Column IV of Form 1.

- Will there be a large change in environmental conditions?
- Will new features be out-of-scale with the existing environment?
- Will the effect be unusual in the area or particularly complex?
- Will the effect extend over a large area?
- Will there be any potential for trans-frontier impact?
- Will many people be affected?
- Will many receptors of other types (fauna and flora, businesses, facilities) be affected?
- Will valuable or scarce features or resources be affected?
- Is there a risk that environmental standards will be breached?
- Is there a risk that protected sites, areas, and features will be affected?
- Is there a high probability of the effect occurring?
- Will the effect continue for a long time?
- Will the effect be permanent rather than temporary?
- Will the impact be continuous rather than intermittent?
- If it is intermittent will it be frequent rather than rare?
- Will the impact be irreversible?
- Will it be difficult to avoid, or reduce or repair or compensate for the effect?

For each "Yes" answer in column 3, the nature of effects and reasons for it should be recorded in column 4. The questions are designed so that a "Yes" answer in column 3, will generally point towards the need for analyzing for the significance and requirement for conducting impact assessment for the effect.

4.3.6 Terms of reference for EIA studies

ToR for EIA studies in respect of proposed CETP may include, but not limited to the following:

1. Executive summary of the project – giving a *prima facie* idea of the objectives of the proposal, use of resources, justification, *etc*. In addition, it should provide a compilation of EIA report, including EMP and post project monitoring plan in brief.

Project description

2. Justification for selecting the proposed unit size.

3. Land requirement for the project including its break up for various purposes, its availability and optimization.

4. Details of proposed layout clearly demarcating various units/industries within the plant.

5. Complete process flow diagram describing each unit, its processes and operations, along with material and energy inputs and outputs (material and energy balance).

6. Details of the industries for which CETP facility is proposed including raw materials used and products manufactured.

7. Expected quantity of wastewater from each industry and justification for selecting the proposed capacity of the treatment plant/modules.

8. Characteristics of effluent and proposed segregation of streams, if any, from individual member industries.

9. Details of mode of effluent collection system either by tankers and/or pipeline, *etc*., or proposed trouble-shooting mechanism.

10. Monitoring protocol in case of collection of effluent through pipeline and/or tankers.

11. Details on physical, chemical and biological characteristics of the combined effluent and its concentrations and the basis for the same.

12. Details of equalization tank at least for 24 hrs; and guard ponds for holding treated wastewater or continuous monitoring facilities, if any.

13. Details of the proposed treatment schemes supported by the treatability studies including source separation of streams for specific mode of collection and treatment either at individual industry or at CETP (based on economic and operational ease considerations).

14. Built-in flexibility provisions to deal with quantitative and qualitative fluctuations.

15. Organizational setup for collection of pretreated effluents, treatment and disposal of the treated effluents, *etc*. and deployment of qualified/skilled man power.

16. Details of O&M for maximum utilization of the designed capacity of the plant.

17. Proposed monitoring protocol for stage-wise quality control w.r.t. various characteristics and maintenance schedules followed for all rotating equipment including lubricating/oil fill, operational chemicals and laboratory chemicals.

18. For any sensitive environmental parameters such as heavy metals, fluorides, *etc*., details on improved material of construction of tanks and other equipments such as corrosion resistance, allowance, *etc*.

19. Details of power consumption and stand-by arrangements like the diesel generator (DG) sets, dual fuel (gas and oil) for uninterrupted operation of treatment plant.

20. Protocol and mechanism to accept the effluent by tankers only during day time, including the adequacy of the receiving/holding tanks, *etc*.

21. Impact of the project on local infrastructure of the study area such as road network, *etc*. If the study area requires any additional infrastructure, details of the agency responsible for the same should be included along with the time frame. Details of the permission from the competent Authority for conveyor belt crossing the village road.

22. If the ultimate disposal is through a marine outfall then preliminary design of the outfall with estimated initial dilution.

23. Details of laboratory, workshop, database, library, waste exchange centers, *etc*. in CETP.

24. Availability of the land for proposed treatment for ultimate capacity and to accommodate required greenbelt development.

25. Details of the proposed methods of water conservation and recharging.

26. Management plan for solid/hazardous waste generation, storage, utilization and disposal.

27. Detailed plan of treated wastewater disposal/ reuse/ utilization / management.

28. Details regarding infrastructure facilities such as sanitation, fuel storage, restroom, *etc*. to the workers during construction and operation phase.

29. In case of expansion of existing industries, remediation measures adopted to restore the environmental quality if the groundwater, soil, crop, air, etc., are affected and a detailed compliance to the prior environmental clearance/consent conditions.

30. Details on equity by the member industries/non refundable membership fee to ensure continuity of membership and financial model, *etc*.

31. Any litigation pending against the project and /or any direction /order passed by any Court of Law related to the environmental pollution and impacts in the last two years, if so, details thereof.

Description of the environment

32. The study area shall be up to a distance of 5 km from the boundary of the proposed site and all along the collection network/route map of tanker movement, treated wastewater carrying pipe-line and the receiving environment at the point of disposal.

33. Location of the project site and nearest habitats with distances from the project site to be demarcated on a toposheet (1: 50000 scale).

34. Landuse based on satellite imagery including location specific sensitivities such as national parks / wildlife sanctuary, villages, industries, etc. for the study area.

35. Demography details of all the villages falling within the study area.

36. Topography details of the project area.

37. The baseline data to be collected from the study area w.r.t. different components of environment viz. air, noise, water, land, and biology and socio-economic (please refer Section 4.4.2 for guidance for assessment of baseline components and identify attributes of concern). Actual monitoring of baseline environmental components shall be strictly according to the parameters prescribed in the ToR after considering the proposed coverage of parameters by the proponent in draft ToR and shall commence after finalization of ToR by the competent Authority.

38. Geological features and geo-hydrological status of the study area.

39. Surface water quality of nearby water sources and other surface drains.

40. Details on ground water quality.

41. Details on water quality parameters such as pH, Temperature (^{o}C), Oil and grease, Cyanide* (as CN), Ammoniacal nitrogen* (as N), Phenolic compounds* (as C6H5OH), Hexavalent Chromium*, Total chromium*, Copper*, Nickel*, Lead*, Arsenic*, Mercury*, Cadmium*, Selenium*, Fluoride*, Boron*, Radioactive materials*, Alfa emitters*, Hc/ml,Beta emitters*, Hc/ml*, *etc*. (* - as applicable).

42. Details on existing ambient air quality and expected, stack and fugitive emissions for PM10, PM2.5, SO_2*, NOx*, VOCs*, carbon oxides (CO and CO_2) *etc*., and evaluation of the adequacy of the proposed pollution control devices to meet standards for point sources and to meet AAQ standards. (* - As applicable)

43. The air quality contours may be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any and wind roses.

44. Details on noise levels at sensitive/commercial receptors.

45. Site-specific micro-meteorological data including mixing height.

46. One season site-specific data excluding monsoon season.

47. Proposed baseline monitoring network for the consideration and approval of the Competent Authority.

48. Ecological status (terrestrial and aquatic) of the study area such as habitat type and quality, species, diversity, rarity, fragmentation, ecological linkage, age, abundance, *etc*.

49. If any incompatible landuse attributes fall within a 5 km radius of the project boundary, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the EAC/SEAC. Incompatible landuse attributes include:

    - Public water supply areas from rivers/surface water bodies, from ground water
    - Scenic areas/tourism areas/hill resorts
    - Religious places, pilgrim centers that attract over 10 lakh pilgrims a year

- Protected tribal settlements (notified tribal areas where industrial activity is not permitted)
- CRZ
- Monuments of national significance, World Heritage Sites
- Cyclone, Tsunami-prone areas (based on last 25 years)
- Airport areas
- Any other feature as specified by the State or local government and other features as locally applicable, including prime agricultural lands, pastures, migratory corridors, *etc*.

50. If ecologically sensitive attributes fall within a 5 km radius of the project boundary, proponent shall describe the sensitivity (distance, area and significance) and propose the additional points based on significance for review and acceptance by the EAC/SEAC. Ecological sensitive attributes include:

    - National parks
    - Wild life sanctuaries, Game reserve
    - Tiger reserve/elephant reserve/turtle nesting ground
    - Mangrove area
    - Wetlands
    - Reserved and Protected forests, *etc*.
    - Any other closed/protected area under the Wild Life (Protection) Act, 1972, any other area locally applicable

51. If the location falls in a valley, studies on specific issues connected to the natural resources management.

52. Identification of CRZ area: A CRZ map duly authenticated by one of the authorized agencies demarcating LTL(Low Tide Level), HTL (High Tide Level), CRZ area, location of the project and associate facilities w.r.t. CRZ, coastal features such as mangroves, if any. The route of the pipeline, *etc*., passing through CRZ, if any, should also be demarcated. Recommendations of the State Coastal Management Authority for the activities to be taken up in the CRZ.

53. CRZ map in 1:10000 scale in general cases and in 1:5000 scale for specific observations.

54. Environmental parameters – Temperature, sea level pressure, wind speed, mean relative humidity, visibility, salinity, density, rainfall, fog, frequency and intensity of cyclones, sediment transport, seismic characteristics, fresh water influx.

55. Details on marine biological parameters – microbiological population, pathogenic bacteria, plankton distribution, fish spawning grounds in the adjoining waters, commercial fisheries potential, vegetation including inter tidal, flora and fauna in the marine, benthal quality assessment for biological species and heavy metals and estuarine environment.

Anticipated environmental impacts and mitigation measures

56. Anticipated generic environmental impacts due to this project are indicated in Table 4-2, which may be evaluated for significance and based on corresponding likely impacts VECs may be identified. Baseline studies may be conducted for all the concerned VECs and likely impacts will have to be assessed for their magnitude in

order to identify mitigation measures (please refer Chapter 4 of the manual for guidance).

57. Tools as given in Section 4.4.3 may be referred for the appropriate assessment of environmental impacts and same may be submitted in draft ToR for consideration and approval by EAC/SEAC.

58. While identifying the likely impacts, also include the following for analysis of significance and required mitigation measures:

- impacts due to transportation of raw materials and end products on the surrounding environment
- impacts on surface water, soil and groundwater
- impacts due to air pollution
- impacts due to odour pollution
- impacts due to noise
- impacts due to fugitive emissions
- impact on health of workers due to proposed project activities
- Impact on the disposal mode-specific receiving environment

59. Proposed odour control measures.

60. Action plan for the greenbelt development – species, width of plantations, planning schedule etc. in accordance to CPCB published guidelines.

61. In case of likely impact from the proposed project on the surrounding reserve forests, Plan for the conservation of wild fauna in consultation with the State Forest Department.

62. For identifying the mitigation measures, please refer Chapter III for source control and treatment. Besides typical mitigation measures which may also be considered are discussed in Table 4-5.

63. Details in case, if the effluent conveyance system uses pipe lines, details regarding minimum (one day) storage tank with mixing facility to keep it in aerobic conditions at source industry and mechanism to ensure compliance with prescribed standards at this storage tank.

64. Details regarding soil and groundwater impacts and regular monitoring protocols suggested for ensuring no significant impacts, besides preventive measures.

65. Impacts due to laying of pipe lines for effluent collection and for the disposal of the treated wastewaters.

66. Bathymetric studies need to be conducted and models shall be applied to predict the dispersion patterns to determine the length of the outfall, if disposal is through a marine outfall.

67. Capital quantity of dredging material, disposal and its impact on aquatic life.

68. Details on fisheries study which are conducted w.r.t. benthos and marine organic material and coastal fisheries.

69. Details of storm water collection network and utilization plan, *etc*.

70. Proposed measures for occupational safety and health of the workers.

Analysis of alternative resources and technologies

71. Comparison of alternate sites considered and the reasons for selecting the proposed site. Conformity of the site with the prescribed guidelines in terms of CRZ, river, highways, railways, *etc*.

72. Drainage area and alterations, if any due to the project.

73. Details on improved technologies.

Environmental monitoring program

74. Monitoring programme for pollution control at source.

75. Monitoring pollutants at receiving environment for the appropriate notified parameters – air quality, groundwater, surface water, etc. during operational phase of the project.

76. Specific programme to monitor safety and health protection of workers.

77. Appropriate monitoring network has to be designed and proposed, to assess the possible residual impacts on VECs.

78. Details of in-house monitoring capabilities and the recognized agencies if proposed for conducting monitoring.

Additional studies

79. Details on risk assessment and damage control during different phases of the project and proposed safeguard measures.

80. Details on socio-economic development activities such as commercial property values, generation of jobs, education, social conflicts, cultural status, accidents, etc.

81. Proposed plan to handle the socio-economic influence on the local community. The plan should include quantitative dimension as far as possible.

82. Details on compensation package for the people affected by the project, considering the socio-economic status of the area, homestead oustees, land oustees, and landless labourers.

83. Points identified in the public hearing and commitment of the project proponent to the same. Detailed action plan addressing the issues raised, and the details of necessary allocation of funds.

Environmental management plan

84. Administrative and technical organizational structure to ensure proposed post-project monitoring programme for approved mitigation measures.

85. EMP devised to mitigate the adverse impacts of the project should be provided along with item-wise cost of its implementation (capital and recurring costs).

86. Allocation of resources and responsibilities for plan implementation.

87. Details of the emergency preparedness plan and on-site and off-site disaster management plan.

Note:

Above points shall be adequately addressed in the EIA report at corresponding chapters, in addition to the contents given in the reporting structure (Table 4-6).

4.4 Environmental Impact Assessment

The approach for accomplishing EIA studies is shown in Figure 4-3. Each stage is discussed in detail, in subsequent sections.

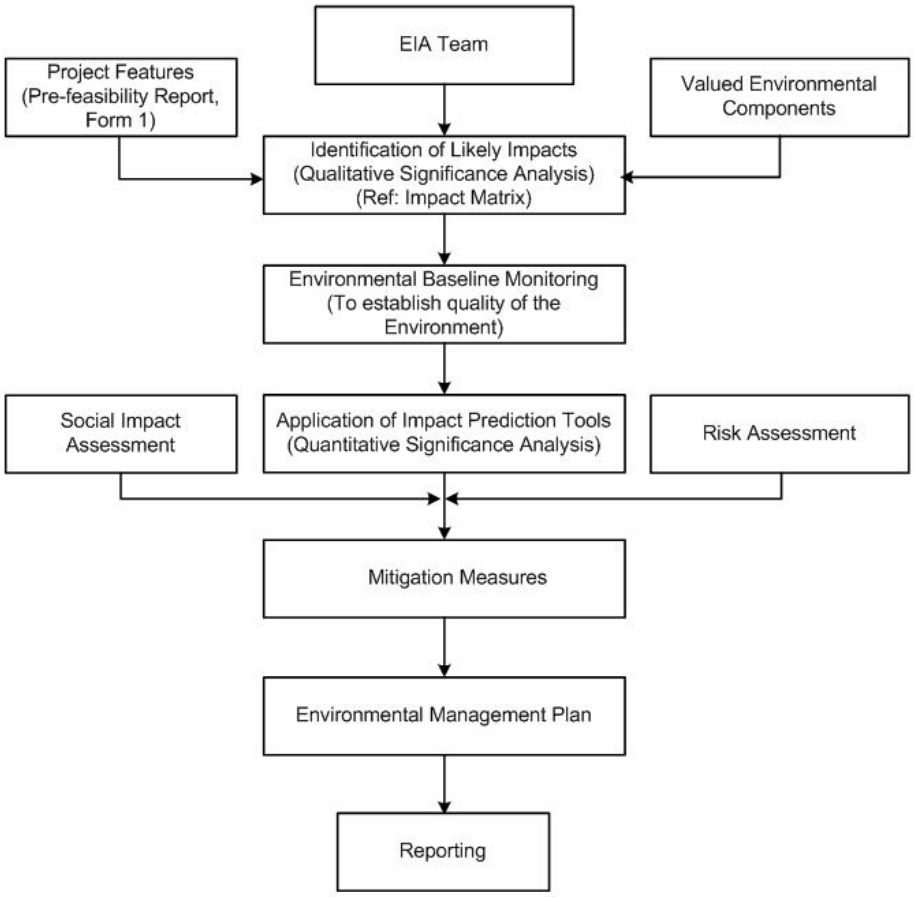

Figure 4-3: Approach for EIA Study

4.4.1 EIA Team

The success of a multi-functional activity like an EIA primarily depends on constitution of a right team at the right time (preferable at the initial stages of an EIA) in order to assess the significant impacts (direct, indirect as well as cumulative impacts).

The professional Team identified for a specific EIA study should comprise of qualified and experienced professionals from various disciplines in order to address the critical aspects identified for the specific project. Based on the nature and the environmental setting, following professionals may be identified for EIA studies:

- Environmental management specialist/Regulator
- Air and noise quality expert
- Occupational health
- Geology/geo-hydrology
- Ecologist
- Transportation Specialist
- Safety and health specialist
- Social scientist
- Chemical engineer, *etc*.

4.4.2 Baseline quality of the environment

EIA Notification 2006 specifies that an EIA report should contain a description of the existing environment that would be or might be affected directly or indirectly by the proposed project. Environmental baseline monitoring (EBM) is a very important stage of EIA. On one hand EBM plays a vital role in EIA and on the other hand, it provides feedback about the actual environmental impacts of a project. EBM during the operational phase helps in judging the success of mitigation measures in protecting the environment. Mitigation measures, in turn are used to ensure compliance with environmental standards, and to facilitate any needed project design or operational changes.

Description of the existing environment should include natural, cultural, socio-economic systems and their interrelationships. The intention is not to describe all baseline conditions, but to focus on the collection and description of baseline data on those VECs that are important and are affected by the proposed CETP activity.

4.4.2.1 Objective of EBM in the EIA context

The term 'baseline' refers to conditions existing before development against which subsequent changes can be referenced. EBM studies are carried out to:

- identify environmental conditions which might influence project design decisions (*e.g*., site layout, structural or operational characteristics)
- identify sensitive issues or areas requiring mitigation or compensation
- provide input data to analytical models used for predicting effects
- provide baseline data against which the results of future monitoring programs can be compared

At this stage of the EIA process, EBM is primarily discussed in the context of first purpose wherein feedback from EBM programs may be used to:

- determine available assimilative capacity of different environmental components within the designated impact zone and whether more or less stringent mitigation measures are needed; and
- improve predictive capability of EIAs.

There are many institutional, scientific, quality control, and fiscal issues that must be addressed in implementation of an environmental monitoring program. Careful consideration of these issues in the design and planning stages will help avoid many of the pitfalls associated with environmental monitoring programs.

4.4.2.2 Environmental monitoring network design

Monitoring refers to the collection of data through a series of repetitive measurements of environmental parameters (or, more generally, to a process of systematic observation). The environmental quality monitoring programme design will depend on the monitoring objectives specified for the selected area of interest. Types of monitoring and network design considerations are discussed in **Annexure VI.**

4.4.2.3 Baseline data generation

List of important physical environmental components and indicators of EBM are given in Table 4-3.

Table 4-3: List of important Physical Environmental Components and Indicators of EBM

Environmental Component	Environmental Indicators
Climatic variables	▪ Rainfall patterns – mean, mode, seasonality ▪ Temperature patterns ▪ Extreme events ▪ Climate change projections ▪ Prevailing wind - direction, speed, anomalies ▪ Relative humidity ▪ Stability conditions and mixing height *etc.*
Geology	▪ Underlying rock type, texture ▪ Surgical material ▪ Geologic structures (faults, shear zones, *etc*.) ▪ Geologic resources (minerals, *etc*.)
Topography	▪ Slope form ▪ Landform and terrain analysis ▪ Specific landform types, *etc*.
Coastal dynamics and morphology	▪ Wave patterns ▪ Currents ▪ Shoreline morphology – near shore, foreshore ▪ Sediment – characteristics and transport, *etc*.
Soil	▪ Type and characteristics ▪ Porosity and permeability ▪ Sub-soil permeability ▪ Run-off rate ▪ Infiltration capacity ▪ Effective depth (inches/centimetres) ▪ Inherent fertility ▪ Suitability for method of sewage disposal *etc.*
Drainage	▪ Surface hydrology ▪ Natural drainage pattern and network ▪ Rainfall runoff relationships ▪ Hydrogeology ▪ Groundwater characteristics – springs, *etc*.
Water	▪ Raw water availability

Environmental Component	Environmental Indicators
	▪ Water quality ▪ Surface water (rivers, lakes, ponds, gullies) – quality, water depths, flooding areas, etc. ▪ Ground water – water table, local aquifer storage capacity, specific yield, specific retention, water level depths and fluctuations, *etc*. ▪ Coastal ▪ Floodplains ▪ Wastewater discharges ▪ Waste discharges, *etc*.
Air	▪ Ambient ▪ Respirable ▪ Airshed importance ▪ Odour levels, *etc*.
Noise	▪ Identifying sources of noise ▪ Noise due to traffic/transportation of vehicles ▪ Noise due to heavy equipment operations ▪ Duration and variations in noise over time, *etc*.
Biological	▪ Species composition of flora and fauna ▪ Flora – type, density, exploitation, *etc*. ▪ Fauna – distribution, abundance, rarity, migratory, species diversity, habitat requirements, habitat resilience, economic significance, commercial value, *etc*. ▪ Fisheries – migratory species, species with commercial/ recreational value, *etc*.
Landuse	▪ Landuse pattern ▪ Change in landuse, *etc*.

Guidance for assessment of baseline components and attributes describing sampling network, sampling frequency, method of measurement is given in **Annexure VII.**

Infrastructure requirements for EBM

In addition to devising a monitoring network design and monitoring plans/program, it is also necessary to ensure adequate resources in terms of staffing, skills, equipment, training, budget, *etc*., for its implementation. Besides assigning institutional responsibility, reporting requirements, QA/QC (Quality Assurance/Quality Control) plans and its enforcement capability are also essential. A monitoring program that does not have an infrastructural support and QA/QC component will have little chance of success.

Defining data statistics/analyses requirements

The data analyses to be conducted are dictated by the objectives of environmental monitoring program. The statistical methods used to analyze data should be described in detail prior to data collection. This is important because repetitive observations are recorded in time and space. Besides, the statistical methods could also be chosen so that uncertainty or error estimates in the data can be quantified. For *e.g*., statistical methods useful in an environmental monitoring program include: 1) frequency distribution analysis; 2) analysis of variance; 3) analysis of covariance; 4) cluster analysis; 5) multiple regression analysis; 6) time series analysis; 7) the application of statistical models.

Use of secondary data

The EBM program for an EIA can, at best, address temporal and/or spatial variations limited to a certain extent because of cost implications and time limitations. Therefore analysis of all available information or data is essential to establish the regional profiles. So all the relevant secondary data available for different environmental components should be collated and analyzed.

To facilitate stakeholders, IL&FS Ecosmart Ltd., has made an attempt to compile the list of information required for EIA studies. Respective sources of secondary data are provided in **Annexures VIIIA** and **VIIIB**.

4.4.3 Impact prediction tools

The scientific and technical credibility of an EIA relies on the ability of EIA practitioners to estimate the nature, extent, and magnitude of change in environmental components that may result from project activities. Information about predicted changes is needed for assigning impact significance, prescribing mitigation measures, designing & developing EMPs and post-project monitoring programs. The more accurate the predictions are, the more confident the EIA practitioner will be in prescribing specific measures to eliminate or minimize the adverse impacts of development project.

Choice of models/methods for impact predictions in respect to noise, water, land, biological and socio-economic environment are precisely tabulated in **Annexure IX.**

4.4.4 Significance of the impacts

Evaluating the significance of environmental effects is perhaps the most critical component of impact analysis. The interpretation of significance bears directly on the subsequent EIA process and also during environmental clearance on project approvals and condition setting. At an early stage, it also enters into screening and scoping decisions on what level of assessment is required and which impacts and issues will be addressed.

Impact significance is also a key to choose among alternatives. In total, the attribution of significance continues throughout the EIA process, from scoping to EIS (Environmental Information System) review, in a gradually narrowing 'cone of resolution' in which one stage sets up the next. But at this stage, it is the most important as better understanding and quantification of impact significance is required.

One common approach is based on determination of the significance of predicted changes in the baseline environmental characteristics and compares these w.r.t regulatory standards, objective criteria and similar 'thresholds' as eco-sensitivity, cultural /religious values. Often, these are outlined in guidance. A better test proposed by the CEAA (1995) is to determine if 'residual' environmental effects are adverse, significant, and likely (given under). But at this stage, the practice of formally evaluating significance of residual impacts, *i.e.*, after predicting the nature and magnitude of impacts based on before-versus-after-project comparisons, and identifying measures to mitigate these effects is not being followed in a systematic way.

Step 1: Are the environmental effects adverse?

Criteria for determining if effects are "adverse" include:

- Effects on biota health
- Effects on rare or endangered species
- Reductions in species diversity
- Habitat loss
- Transformation of natural landscapes
- Effects on human health
- Effects on current use of lands and resources for traditional purposes by aboriginal persons; and
- Foreclosure of future resource use or production

Step 2: Are the adverse environmental effects significant?

Criteria for determining 'significance' are to judge that the impacts:

- Are extensive over space or time
- Are intensive in concentration or proportion to assimilative capacity
- Exceed environmental standards or thresholds
- Do not comply with environmental policies, landuse plans, sustainability strategy
- Adversely and seriously affect ecologically sensitive areas
- Adversely and seriously affect heritage resources, other landuses, community lifestyle and/or indigenous peoples traditions and values

Step 3: Are the significant adverse environmental effects likely?

Criteria for determining 'likelihood' include:

- Probability of occurrence, and
- Scientific uncertainty

4.5 Social Impact Assessment

Social impact assessment is the instrument used to analyze social issues and solicit stakeholder views for the design of projects. Social assessment helps make the project responsive to social development concerns, including seeking to enhance benefits for poor and vulnerable people while minimizing or mitigating risk and adverse impacts. It analyzes distributional impacts of intended project benefits on different stakeholder groups, and identifies differences in assets and capabilities to access the project benefits.

The scope and depth of SIA should be determined by the complexity and importance of issues studied, taking into account the skills and resources available. SIA should include studies related to involuntary resettlement, compulsory land acquisition, impact of imported workforces, job losses among local people, damage to sites of cultural, historic or scientific interest, impact on minority or vulnerable groups, child or bonded labour, use of armed security guards. However, SIA may primarily include the following:

Description of the socio-economic, cultural and institutional profile

Conduct a rapid review of available sources of information to describe the socio-economic, cultural and institutional interface in which the project operates.

Socio-economic and cultural profile: Describe the most significant social, economic and cultural features that differentiate social groups in the project area. Describe the different interests in the project, and their levels of influence. Explain specific effects that the project may have on the poor and underprivileged. Identify any known conflicts among groups that may affect project implementation.

Institutional profile: Describe the institutional environment; consider both the presence and function of public, private and civil society institutions relevant to the operation. Are there important constraints within existing institutions? *e.g.* disconnect between institutional responsibilities and the interests and behaviors of personnel within those institutions. Or are there opportunities to utilize the potential of existing institutions, *e.g.* private or civil society institutions, to strengthen implementation capacity?

Legislative and regulatory considerations

To review laws and regulations governing the project's implementation and access of poor and excluded groups to goods, services and opportunities provided by the project. In addition, review the enabling environment for public participation and development planning. Social analysis should be built on strong aspects of legal and regulatory systems to facilitate program implementation and identify weak aspects while recommending alternative arrangements.

Key social issues

The social analysis provides baseline information for designing social development strategy. The analysis should determine the key social and institutional issues which affect the project objectives; identify the key stakeholder groups in this context and determine how relationships between stakeholder groups will affect or be affected by the project; and identify expected social development outcomes and actions proposed to achieve those outcomes.

Data collection and methodology

Describe the design and methodology for social analysis. In this regard:

- Build on existing data
- Clarify the units of analysis for social assessment: intra-household, household level, as well as communities/settlements and other relevant social aggregations on which data is available or will be collected for analysis
- Choose appropriate data collection and analytical tools and methods, employing mixed methods wherever possible; mixed methods include a mix of quantitative and qualitative methods.

Strategy to achieve social development outcomes

Identify the likely social development outcomes of the project and propose a social development strategy, including recommendations for institutional arrangements to achieve them, based on the findings of the social assessment. The social development strategy could include measures that:

- strengthen social inclusion by ensuring inclusion of both poor and excluded groups as well as intended beneficiaries in the benefit stream; offer access to opportunities created by the project

- empower stakeholders through their participation in design and implementation of the project, their access to information, and their increased voice and accountability (*i.e.*, a participation framework); and
- enhance security by minimizing and managing likely social risks and increasing the resilience of intended beneficiaries and affected persons to socio-economic shocks

Implications for analysis of alternatives

Review proposed approaches for the project, and compare them in terms of their relative impacts and social development outcomes. Consider what implications the findings of social assessment might have on those approaches. Should some new components be added to the approach, or other components be reconsidered or modified?

If SIA and consultation processes indicate that alternative approaches may have better development outcomes, such alternatives should be described and considered, along with the likely budgetary and administrative effects these changes might have.

Recommendations for project design and implementation arrangements

Provide guidance to project management and other stakeholders on how to integrate social development issues into project design and implementation arrangements. As much as possible, suggest specific action plans or implementation mechanisms to address relevant social issues and potential impacts. These can be developed as integrated or separate action plans, for example, as resettlement action plans, indigenous peoples development plans, community development plans, *etc*.

Developing a monitoring plan

Through social assessment process, a framework for monitoring and evaluation should be developed. To the extent possible, this should be done in consultation with key stakeholders, especially beneficiaries and affected people. The framework shall identify expected social development indicators, establish benchmarks, and design systems and mechanisms for measuring progress and results related to social development objectives. The framework shall identify organizational responsibilities in terms of monitoring, supervision, and evaluation procedures. Wherever possible, participatory monitoring mechanisms shall be incorporated. The framework should have:

- a set of monitoring indicators to track the progress achieved. The benchmarks and indicators should be limited in number, and should combine both quantitative and qualitative types of data. The indicators for outputs to be achieved by the social development strategy should include indicators to monitor the process of stakeholder participation, implementation and institutional reform
- indicators to monitor social risk and social development outcomes; and indicators to monitor impacts of the project's social development strategy. It is important to suggest mechanisms through which lessons learnt from monitoring and stakeholder feedback can result in changes to improve operation of the project. Indicators should be of such nature that results and impacts can be disaggregated by gender and other relevant social groups
- define transparent evaluation procedures: Depending on context, these may include a combination of methods, such as participant observation, key informant interviews, focus group discussions, census and socio-economic surveys, gender analysis, participatory rural appraisal (PRA), participatory poverty assessment (PPA) methodologies, and other tools. Such procedures should be tailored to the special

conditions of the project and to the different groups living in the project area. Estimate resource and budget requirements for monitoring and evaluation activities, and a description of other inputs (such as institutional strengthening and capacity building) need to be carried out.

4.6 Risk Assessment and Disaster Management Plan

Industrial accidents results in great personal and financial loss. Managing these accidental risks in today's environment is the concern of every industry including CETP facilities, because either real or perceived incidents can quickly jeopardize the financial viability of a business. CETP facilities involve various treatment processes that have the potential for accidents which may be catastrophic to the plant, work force, environment, or public.

The main objective of risk assessment study is to propose a comprehensive but simple approach to carry out risk analysis and conducting feasibility studies for industries, planning and management of industrial prototype hazard analysis study in Indian context.

Risk analysis and risk assessment should provide details on quantitative risk assessment (QRA) techniques used world-over to determine risk posed to people who work inside or live near hazardous facilities, and to aid in preparing effective emergency response plans by delineating a disaster management plan (DMP) to handle onsite and offsite emergencies. Hence, QRA is an invaluable method for making informed risk-based process safety and environmental impact planning decisions, as well as being fundamental to any decision while siting a facility. QRA whether, site-specific or risk-specific for any plant is complex and needs extensive study that involves process understanding, hazard identification, consequence modeling, probability data, vulnerability models/data, local weather and terrain conditions and local population data. QRA may be carried out to serve the following objectives:

- Identification of safety areas
- Identification of hazard sources
- Generation of accidental release scenarios for escape of hazardous materials from the facility
- Identification of vulnerable units with recourse to hazard indices
- Estimation of damage distances for the accidental release scenarios with recourse to maximum credible accident (MCA) analysis
- Hazard and Operability studies (HAZOP) in order to identify potential failure cases of significant consequences
- Estimation of probability of occurrences of hazardous event through fault tree analysis and computation of reliability of various control paths
- Assessment of risk on basis of above evaluation against the risk acceptability criteria relevant to the situation
- Suggest risk mitigation measures based on engineering judgement, reliability and risk analysis approaches
- Delineation / upgradation of DMP
- Safety reports: with external safety report/ occupational safety report,

The risk assessment report may cover the following in terms of the extent of damage with resource to MCA analysis and delineation of risk mitigations measures with an approach to DMP.

- Hazard identification – identification of hazardous activities, hazardous materials, past accident records, *etc*.
- Hazard quantification – consequence analysis to assess the impacts
- Risk presentation
- Risk mitigation measures
- DMP

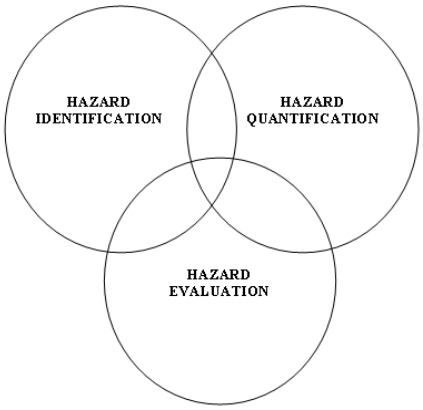

Figure 4-4: Risk Assessment – Conceptual Framework

Methods of risk prediction should cover all design intentions and operating parameters to quantify risk in terms of probability of occurrence of hazardous events and magnitude of its consequence. Table 4-4 shows the predicted models for risk assessment.

Table 4-4: Guidance for Accidental Risk Assessment

Name	Application	Remarks
EFFECT	Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence	Heat load, press wave & toxic release exposure neutral gas dispersion
WHAZAN	Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence	
EGADIS	Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence	Dense gas dispersion
HAZOP and Fault Tree Assessment	For estimating top event probability	Failure frequency data is required
Pathways reliability and protective system hazard analysis	For estimating reliability of equipments and protective systems	Markov models
Vulnerability Exposure models	Estimation of population exposure	Uses probit equation for population exposure
F-X and F-N curves	Individual / Societal risks	Graphical Representation

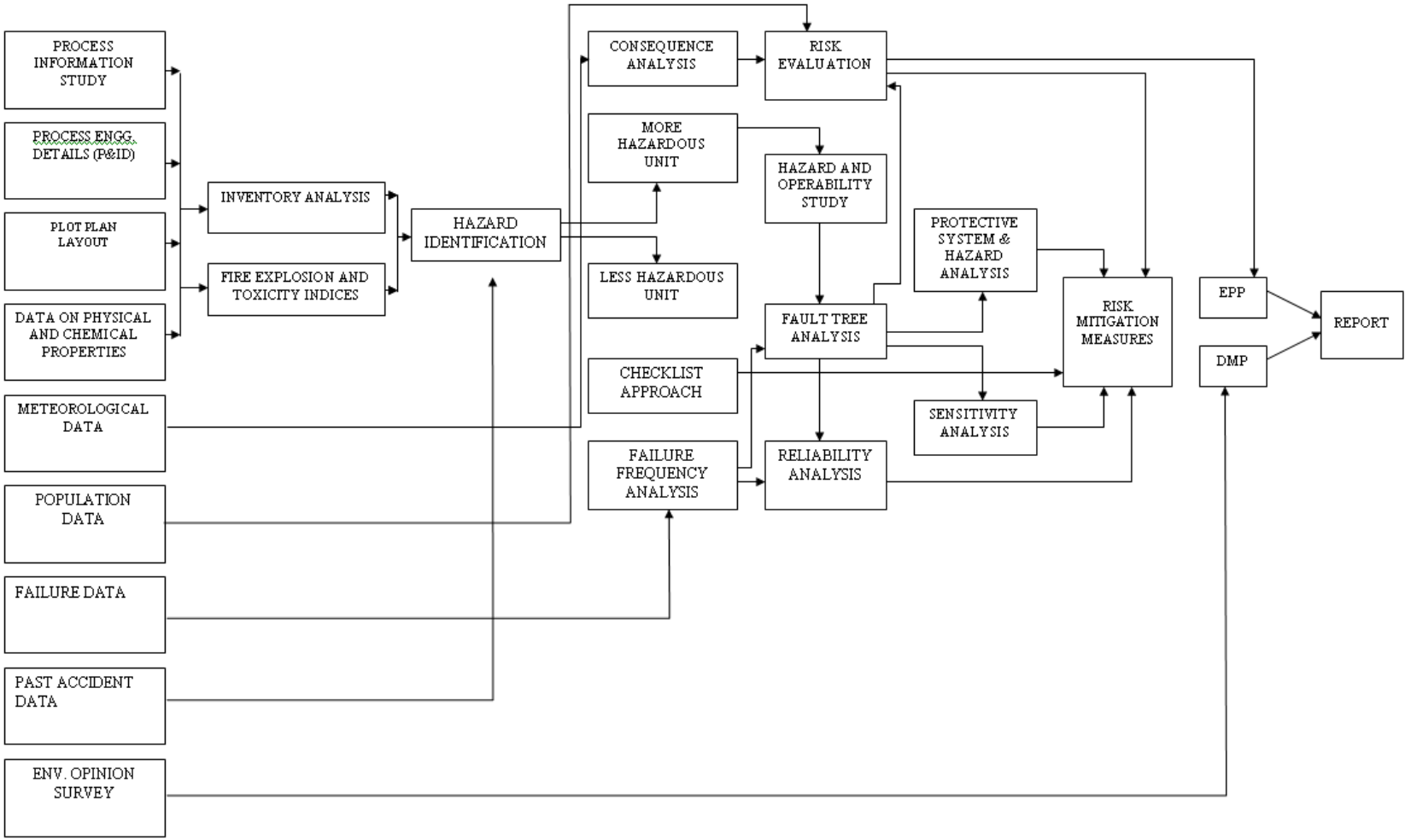

Figure 4-5: Comprehensive Risk Assessment –At a Glance

4.7 Mitigation Measures

The purpose of mitigation is to identify measures that safeguard the environment and the community affected by the proposal. Mitigation is both a creative and practical phase of the EIA process. It seeks best ways and means of avoiding, minimizing and remedying impacts. Mitigation measures must be translated into action in right way and at the right time, if they are to be successful. This process is referred to as impact management and takes place during project implementation. A written plan should be prepared for this purpose, and should include a schedule of agreed actions. Opportunities for impact mitigation will occur throughout the project cycle.

4.7.1 Important considerations for mitigation methods

The responsibility of project proponents to 'internalize' the full environmental costs of development proposals is now widely accepted under "Polluter Pay" principle. In addition, many proponents have found that good design and impact management can result in significant savings applying the principles of cleaner production to improve their environmental performance.

- The predicted adverse environmental as well as social impacts for which mitigation measures are required, should be identified and briefly summarized along with cross referencing them to the significance, prediction components of the EIA report or other documentation.
- Each mitigation measure should be briefly described w.r.t the impact of significances to which it relates and the conditions under which it is required (for example, continuously or in the event of contingencies). These should also be cross-referenced to the project design and operating procedures which elaborate on the technical aspects of implementing the various measures.
- Cost and responsibilities for mitigation and monitoring should be clearly defined, including arrangements for coordination between various authorities responsible for mitigation.
- The proponent can use the EMP to develop environmental performance standards and requirements for the project site as well as supply chain. An EMP can be implemented through EMS for the operational phase of the project.

Prior to mitigation plans, it is appropriate to study the mitigation alternatives for cost-effectiveness, technical and socio-political feasibility. Such mitigation measures could include:

- Avoiding eco-sensitive areas *e.g.* fish spawning areas, dense mangrove areas or areas known to contain rare or endangered species
- Adjusting work schedules to minimize disturbance
- Engineered structures such as berms and noise attenuation barriers
- Pollution control devices such as scrubbers and electrostatic precipitators, *etc.,*
- Changes in fuel feed, manufacturing, process, technology use, or waste management practices, *etc*.

4.7.2 Hierarchy of elements of mitigation plan

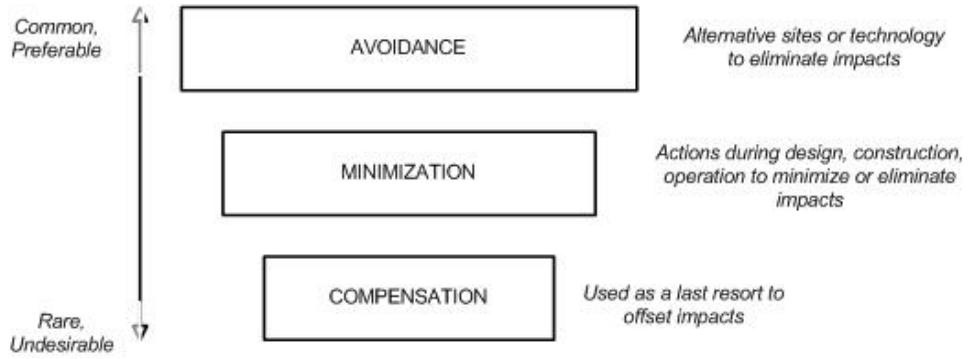

Figure 4-6: Hierarchy of Elements of Mitigation Plan

A good EIA practice requires technical understanding of a relevant issues and the measures that work in all circumstances. The priority of selection of mitigation measures should be in the order:

Step one: impact avoidance

This step is most effective when applied at an early stage of project planning. It can be achieved by:

- Not undertaking certain projects or elements that could result in adverse impacts
- Avoiding areas that are environmentally sensitive; and
- Putting in place the preventative measures to stop adverse impacts from occurring, for example, release of water from a reservoir to maintain a fisheries regime.

Step two: impact minimization

This step is usually taken during impact identification and prediction to limit or reduce the degree, extent, magnitude, or duration of adverse impacts. It can be achieved by:

- Scaling down or relocating the project
- Redesigning elements of the project and
- Taking supplementary measures to manage the impacts

Step three: impact compensation

This step is usually applied to remedy unavoidable residual adverse impacts. It can be achieved by:

- Rehabilitation of the affected site or environment, for example, by habitat enhancement and restocking fish
- Restoration of the affected site or environment to its previous state or better, as typically required for mine sites, forestry roads and seismic lines; and
- Replacement of the same resource values at another location. For example, by wetland engineering to provide an equivalent area to that lost to drainage or infill.

Important compensation elements

Special considerations apply to mitigation of proposals that displace or disrupt people. Certain types of projects, such as reservoirs and irrigation schemes and public works, are known to cause involuntary resettlement. This is a contentious issue because it involves far more than re-housing people; in addition, income sources and access to common property resources are likely to be lost. Almost certainly, a resettlement plan will be required to ensure that no one is worse off than before, which may not be possible for indigenous people whose culture and lifestyle is tied to a locality. This plan must include the means for those displaced to reconstruct their economies and communities and should include an EIA of the receiving areas. Particular attention should be given to indigenous, minority and vulnerable groups who are at higher risk from resettlement.

In-kind compensation

When significant or net residual loss or damage to the environment is likely, in kind compensation is appropriate. As noted earlier, environmental rehabilitation, restoration or replacement have become standard practices for many proponents. Now, increasing emphasis is given to a broader range of compensation measures to offset impacts and assure the sustainability of development proposals. These include impact compensation 'trading', such as offsetting CO_2 emissions by planting forests to sequester carbon.

4.7.3 Typical mitigation measures

Choice of location for the developmental activity plays an important role in preventing adverse impacts on surrounding environment. Detailed guidelines on siting of industries are provided in Section 4.2. However, if the developmental activity still produces any more adverse impacts, mitigation measures should be taken.

Previous subsections of the Section 4.7 could be precisely summarized into following:

- Impacts from a developmental project could have many dimensions. As most of the direct impacts are caused by the releases from developmental projects, often impact control at source is the best opportunity to either eliminate or mitigate the impacts, in case these are cost-effective. In other words, the best way to mitigate the impacts is to prevent them from occurring. Choice of raw materials/technologies/processes which produce least impact would be one of the options to achieve it.
- After exploring cost-effective feasible alternatives to control impacts at source, various interventions to minimize the adverse impacts may be considered. These interventions, primarily aim at reducing the residual impacts on VECs of the receiving environment to acceptable concentrations.
- The degree of control at source and external interventions differs from situation-to - situation and is largely governed by techno-economic feasibility. While the regulatory bodies stress for further source control (due to high reliability), the project proponents bargain for other interventions which may be relatively cost-effective than further control at source (in any case project authority is required to meet the industry-specific standards by adopting the best practicable technologies. However, if the location demands further control at source, then the proponents are required to adopt further advanced control technologies *i.e.*, towards best available control technologies). After having discussions with the project proponent, EAC/SEAC reaches to an agreed level of source control+other interventions (together called as mitigation measures in the given context) that achieve the targeted protection levels

for the VECs in the receiving environment. These levels will become the principal clearance conditions.

- Chapter 3 of this TGM offers elaborate information on cleaner technologies, waste minimization opportunities, and control technologies for various kinds of polluting parameters that emanate from this developmental activity. This information may be used to draw appropriate control measures applicable at source.

The choice of interventions for mitigation of impacts may also be numerous and depend on various factors. Mitigation measures based on location-specific suitability and some other factors are discussed in sub-sections 4.7.1 and 4.7.2. A few typical measures which may also be explored for mitigation of impacts are listed in Table 4-5.

Table 4-5: Typical Mitigation Measures

Impacts	Typical Mitigation Measures
Soil	▪ Windscreens, maintenance, and installation of ground cover ▪ Installation of drainage ditches ▪ Runoff and retention ponds ▪ Minimize disturbances and scarification of the surface ▪ Usage of appropriate monitoring and control facilities for construction equipments deployed ▪ Methods to reuse earth material generated during excavation
Resources – fuel/construction material, etc.	▪ Availing the resources which could be replenished by natural systems, etc.
Deforestation	▪ Plant or create similar areas ▪ Initiate a tree planning program in other areas ▪ Donate land to conservationalist groups
Water pollution (Ground water/ Surface water)	▪ Conjunctive use of ground/surface water, to prevent flooding/water logging/depletion of water resources. Included are land use pattern, land filling, lagoon/reservoir/garland canal construction, and rainwater harvesting and pumping rate. ▪ Stormwater drainage system to collect surface runoff ▪ Minimise flow variation from the mean flow ▪ Storing of oil wastes in lagoons should be minimised in order to avoid possible contamination of the ground water system. ▪ All effluents containing acid/alkali/organic/toxic wastes should be properly treated. ▪ Monitoring of ground waters ▪ Use of biodegradable or otherwise readily treatable additives ▪ Neutralization and sedimentation of wastewaters, where applicable ▪ Dewatering of sludges and appropriate disposal of solids ▪ In case of oil waste, oil separation before treatment and discharge into the environment ▪ By controlling discharge of sanitary sewage and industrial waste into the environment ▪ By avoiding the activities that increases erosion or that contributes nutrients to water (thus stimulating alga growth) ▪ For wastes containing high TDS, treatment methods include removal of liquid and disposal of residue by controlled landfilling to avoid any possible leaching of the fills ▪ All surface runoffs around mines or quarries should be collected treated and disposed. ▪ Treated wastewater (such as sewage, industrial wastes, or stored surface runoffs) can be used as cooling water makeup.

Impacts	Typical Mitigation Measures
	▪ Wastewater carrying radioactive elements should be treated separately by means of de-watering procedures, and solids or brine should be disposed of with special care. ▪ Develop spill prevention plans in case of chemical discharges and spills ▪ Develop traps and containment system and chemically treat discharges on site
Air Pollution	▪ Periodic checking of vehicles and construction machinery to ensure compliance to emission standards ▪ Attenuation of pollution/protection of receptor through green belts/green cover ▪ Dilution of odourant (dilution can change the nature as well as strength of an odour), odour counteraction or neutralise (certain pairs of odours in appropriate concentrations may neutralise each other), odour masking or blanketing (certain weaker malodours may be suppressed by a considerably stronger good odour). ▪ Regular monitoring of air polluting concentrations
Dust pollution	▪ Adopt sprinkling of water ▪ Wetting of roadways to reduce traffic dust and reentrained particles ▪ Control vehicle speed on sight ▪ Ensure priodical wahsing of cosntruction equipment and transport vehicles to prevent accumulated dust ▪ Ensure that vehicles should be covered during transportation ▪ Installation of windscreens to breakup the wind flow ▪ Burning of refuse on days when meteorological conditions provide for good mixing and dispersion ▪ Providing dust collection equipment at all possible points ▪ Maintaining dust levels within permissible limits ▪ Provision for masks when dust level exceeds
Noise pollution	▪ Use of suitable muffler systems/enclosures/sound-proof glass panelling on heavy equipment/pumps/blowers ▪ Pumps and blowers may be mounted on rubber pads or any other noise absorbing materials ▪ Limiting certain activities ▪ Proper scheduling of high noise generating activities to minimise noise impacts ▪ Usage of well maintained construction equipment meeting the regulatory standards ▪ Placement of equipments emitting high noise in an orientation that directs the noise away from sensitive receptors ▪ Periodic maintenance of equipments/repalcing whenever necessary/lubrication of rotating parts, etc. ▪ By using damping, absorption, dissipation, and deflection methods ▪ By using common techniques such as constructing sound enclosures, applying mufflers, mounting noise sources on isolators, and/or using materials with damping properties ▪ Performance specifications for noise represent a way to insure the procured item is controlled ▪ Use of ear protective devices. ▪ In case of steady noise levels above 85-dB (A), initiation of hearing conservation measures ▪ Implementation of greenbelt for noise attentuation may be taken up
Biological	▪ Installation of systems to discourage nesting or perching of birds in dangerous environments ▪ Increased employee awareness to sensitive areas

Impacts	Typical Mitigation Measures
Social	▪ Health and safety measures for workers ▪ Development of traffic plan that minimizes road use by workers ▪ Upgrade of roads and intersections ▪ Provide sufficient counselling and time to the affected population for relocation ▪ Discuss and finalize alternate arrangements and associated infrastructure in places of religious importance ▪ Exploration of alternative approach routes in consultation with local community and other stakeholders ▪ Provision of alternate jobs in unskilled and skilled categories
Marine	▪ Water quality monitoring program ▪ Limit construction activities to day time to provide recuperation time at night and reduce turbidity ▪ Prevention of spillage of diesel, oil, lubes, etc. ▪ Usage of appropriate system to barges/workboats for collection of liquid/solid waste generated onboard ▪ Avoid discharge of construction/dredging waste (lose silt) into sea. It may be disposed at the identified disposal point. ▪ Ensure usage of suitable/proper equipment for dredging in order to minimize the turbidity and suspensions at the dredging site. ▪ Checking with the complainace conditions before discharging wastes into the sea water ▪ Have a post-dregding monitoring programme in place ▪ Take up periodic maintenance dredging including inspectionof sub-sea conditions, etc.
Occupational health and safety	▪ Provision of worker camps with proper santiation and medical facilities, as well as making the worker camps self- sufficient with resources like water supply, power supply, etc ▪ Arrangement of periodic health check-ups for early detection and control of communicatble diseases. ▪ Arrangement to dispose off the wastes at approved disposal sites. ▪ Provide preventive measures for potentital fire hazards with requisite fire detection, fire-fighting facilities and adequate water storage
Construction	▪ Have a Transport Management Plan in place in order to prevent/minimize the disturbance on surrounding habitats ▪ Initiate traffic density studies
Solid/Hazardous waste	▪ Proper handling of excavated soil ▪ Proper plan to collect and dispose off the solid waste generated onsite. ▪ Identify an authorized waste handler for segregation of construction and hazardous waste and its removal on a regular basis to minimise odour, pest and litter impacts ▪ Prohibit buring of refuse onsite.

4.8 Environmental Management Plan

A typical EMP shall be composed of the following:

1. summary of potential impacts of the proposal
2. description of recommended mitigation measures
3. description of monitoring programme to ensure compliance with relevant standards and residual impacts
4. allocation of resources and responsibilities for plan implementation
5. implementation schedule and reporting procedures
6. contingency plan when impacts are greater than expected

Summary of impacts: The predicted adverse environmental and social impacts for which mitigation measures are identified in earlier sections to be briefly summarized with cross referencing to the corresponding sections in EIA report.

Description of mitigation measures: Each mitigation measure should be briefly described w.r.t the impact to which it relates and the conditions under which it is required. These should be accompanied by/ referenced to, project design and operating procedures which elaborate on the technical aspects of implementing various measures.

Description of monitoring programme to ensure compliance with relevant standards and residual impacts: Environmental monitoring refers to compliance monitoring and residual impact monitoring. Compliance monitoring refers to meeting the industry-specific statutory compliance requirements (Ref. Applicable National regulations as detailed in Chapter 3).

Residual impact monitoring refers to monitoring of identified sensitive locations with adequate number of samples and frequency. The monitoring programme should clearly indicate the linkages between impacts identified in the EIA report, measurement indicators, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions.

Allocation of resources and responsibilities for plan implementation: These should be specified for both the initial investment and recurring expenses for implementing all measures contained in the EMP, integrated into the total project costs, and factored into loan negotiation.

The EMP should contain commitments that are binding on the proponent in different phases of project implementation *i.e.,* pre-construction or site clearance, construction, operation, decommissioning.

Responsibilities for mitigation and monitoring should be clearly defined, including arrangements for coordination between various actors responsible for mitigation. Details should be provided w.r.t deployment of staff (detailed organogram), monitoring network design, parameters to be monitored, analysis methods, associated equipments, *etc*.

Implementation schedule and reporting procedures: The timing, frequency and duration of mitigation measure should be specified in an implementation schedule, showing links with overall project implementation. Procedures to provide information on progress and results of mitigation and monitoring measures should also be clearly specified.

Contingency Plan when the impacts are greater than expected: There shall be a contingency plan for attending the situations where the residual impacts are higher than expected. It is an imperative requirement for all project Authorities to plan additional programmes to deal with the situation, after duly intimating the concerned local regulatory bodies.

4.9 Reporting

Structure of the EIA report (Appendix III of the EIA Notification), applicable for CETP is given in the following Table 4-6. Each task prescribed in ToR shall be incorporated appropriately in the contents in addition to the contents described in the Table.

Table 4-6: Generic Structure of EIA Document

S.NO	EIA STRUCTURE	CONTENTS
1.	Introduction	▪ Purpose of the report ▪ Identification of project & project proponent ▪ Brief description of nature, size, location of the project and its importance to the country, region ▪ Scope of the study – details of regulatory scoping carried out (As per the ToR for EIA Studies)
2.	Project Description	Condensed description of those aspects of the project (based on project feasibility study), likely to cause environmental effects. Details should be provided to give clear picture of the following: ▪ Type of project ▪ Need for the project ▪ Location (maps showing general location, specific location, project boundary & project site layout) ▪ Size or magnitude of operation (incl. Associated activities required by / for the project) ▪ Proposed schedule for approval and implementation ▪ Technology and process description ▪ Project description including drawings showing project layout, components of project *etc*. Schematic representations of feasibility drawings which give information important for EIA purpose ▪ Description of mitigation measures incorporated into the project to meet environmental standards, environmental operating conditions, or other EIA requirements (as required by the scope) ▪ Assessment of New & untested technology for the risk of technological failure
3.	Description of the Environment	▪ Study area, period, components & methodology ▪ Establishment of baseline for VECs, as identified in the scope ▪ Base maps of all environmental components
4.	Anticipated Environmental Impacts & Mitigation Measures	▪ Details of Investigated Environmental impacts due to project location, possible accidents, project design, project construction, regular operations, final decommissioning or rehabilitation of a completed project ▪ Measures for minimizing and / or offsetting adverse impacts identified ▪ Irreversible and irretrievable commitments of environmental components ▪ Assessment of significance of impacts (Criteria for determining significance, Assigning significance) ▪ Mitigation measures
5.	Analysis of Alternatives (Technology & Site)	In case, the scoping exercise results in need for alternatives: ▪ Description of each alternative ▪ Summary of adverse impacts of each alternative ▪ Mitigation measures proposed for each alternative and selection of alternative
6.	Environmental Monitoring Program	▪ Technical aspects of monitoring the effectiveness of mitigation measures (incl. Measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules)
7.	Additional Studies	▪ Public Consultation ▪ Risk assessment

S.NO	EIA STRUCTURE	CONTENTS
		▪ Social Impact Assessment, R&R Action Plans
8.	Project Benefits	▪ Improvements in physical infrastructure ▪ Improvements in social infrastructure ▪ Employment potential – skilled; semi-skilled and unskilled ▪ Other tangible benefits
9.	Environmental Cost Benefit Analysis	▪ If recommended at the Scoping stage
10.	EMP	▪ Description of administrative aspects that ensure proper implementation of the mitigative measures are implemented and their effectiveness monitored, after approval of the EIA
11.	Summary & Conclusion (This will constitute the summary of the EIA Report)	▪ Overall justification for implementation of the project ▪ Explanation of how, adverse effects have been mitigated
12.	Disclosure of Consultants engaged	▪ Names of the Consultants engaged with their brief resume and nature of Consultancy rendered

4.10 Public Consultation

Public consultation refers to the process by which the concerns of local affected people and others who have plausible stake in the environmental impacts of the project or activity are ascertained.

- Public consultation is not a decision taking process, but is a process to collect views of the people having plausible stake. If the SPCB/Public agency conducting public hearing is not convinced with the plausible stake, then such expressed views need not be considered.
- Public consultation involves two components, one is public hearing, and other one is inviting written responses/objections through Internet/by post, *etc*., by placing the summary of EIA report on the website.
- All Category A and Category B1 projects require public hearing except the following:
  - Once environmental clearance is granted to an industrial estate/SEZ/EPZ *etc*., for a given composition (type and capacity) of industries, then individual units will not require public hearing
  - Expansion of roads and highways, which do not involve any further acquisition of land.
  - Maintenance dredging provided the dredged material shall be disposed within port limits
  - All building/ construction projects/ area development projects/townships
  - All Category B2 projects
  - All projects concerning national defense and security or involving other strategic considerations as determined by the Central Government
- Public hearing shall be carried out at the site or in its close proximity, district-wise, for ascertaining concerns of local affected people including the affected people due to the discharge of treated wastewater.
- Project proponent shall make a request through a simple letter to the Member-Secretary of the SPCB or UTPCC to arrange public hearing.

- Project proponent shall enclose with the letter of request, at least 10 hard copies and 10 soft copies of the draft EIA report including the summary EIA report in English and in the official language of the State/local language prepared as per the approved scope of work, to the concerned Authority.
- Simultaneously, project proponent shall arrange to send, one hard copy and one soft copy, of the above draft EIA report along with the summary EIA report to the following Authorities within whose jurisdiction the project will be located:
  - District magistrate(s) /District Collector/Deputy Commissioner (s)
  - Zilla parishad and municipal corporation or panchayats union
  - District industries office
  - Urban local bodies (ULBs)/PRIs concerned/development authorities
  - Concerned regional office of the MoEF/SPCB
- Above mentioned Authorities except regional office of MoEF shall arrange to widely publicize the draft EIA report within their respective jurisdictions requesting the interested persons to send their comments to the concerned regulatory authorities. They shall also make draft EIA report for inspection electronically or otherwise to the public during normal office hours till the public hearing is over.
- Concerned regulatory Authority (MoEF/SEIAA/UTEIA) shall display the summary of EIA report on its website and also make full draft EIA report available for reference at a notified place during normal office hours at their head office.
- SPCB or UTPCC concerned shall also make similar arrangements for giving publicity about the project within the State/UT and make available the summary of draft EIA report for inspection in select offices, public libraries or any other suitable location, *etc*. They shall also additionally make available a copy of the draft EIA report to the five authorities/offices as mentioned above.
- The MemberSecretary of the concerned SPCB or UTPCC shall finalize the date, time and exact venue for the conduct of public hearing within seven days of the date of the receipt of the draft EIA report from the project proponent and advertise the same in one major national daily and one regional vernacular daily/official State language.
- A minimum notice period of 30 (thirty) days shall be provided to the public for furnishing their responses.
- No postponement of the date, time, venue of the public hearing shall be undertaken, unless some untoward emergency situation occurs Only in case of emergencies and up on the recommendation of the concerned District Magistrate/District Collector/Deputy Commissioner (s) the postponement shall be notified to the public through the same National and Regional vernacular dailies and also prominently displayed at all the identified offices by the concerned SPCB or UTPCC.
- In the above exceptional circumstances fresh date, time and venue for the public consultation shall be decided by the Member–Secretary of the concerned SPCB or UTPCC only in consultation with the District Magistrate/District Collector/Deputy Commissioner (s) and notified afresh as per the procedure.
- The District Magistrate/District Collector/Deputy Commissioner (s) or his or her representative not below the rank of an Additional District Magistrate assisted by a representative of SPCB or UTPCC, shall supervise and preside over the entire public hearing process.
- The SPCB or UTPCC shall arrange to video film the entire proceedings. A copy of the videotape or a CD shall be enclosed with the public hearing proceedings while forwarding it to the Regulatory Authority concerned.

- The attendance of all those who are present at the venue shall be noted and annexed with the final proceedings.
- There shall be no quorum required for attendance for starting the proceedings.
- Persons present at the venue shall be granted the opportunity to seek information or clarifications on the project from the proponent. The summary of the public hearing proceedings accurately reflecting all the views and concerns expressed shall be recorded by the representative of the SPCB or UTPCC and read over to the audience at the end of the proceedings explaining the contents in the local/vernacular language and the agreed minutes shall be signed by the District Magistrate/District Collector/Deputy Commissioner (s) or his or her representative on the same day and forwarded to the SPCB/UTPCC concerned.
- A statement of the issues raised by the public and the comments of the proponent shall also be prepared in the local language or the official State language, as the case may be and in English and annexed to the proceedings.
- The proceedings of the public hearing shall be conspicuously displayed at the office of the Panchayats within whose jurisdiction the project is located, office of the concerned Zilla Parishad, District Magistrate/District Collector/Deputy Commissioner (s), and the SPCB or UTPCC. The SPCB or UTPCC shall also display the proceedings on its website for general information. Comments, if any, on the proceedings, may be sent directly to the concerned regulatory authorities and the Applicant concerned.
- The public hearing shall be completed within a period of 45 (forty five) days from date of receipt of the request letter from the Applicant. Therefore the SPCB or UTPCC concerned shall send public hearing proceedings to the concerned regulatory authority within 8(eight) days of the completion of public hearing. Simultaneously, a copy will also be provided to the project proponent. The proponent may also directly forward a copy of the approved public hearing proceedings to the regulatory authority concerned along with the final EIA report or supplementary report to the draft EIA report prepared after the public hearing and public consultations incorporating the concerns expressed in the public hearing along with action plan and financial allocation, item-wise, to address those concerns.
- Up on receipt of the same, the Authority will place executive summary of the report on the website to invite responses from other concerned persons having a plausible stake in the environmental aspects of the project or activity.
- If SPCB/UTPCC is unable to conduct public hearing in the prescribed time, the Central Government in case of Category A projects and State Government or UT administration in case of Category B projects at the request of SEIAA may engage any other agency or authority for conducting the public hearing process within a further period of 45 days. The respective governments shall pay appropriate fee to the public agency for conducting public hearing.
- A public agency means a non-profit making institution/ body such as technical/academic institutions, government bodies not subordinate to the concerned Authority.
- If SPCB/Public Agency authorized for conducting public hearing informs the Authority, stating that it is not possible to conduct the public hearing in a manner, which will enable the views of the concerned local persons to be freely expressed, then Authority may consider such report to take a decision that in such particular case, public consultation may not have the component of public hearing.

- Often restricting the public hearing to the specific district may not serve the entire purpose, therefore, NGOs who are local and registered under the Societies Act in the adjacent districts may also be allowed to participate in public hearing, if they so desire.
- Confidential information including non-disclosable or legally privileged information involving intellectual property right, source specified in the application shall not be placed on the website.
- The Authority shall make available, on a written request from any concerned person, the draft EIA report for inspection at a notified place during normal office hours till the date of the public hearing.
- While mandatory requirements will have to be adhered to, utmost attention shall be given to the issues raised in the public hearing for determining the modifications needed in the project proposal and EMP to address such issues.
- Final EIA report after making needed amendments, as aforesaid, shall be submitted by the applicant to the concerned Authority for prior environmental clearance. Alternatively, a supplementary report to draft EIA and EMP addressing all concerns expressed during the public consultation may be submitted.

4.11 Appraisal

Appraisal means the detailed scrutiny by the EAC/SEAC of the application and the other documents like the final EIA report, outcome of the public consultation including public hearing proceedings submitted by the applicant for grant of environmental clearance.

- The appraisal shall be made by EAC to the Central Government or SEAC to SEIAA.
- Project proponent either personally or through consultant can make a presentation to EAC/SEAC for the purpose of appraising the features of the project proposal and also to clarify the issues raised by the members of the EAC/SEAC.
- On completion of these proceedings, concerned EAC/SEAC shall make categorical recommendations to the respective Authority, either for grant of prior environmental clearance on stipulated terms & conditions, if any, or rejection of the application with reasons.
- In case EAC/SEAC needs to visit the site or obtain further information before being able to make categorical recommendations, EAC/SEAC may inform the project proponent accordingly. In such an event, it should be ensured that the process of environmental clearance is not unduly delayed to go beyond the prescribed timeframe.
- Up on the scrutiny of the final report, if EAC/SEAC opines that ToR for EIA studies finalized at the scoping stage are not covered by the proponent, then the project proponent may be asked to provide such information. If such information is declined by the project proponent or is unlikely to be provided early enough so as to complete the environmental appraisal within prescribed time of 60 days, the EAC/SEAC may recommend for rejection of the proposal with the same reason.
- Appraisal shall be strictly in terms of the ToR for EIA studies finalized at the scoping stage and the concerns expressed during public consultation.
- This process of appraisal shall be completed within 60 days from the receipt of the updated EIA report and EMP report, after completing public consultation.
- The EIA report will be typically examined for following:

- Project site description supported by topographic maps & photographs – detailed description of topography, land use and activities at the proposed project site and its surroundings (buffer zone) supported by photographic evidence.
- Clarity in description of drainage pattern, location of eco-sensitive areas, vegetation characteristics, wildlife status - highlighting significant environmental attributes such as feeding, breeding and nesting grounds of wildlife species, migratory corridor, wetland, erosion and neighboring issues.
- Description of the project site – how well the interfaces between the project related activities and the environment have been identified for the entire project cycle *i.e.*, construction, operation and decommissioning at the end of the project life.
- How complete and authentic are the baseline data pertaining to flora and fauna and socio economic aspects?
- Citing of proper references, with regard to the source(s) of baseline data as well as the name of the investigators/ investigating agency responsible for collecting the primary data.
- How consistent are the various values of environmental parameters with respect to each other?
- Is a reasonable assessment of the environmental and social impact made for the identified environmental issues including project affected people?
- To what extent the proposed environmental plan will mitigate the environmental impact and at what estimated cost, shown separately for construction, operation and closure stages and also separately in terms of capital and recurring expenses along with details of agencies that will be responsible for the implementation of environmental plan/ conservation plan.
- How well the concerns expressed/highlighted during the public hearing have been addressed and incorporated in the EMP giving item wise financial provisions and commitments (in quantified terms)?
- How far the proposed environmental monitoring plan will effectively evaluate the performance EMP's? Are details for environmental monitoring plan provided in the same manner as the EMP?
- Identification of hazard and quantification of risk assessment and whether appropriate mitigation plan has been included in the EMP?
- Does the proposal include a well formulated time bound green belt development plan for mitigating environmental problems such as fugitive emissions of dust, gaseous pollutants, noise, odour, *etc*.?
- Does EIA make a serious attempt to guide the project proponent for minimizing the requirement of natural resources including land, water energy and other non renewable resources?
- How well has the EIA statement been organized and presented so that the issues, their impact and environmental management strategies emerge clearly from it and how well organized was the power point presentation made before the expert committee?
- Is the information presented in EIA adequately and appropriately supported by maps, imageries and photographs highlighting site features and environmental attributes?

4.12 Decision-making

The Chairperson reads the sense of the Committee and finalizes the draft minutes of the meeting, which are circulated by the Secretary to all the expert members invited to the meeting. Based on the response from the members, the minutes are finalized and signed by the Chairperson. This process for finalization of the minutes should be so organized that the time prescribed for various stages is not exceeded.

Approval / rejection / reconsideration

- The Authority shall consider the recommendations of concerned Appraisal Committee and convey its decision within 45 days of the receipt of recommendations.
- If the Authority disagrees with the recommendations of the Appraisal Committee, then reasons shall be communicated to concerned Appraisal Committee and applicant within 45 days from the receipt of the recommendations. The Appraisal Committee concerned shall consider the observations of the Authority and furnish its views on the observations within further period of 60 days. The Authority shall take a decision with in the next 30 days based on the views of Appraisal Committee.
- If the decision of the Authority is not conveyed within the time, then the proponent may proceed as if the environmental clearance sought has been granted or denied by the regulatory authority in terms of the final recommendation of the concerned appraisal Committee. For this purpose, the decision of the Appraisal Committee will be public document, once the period specified above for taking the decision by the Authority is over.
- In case of Category B projects, application shall be received by the Member–Secretary of the SEIAA and clearance shall also be issued by the same SEIAA.
- Deliberate concealment and/or submission of false or misleading information or data which is material to screening or scoping or appraisal or decision on the application shall make the application liable for rejection, and cancellation of prior environmental clearance granted on that basis. Rejection of an application or cancellation of a prior environmental clearance already granted, on such ground, shall be decided by the regulatory authority, after giving a personal hearing to the applicant, and following the principles of natural justice.

If approved

- The MoEF concerned /SEIAA will issue an environmental clearance for the project.
- The project proponent should make sure that the award of environmental clearance is properly publicized in at least two local newspapers of the district or state where the proposed project is located. For instance, the executive summary of the environmental clearance may be published in the newspaper along with the information about the location (website/office where it is displayed for public) where the detailed environmental clearance is made available. The MoEF and the SEIAA/UTEIAA, as the case may be, shall also place the environmental clearance in the public domain on Government Portal. Further copies of the environmental clearance shall be endorsed to the Heads of local bodies, Panchayats and Municipal bodies in addition to the relevant offices of the Government
- The environmental clearance will be valid from the start date to actual commencement of the production of the developmental activity.
- Usual validity period will be 5 years from the date of issuing environmental clearance, unless specified by EAC/SEAC.
- A prior environmental clearance issued to a project proponent can be transferred to another legal person entitled to undertake the project, upon application by the transferor to the concerned Authority or submission of no-objection of the transferor by the transferee to the concerned Authority for the concurrence. In this case, EAC/SEAC concurrence is not required, but approval from the concerned authority is

required to avail the same project configurations, validity period transferred to the new legally entitled person to undertake the project.

4.13 Post Clearance Monitoring Protocol

The MoEF, Government of India will monitor and take appropriate action under the EP Act, 1986.

- In respect of Category A projects, it shall be mandatory for the project proponent to make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by advertising it at least in two local newspapers of the district or State where the project is located and in addition, this shall also be displayed in the project proponent's website permanently.
- In respect of Category B projects, irrespective of its clearance by MoEF/SEIAA, the project proponent shall prominently advertise in the newspapers indicating that the project has been accorded environment clearance and the details of MoEF website where it is displayed.
- The MoEF and the SEIAAs/UTEIAAs, as the case may be, shall also place the environmental clearance in the public domain on Government Portal.
- Copies of the environmental clearance shall be submitted by the project proponents to the Heads of the local bodies, Panchayats and Municipal bodies in addition to the relevant offices of the Government who in turn have to display the same for 30 days from the date of receipt.

The project proponent must submit half-yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions in hard and soft copies to the regulatory authority concerned, on 1st June and 1st December of each calendar year.

All such compliance reports submitted by the project management shall be public documents. Copies of the same shall be given to any person on application to the concerned regulatory authority. The latest such compliance report shall also be displayed on the website of the concerned regulatory authority.

The SPCB shall incorporate EIA clearance conditions into consent conditions in respect of Category A and Category B projects and in parallel monitor and enforce the same.

5. STAKEHOLDERS' ROLES AND RESPONSIBILITIES

Prior environmental clearance process involves many stakeholders *i.e.*, Central Government, State Government, SEIAA, EAC at the National Level, SEAC, Public Agency, SPCB, the project proponent, and the public.

- The roles and responsibilities of the organizations involved in different stages of prior environmental clearance are listed in Table 5-1.
- Organization-specific functions are listed in Table 5-2.

In this Chapter, constitution, composition, functions, *etc*., of the Authorities and the Committees are discussed in detail.

Table 5-1: Roles and Responsibilities of Stakeholders Involved in Prior Environmental Clearance

Stage	MoEF/ SEIAA	EAC/SEAC	Project Proponent	EIA Consultant	SPCB/ Public Agency	Public and Interest Group
Screening	Receives application and takes advice of EAC/ SEAC	Advises the MoEF/ SEIAA	Submits application (Form 1) and provides necessary information	Advises and assists the proponent by providing technical information		
Scoping	Approves the ToR, communicates the same to the project proponent and places the same in the website	Reviews the ToR, visits the proposed site, if required, and recommends the ToR to the MoEF/ SEIAA	Submits the draft ToR to MoEF/SEIAA and facilitates the visit of the EAC/SEAC members to the project site	Prepares ToR		
EIA Report & Public Hearing	Reviews and forwards copies of the EIA report to SPCB /public agency for conducting public hearing Places the summary of EIA		Submits detailed EIA report as per the finalized ToR Facilitates the public hearing by arranging presentation on the project, EIA and EMP – takes note of objections and updates the EMP	Prepares the EIA report Presents and appraises the likely impacts and pollution control measures proposed in the public hearing	Reviews EIA report and conducts public hearing in the manner prescribed Submits proceedings and views of SPCB, to the Authority and the project	Participates in public hearings and offers comments and observations . Comments can be sent directly to SEIAA through Internet in response to

Stage	MoEF/ SEIAA	EAC/SEAC	Project Proponent	EIA Consultant	SPCB/ Public Agency	Public and Interest Group
	report in the website Conveys objections to the project proponent for update, if any.		accordingly		proponent as well	the summary placed in the website
Appraisal and Clearance	Receives updated EIA Takes advice of EAC/ SEAC, approves EIA and attaches the terms and conditions	Critically examines the reports, presentation of the proponent and appraises MoEF/ SEIAA (recommendations are forwarded to MoEF/ SEIAA)	Submits updated EIA , EMP reports to MoEF/SEIAA. Presents the overall EIA and EMP including public concerns to EAC/SEAC	Provides technical advise to the project proponent and if necessary presents the proposed measures for mitigation of likely impacts (terms and conditions of clearance)		
Post-clearance Monitoring			Implements environmental protection measures prescribed and submits periodic monitoring results	Conducts periodic monitoring	Incorporates the clearance conditions into appropriate consent conditions and ensures implementation	

Table 5-2: Organization-Specific Functions

ORGANIZATION	FUNCTIONS
Central Government	▪ Constitutes the EAC ▪ Considering recommendations of the State Government, constitutes the SEIAA & SEAC ▪ Receives application from the project proponent in case of Category A projects or Category B projects attracting general condition ▪ Communicates the ToR finalized by the EAC to the project proponent. ▪ Receives EIA report from the project proponent and soft copy of summary of the report for placing in the website ▪ Summary of EIA report will be placed in website. Forwards the received responses to the project proponent ▪ Engages other public agency for conducting public hearings in cases where the

ORGANIZATION	FUNCTIONS
	SPCB does not respond within time ▪ Receives updated EIA report from project proponent incorporating the considerations from the proceedings of public hearing and responses received through other media ▪ Forwards updated EIA report to the EAC for appraisal ▪ Either accepts the recommendations of EAC or asks for reconsideration of specific issues for review by the EAC. ▪ Takes the final decision – acceptance/ rejection – of the project proposal and communicates the same to the project proponent
State Government	▪ Identifies experts as per the composition specified in the Notification and subsequent guidelines to recommend to the Central Government. ▪ Extends funding support to fulfill the functions of SEIAA/SEAC ▪ Engages other public agency for conducting public hearings in cases where the SPCB does not respond within time ▪ State Governments will suitably pay the public agency for conducting such activity
EAC	▪ Reviews Form 1 and its attachments ▪ Visits site(s), if necessary ▪ Finalizes ToR and recommends to the Central Government, which in turn communicates the finalized ToR to the project proponent, if not exempted by the Notification ▪ Reviews EIA report, proceedings and appraises their views to the Central government ▪ If the Central Government has any specific views, then the EAC reviews again for appraisal
SEIAA	▪ Receives application from the project proponent ▪ Considers SEAC's views for finalization of ToR ▪ Communicates the finalized ToR to the project proponent ▪ Receives EIA report from project proponent ▪ Uploads the summary of EIA report in the website in cases of Category B projects ▪ Forwards the responses received to the project proponent ▪ Receives updated EIA report from project proponent incorporating the considerations from the proceedings of public hearing and responses received through other media ▪ Forwards updated EIA report to SEAC for appraisal ▪ Either accepts the recommendations of SEAC or asks for reconsideration of specific issues for review by SEAC. ▪ Takes the final decision and communicates the same to the project proponent
SEAC	▪ Reviews Form 1 ▪ If necessary visits, site(s) for finalizing the ToR ▪ Reviews updated EIA - EMP report and ▪ Appraises the SEIAA
SPCB	▪ Receives request from project proponent and conducts public hearing in the manner prescribed. ▪ Conveys proceedings to concerned authority and project proponent
Public Agency	▪ Receives request from the respective Governments to conduct public hearing ▪ Conducts public hearing in the manner prescribed. ▪ Conveys proceedings to the concerned Authority/EAC /Project proponent

5.1 SEIAA

- SEIAA is constituted by the MoEF to take final decision regarding the acceptance/rejection of prior environmental clearance to the project proposal for all Category 'B' projects.
- The state government may decide whether to house them at the Department of Environment or at any other Board for effective operational support.
- State Governments can decide whether the positions are permanent or part-time. The Central Government (MoEF) continues to follow the model of paying fee (TA/DA, accommodation, sitting fee) to the Chairperson and the members of EAC. As such, the State Government is to fund SEIAA & SEAC and decide the appropriate institutional support for them.

A. Constitution

- SEIAA is constituted by the Central Government comprising of three members including a Chairperson and the Member-Secretary to be nominated by the State Government or UT Administration concerned.
- The Central Government will notify as and when the nominations (in order) are received from the State Governments, within 30 days from the date of receipt.
- The Chairperson and the non-official member shall have a fixed term of three years, from the date of Notification by the Central Government constituting the Authority.
- The form used by the State Governments to submit nominations for Notification by the Central Government is provided in **Annexure X**.

B. Composition

- Chairperson shall be an expert in the EIA process
- Member-Secretary shall be a serving officer of the concerned State Government/ UT Administration familiar with the environmental laws.
- Member-Secretary may be of a level equivalent to the Director, Dept. of Environment or above – a full time member.
- All the members including the Chairperson shall be the experts as per the criteria set in the Notification.
- The Government servants can only serve as the Member-Secretary to SEIAA and the Secretary to SEAC. All other members including Chairperson of the SEIAA and SEAC shall not be comprised of serving Government Officers; industry representatives; and activists.
- Serving faculty (academicians) is eligible for the membership in the Authority and/or the Committees, if they fulfill the criteria given in Appendix VI to the Notification.
- This is to clarify that the serving Government officers shall not be nominated as professional/expert member of SEIAA/SEAC/EAC.
- Professionals/Experts in the SEIAA and SEAC shall be different.
- Summary regarding the eligibility criteria for Chairperson and Members of the SEIAA is given in Table 5-3.

C. Decision-making process

- The decision of the Authority shall be arrived through consensus.
- If there is no consensus, the Authority may either ask SEAC for reconsideration or may reject the approval.
- All decisions of the SEIAA shall be taken in a meeting and shall ordinarily be unanimous. In case a decision is taken by majority, the details of views, for and against the decision, shall be clearly recorded in the minutes of meeting and a copy thereof be sent to MoEF.

Table 5-3: SEIAA: Eligibility Criteria for Chairperson / Members / Secretary

S. No.	Attribute		Requirement		
			Members	Member-Secretary	Chairperson
1	Professional qualification as per the Notification		Compulsory	Compulsory	Compulsory
2	Experience (Fulfilling any one of a, b, c)	a	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI
		b	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in Appendix VI	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in the Appendix VI
		c	Professional Qualification +10 years of experience in one of the expertise area mentioned in the Appendix VI + 5 years interface with environmental issues, problems and their management	Professional Qualification +10 years of experience in one of the expertise area mentioned in the Appendix VI + 5 years interface with environmental issues, problems and their management	----------
3	Test of independence (conflict of interest) and minimum grade of the Secretary of the Authority		Shall not be a serving government officer Shall not be a person engaged in industry and their associations Shall not be a person associated with environmental activism	Only serving officer from the State Government (DoE) familiar with environmental laws not below the level of Director	Shall not be a serving government officer Shall not be a person engaged in industry and their associations Shall not be a person associated with environmental

S. No.	Attribute	Requirement		
		Members	Member-Secretary	Chairperson
				activism
4	Age	Below 67 years at the time of Notification of the Authority	As per State Government Service Rules	Below 72 Years at the time of the Notification of the Authority
5	Other memberships in Central/State Expert Appraisal committee	Shall not be a member in any SEIAA/EAC/SEAC	Shall not be a member in any SEIAA/EAC/SEAC	Shall not be a member in any SEIAA/EAC/SEAC
6	Tenure of earlier appointment (continuous)	Only one term before this in continuity is permitted	Not applicable	Only one term before this in continuity is permitted
7	Eminent environmental expertise with understanding on environmental aspects and impacts	Desirable	Desirable	Compulsory
8	Expertise in the environmental clearance process	Desirable	Desirable	Compulsory

Notes:

1. A member after continuous membership in two terms (6 years) shall not be considered for further continuation. His/her nomination may be considered after a gap of one term (three years), if other criteria meet.

2. Chairperson/Member once notified may not be removed prior to the tenure of three years without cause and proper enquiry.

5.2 EAC and SEAC

EAC and SEAC are independent Committees to review each developmental activity and offer its recommendations for consideration of the Central Government and SEIAA respectively.

A. Constitution

- EAC and SEAC shall be constituted by the Central Government comprising a maximum of 15 members including a Chairperson and Secretary. In case of SEAC, the State Government or UT Administration is required to nominate the professionals/experts for consideration and Notification by the Central Government.
- The Central Government will notify as and when the nominations (in order) are received from the State Governments, within 30 days from the date of receipt.
- The Chairperson and the non-official member shall have a fixed term of three years, from the date of Notification by the Central Government.

- The Chairperson shall be an eminent environmental expert with understanding on environmental aspects and environmental impacts. The Secretary of the SEAC shall be a State Government officer, not below the level of a Director/Chief Engineer.
- The members of the SEAC need not be from the same State/UT.
- In case the State Governments/ UTs so desire, the MoEF can form regional EAC to serve the concerned States/UTs.
- State Governments may decide to their convenience to house SEAC at the Department of Environment or at SPCB or at any other department, to extend support to the SEAC activities.

B. Composition

- Composition of EAC/SEAC as per the Notification is given in **Annexure XI**.
- Secretary to EAC/SEAC may invite a maximum of two professionals/experts with the prior approval of the Chairperson, if desired, for taking the advisory inputs for appraisal. In such case, the invited experts will not take part in the decision making process.
- The Secretary of each EAC/SEAC preferably be an officer of the level equivalent to or above the level of Director, MoEF, GoI.

C. Decision-making

The EAC and SEAC shall function on the principle of collective responsibility. The Chairperson shall endeavor to reach a consensus in each case, and if consensus cannot be reached, the view of the majority shall prevail.

D. Operational issues

- Secretary may deal with all correspondence, formulate agenda and prepare agenda notes. Chairperson and other members may act only for the meetings.
- Chairperson of EAC/SEAC shall be one among the expert members having considerable professional experience with proven credentials.
- EAC/SEAC shall meet at least once every month or more frequently, if so needed, to review project proposals and to offer recommendations for the consideration of the Authority.
- EAC/SEAC members may inspect the site at various stages *i.e.*, during screening, scoping and appraisal, as per the need felt and decided by the Chairperson of the Committee.
- The respective Governments through the Secretary of the Committee may pay/reimburse the participation expenses, honorarium *etc*., to the Chairperson and members.

i. Tenure of EAC/SEIAA/SEAC

The tenure of Authority/Committee(s) shall be for a fixed period of three years. At the end of the three years period, the Authority and the committees need to be re-constituted. However, staggered appointment dates may be adopted to maintain continuity of members at a given point of time.

ii. Qualifying criteria for nomination of a member to EAC/SEIAA/SEAC

While recommending nominations and while notifying the members of the Authority and Expert Committees, it shall be ensured that all the members meet the following three criteria:

- Professional qualification
- Relevant experience/Experience interfacing with environmental management
- Absence of conflict of interest

These are elaborated subsequently.

a) Professional qualification

The person should have at least

- 5 years of formal University training in the concerned discipline leading to a MA/MSc Degree, or
- In case of Engineering/Technology/Architecture disciplines, 4 years formal training in a professional training course together with prescribed practical training in the field leading to a B.Tech/B.E./B.Arch. Degree, or
- Other professional degree (*e.g.* Law) involving a total of 5 years of formal University training and prescribed practical training, or
- Prescribed apprenticeship/articleship and pass examinations conducted by the concerned professional association (*e.g.* MBA/IAS/IFS). In selecting the individual professionals, experience gained by them in their respective fields will be taken note of.

b) Relevant experience

- Experience shall be related to professional qualification acquired by the person and be related to one or more of the expertise mentioned for the expert members. Such experience should be a minimum of 15 years.
- When the experience mentioned in the foregoing sub-paragraph interfaces with environmental issues, problems and their management, the requirement for the length of the experience can be reduced to a minimum of 10 years.

c) Absence of conflict of interest

For the deliberations of the EAC/SEAC to be independent and unbiased, all possibilities of potential conflict of interests have to be eliminated. Therefore, serving government officers; persons engaged in industry and their associations; persons associated with the formulation of development projects requiring environmental clearance, and persons associated with environmental activism shall not be considered for membership of SEIAA/SEAC/EAC.

iii. Age

Below 70 years for the members and below 72 years for the Chairperson of the SEIAA/SEAC/EAC. The applicability of the age is at the time of the Notification of the SEIAA/SEAC/EAC by the Central Government.

Summary regarding the eligibility criteria for Chairperson and Members of the EAC/ SEAC are given in Table 5-4.

Table 5-4: EAC/SEAC: Eligibility Criteria for Chairperson / Members / Secretary

S. No.	Attribute		Requirement		
			Expert members	Secretary	Chairperson
1	Professional qualification as per the Notification		Compulsory	Compulsory	Compulsory
2	Experience (Fulfilling any one of a, b, c)	a	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification + 15 years of experience in one of the expertise area mentioned in the Appendix VI
		b	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in the Appendix VI	Professional Qualification +PhD+10 years of experience in one of the expertise area mentioned in Appendix VI
		c	Professional Qualification +10 years of experience in one of the expertise area mentioned in the Appendix VI + 5 years interface with environmental issues, problems and their management	Professional Qualification +10 years of experience in one of the expertise area mentioned in the Appendix VI + 5 years interface with environmental issues, problems and their management	----------
3	Test of independence (conflict of interest) and minimum grade of the Secretary of the Committees		Shall not be a serving government officer Shall not be a person engaged in industry and their associations Shall not be a person associated with environmental activism	In case of EAC, not less than a Director from the MoEF, Government of India Incase of SEAC, not below the level of Director/Chief Engineer from the State Government (DoE)	Shall not be a serving government officer Shall not be a person engaged in industry and their associations Shall not be a person associated with environmental activism
4	Age		Below 67 years at the time of Notification of the Committee	As per state Government Service Rules	Below 72 Years at the time of the Notification of the Committee
5	Membership in Central/State Expert Appraisal committees		Only one other than this nomination is permitted	Shall not be a member in other SEIAA/EAC/SEAC	Shall not be a member in any other SEIAA/EAC/SEAC

S. No.	Attribute	Requirement		
		Expert members	Secretary	Chairperson
6	Tenure of earlier appointment (continuous)	Only one term before this in continuity is permitted	Not applicable	Only one term before this in continuity is permitted
7	Eminent environmental expertise with understanding on environmental aspects and impacts	Desirable	Not applicable	Compulsory

Note:

1. A member after continuous membership in two terms (six years) shall not be considered for further continuation. His/her nomination may be reconsidered after a gap of one term (three years), if other criteria meet.

2. Chairperson/Member once notified may not be removed prior to the tenure of 3 years with out cause and proper enquiry. A member after continuous membership in two terms (6 years) shall not be considered for further continuation. The same profile may be considered for nomination after a gap of three years, i.e., one term, if other criteria are meeting.

E. Other conditions

- An expert member of one State/UT, can have at the most another State/UT Committee membership (core or sectoral expert member), but in no case more than two Committees at a given point of time.
- An expert member of a Committee shall not have membership continuously in the same committee for more than two terms, *i.e.*, six years. They can be nominated after a gap of three years, *i.e.*, one term. When a member of Committee has been associated with any development project, which comes for environmental clearance, he/she may not participate in the deliberations and the decisions in respect to that particular project.
- At least four members shall be present in each meeting to fulfill the quorum.
- If a member does not consecutively attend six meetings, without prior intimation to the Committee his/her membership may be terminated by the Notifying Authority. Prior information for absence due to academic pursuits, career development and national/state-endorsed programmes may be considered as genuine grounds for retention of membership.

ANNEXURE I
A Compilation of Legal Instruments

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
1	Air (Prevention and Control of Pollution) Act, 1981 amended 1987	Central Pollution Control Board and State Pollution Control Boards	Air pollutants from chemical industries	The prevention, control and abatement of air pollution	Section 2: Definitions Section 21: Consent from State Boards Section 22: Not to allow emissions exceeding prescribed limits Section 24: Power of Entry and Inspection Section 25: Power to Obtain Information Section 26: Power to Take Samples Section 37-43: Penalties and Procedures
2	Air (Prevention and Control of Pollution) (Union Territories) Rules, 1983	Central Pollution Control Board and State Pollution Control Boards	Air pollutants from chemical industries	The prevention, control and abatement of air pollution	Rule 2: Definitions Rule 9: Consent Applications
3	Water (Prevention and Control of Pollution) Act, 1974 amended 1988	Central Pollution Control Board and State Pollution Control Boards	Water Pollutants from water polluting industries	The prevention and control of water pollution and also maintaining or restoring the wholesomeness of water	Section 2: Definitions Section 20: Power to Obtain Information Section 21: Power to Take Samples Section 23: Power of Entry and Inspection Section 24: Prohibition on Disposal Section 25: Restriction on New Outlet and New Discharge Section 26: Provision regarding existing discharge of sewage or trade effluent Section 27: Refusal or withdrawal of consent by state boards Section 41-49: Penalties and Procedures
4	Water (Prevention and Control of Pollution) Rules, 1975	Central Pollution Control Board and State Pollution Control Boards	Water Pollutants from water polluting industries	The prevention and control of water pollution and also maintaining or restoring the wholesomeness of water	Rule 2: Definitions Rule 30: Power to take samples Rule 32: Consent Applications
5	The Environment (Protection) Act, 1986, amended 1991	Ministry of Environment and Forests, Central Pollution Control	All types of environmental pollutants	Protection and Improvement of the Environment	Section 2: Definitions Section 7: Not to allow emission or discharge of environmental pollutants in excess of

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
		Board and State Pollution Control Boards			prescribed standards Section 8: Handing of Hazardous Substances Section 10: Power of Entry and Inspection Section 11: Power to take samples Section 15-19: Penalties and Procedures
6	Environmental (Protection) Rules, 1986 (Amendments in 1999, 2001, 2002, 2002, 2002, 2003, 2004)	Ministry of Environment and Forests, Central Pollution Control Board and State Pollution Control Boards	All types of Environmental Pollutants	Protection and Improvement of the Environment	Rule 2: Definitions Rule 3: Standards for emission or discharge of environmental pollutants Rule 5: Prohibition and restriction on the location of industries and the carrying on process and operations in different areas Rule 13: Prohibition and restriction on the handling of hazardous substances in different areas Rule 14: Submission of environmental statement
7	Hazardous Waste (Management and Handling) Rules, 1989 amended 2000 and 2003	MoEF, CPCB, SPCB, DGFT, Port Authority and Customs Authority	Hazardous Wastes generated from industries using hazardous chemicals	Management & Handling of hazardous wastes in line with the Basel convention	Rule 2: Application Rule 3: Definitions Rule 4: Responsibility of the occupier and operator of a facility for handling of wastes Rule 4A: Duties of the occupier and operator of a facility Rule 4B: Duties of the authority Rule 5: Grant of authorization for handling hazardous wastes Rule 6: Power to suspend or cancel authorization Rule 7: Packaging, labeling and transport of hazardous wastes

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
					Rule 8: Disposal sites Rule 9: Record and returns Rule 10: Accident reporting and follow up Rule 11: Import and export of hazardous waste for dumping and disposal Rule 12: Import and export of hazardous waste for recycling and reuse Rule 13: Import of hazardous wastes Rule 14: Export of hazardous waste Rule 15: Illegal traffic Rule 16: Liability of the occupier, transporter and operator of a facility Rule 19: Procedure for registration and renewal of registration of recyclers and re-refiners Rule 20: Responsibility of waste generator
8	Manufacture Storage and Import of Hazardous Chemicals Rules, 1989 amended 2000	Ministry of Environment & Forests, Chief Controller of Imports and Exports, CPCB, SPCB, Chief Inspector of Factories, Chief Inspector of Dock Safety, Chief Inspector of Mines, AERB, Chief Controller of Explosives, District Collector or District Emergency Authority, CEES under DRDO	Hazardous Chemicals - Toxic, Explosive, Flammable, Reactive	Regulate the manufacture, storage and import of Hazardous Chemicals	Rule 2: Definitions Rule 4: responsibility of the Occupier Rule 5: Notification of Major Accidents Rule 7-8: Approval and notification of site and updating Rule 10-11: Safety Reports and Safety Audit reports and updating Rule 13: Preparation of Onsite Emergency Plan Rule 14: Preparation of Offsite Emergency Plan Rule 15: Information to persons likely to get affected Rule 16: Proprietary Information Rule 17: Material Safety Data Sheets Rule 18: Import of Hazardous Chemicals
9	Chemical Accidents (Emergency Planning, Preparedness and	CCG, SCG, DCG, LCG and MAH Units	Hazardous Chemicals - Toxic, Explosive, Flammable, Reactive	Emergency Planning Preparedness and Response to chemical accidents	Rule 2: Definitions Rule 5: Functions of CCG Rule 7: Functions of SCG

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
	Response) Rules, 1996				Rule 9: Functions of DCG Rule 10: Functions of LCG
10	EIA Notification, 2006	MoEF, SPCB	For all the identified developmental activities in the notification	Requirement of environmental clearance before establishment of or modernization / expansion of certain type of industries/ projects.	Requirements and procedure for seeking environmental clearance of projects
11	Batteries (Management and Handling) Rules, 2001.	SPCB, CPCB and MoEF	Lead Acid Batteries	To control the hazardous waste generation (lead waste) from used lead acid batteries	Rule 2: Application Rule 3: Definitions Rule 4: Responsibilities of manufacturer, importer, assembler and re-conditioner Rule 5: Registration of Importers Rule 7: Responsibilities of dealer Rule 8: Responsibilities of recycler Rule 9: Procedure for registration / renewal of registration of recyclers Rule 10: Responsibilities of consumer or bulk consumer Rule 11: Responsibilities of auctioneer Rule 14: Computerization of Records and Returns
12	Public Liability Insurance Act, 1991 amended 1992	Ministry of Environment & Forests, District Collector	Hazardous Substances	To provide immediate relief to persons affected by accident involving hazardous substances	Section 2: Definitions Section 3: Liability to give relief in certain cases on principle of no fault Section 4: Duty of owner to take out insurance policy Section 7A: Establishment of Environmental Relief Fund Section 14-18: Penalties and Offences
13	Public Liability Insurance Rules, 1991 amended 1993	Ministry of Environment & Forests, District	Hazardous Substances	To provide immediate relief to persons affected by accident involving hazardous substances	Rule 2: Definitions Rule 6: Establishment of administration of fund

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
		Collector		and also for Establishing an Environmental Relief fund	Rule 10: Extent of liability Rule 11: Contribution of the owner to environmental relief fund
14	Factories Act, 1948	Ministry of Labour, DGFASLI and Directorate of Industrial Safety and Health/Factories Inspectorate	Chemicals as specified in the Table	Control of workplace environment, and providing for good health and safety of workers	Section 2: Interpretation Section 6: Approval, licensing and registration of factories Section 7A: General duties of the occupier Section 7B: General duties of manufacturers etc., as regards articles and substances for use in factories Section 12: Disposal of wastes and effluents Section 14: Dust and fume Section 36: Precautions against dangerous fumes, gases, etc. Section 37: Explosion or inflammable dust, gas, etc. Chapter IVA: Provisions relating to Hazardous processes Section 87: Dangerous operations Section 87A: Power to prohibit employment on account of serious hazard Section 88: Notice of certain accident Section 88A: Notice of certain dangerous occurrences Chapter X: Penalties and procedures
15	The Explosives Act, 1884	Ministry of Commerce and Industry (Department of Explosives)	Explosive substances as defined under the Act	To regulate the manufacture, possession, use, sale, transport, export and import of explosives with a view to prevent accidents	Section 4: Definition Section 6: Power for Central government to prohibit the manufacture, possession or importation of especially dangerous explosives Section 6B: Grant of Licenses
16	The Explosive Rules, 1983	Ministry of Commerce and Industry and Chief	Explosive substances as defined under the Act	To regulate the manufacture, possession, use, sale, transport,	Rule 2: Definition Chapter II: General Provisions

Sl. No.	Legal Instrument (Type, Reference, Year)	Responsible Ministries or Bodies	Chemical Use Categories/ Pollutants	Objective of Legislation	Relevant Articles/Provisions
		Controller of Explosives, port conservator, customs collector, railway administration		export and import of explosives with a view to prevent accidents	Chapter III: Import and Export Chapter IV: Transport Chapter V: Manufacture of explosives Chapter VI: Possession sale and use Chapter VII: Licenses
17	The Motor Vehicle Act, 1988	Ministry of Shipping, Road Transport and Highways	Hazardous and Dangerous Goods	To consolidate and amend the law relating to motor vehicles including to regulate the transportation of dangerous goods with a view to prevent loss of life or damage to the environment	Rule 2: Definition Rule 9: Educational qualification for driver's of goods carriages carrying dangerous or hazardous goods Rule 129: Transportation of goods of dangerous or hazardous nature to human life Rule 129A: Spark arrestors Rule 130: Manner of display of class labels Rule 131: Responsibility of the consignor for safe transport of dangerous or hazardous goods Rule 132: Responsibility of the transporter or owner of goods carriage Rule 133: Responsibility of the driver Rule 134: Emergency Information Panel Rule 135: Driver to be instructed Rule 136: Driver to report to the police station about accident Rule 137: Class labels

ANNEXURE II
General Standards for Discharge of Environmental Pollutants

Table: Water Quality Standards

S. No.	Parameter	Standards			
		Inland Surface Water	Public Sewer	Land for Irrigation	Marine Coastal Areas
1.	2.	3.			
		(a)	(b)	(c)	(d)
1.	Colour and odour	See Note-1	—	See Note-1	See Note-1
2.	Suspended Solids, mg/l, Max	100	600	200	(a) For process waste water-100 (b) For cooling water effluent-10 per cent above total suspended matter of influent cooling water.
3.	Particle size of suspended solids	Shall pass 850 micron IS Sieve	—	—	(a) Floatable solids, Max 3 mm (b) Settleable solids Max 850 microns.
4.	Dissolved solids (inorganic), mg/a, mac	2100	2100	2100	—
5.	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6.	Temperature ^{o}C, Max	Shall not exceed 40 in any section of the stream within 15 meters down stream from the effluent outlet	45 at the point of discharge	—	45 at the point of discharge
7.	Oil and grease, mg/l, max	10	20	10	20
8.	Total residual chlorine, mg/l, Max.	1.0	—	—	1.0
9.	Ammonical nitrogen (as N), mg/l, Max.	50	50	—	50
10.	Total Kjeldahl nitrogen (as N), mg/l, Max.	100	—	—	100
11.	Free Ammonia (as NH3), mg/l, Max.	5.0	—	—	5.0
12.	Biochemical Oxygen Demand (5 days at 20^{o}C) Max.	30	350	100	100
13.	Chemical Oxygen Demand, mg/l, Max.	250	—	—	250
14.	Arsenic (as As), mg/l, Max.	0.2	0.2	0.2	0.2
15.	Mercury (as Hg), mg/l, Max.	0.01	0.01	—	0.01
16.	Lead (as Pb), mg/l, Max.	0.1	1.0	—	1.0
17.	Cadmium (as Cd), mg/l, Max.	2.0	1.0	—	2.0

18.	Hexavalent chromium (as Cr+6) mg/l, Max.	0.1	2.0	—	1.0
19.	Total chromium as (Cr), mg/l, Max.	2.0	2.0	—	2.0
20.	Copper (as Cu), mg/l, Max.	3.0	3.0	—	3.0
21.	Zinc (as Zn), mg/l, Max.	5.0	15	—	15
22.	Selenium (as Se), mg/l, Max.	0.05	0.05	—	0.05
23.	Nickel (as Ni), mg/l, Max.	3.0	3.0	—	5.0
24.	Boron (as B), mg/l, Max.	2.0	2.0	2.0	—
25.	Percent Sodium, Max.	—	60	60	—
26.	Residual sodium carbonate, mg/l, Max.	—	—	5.0	—
27.	Cyanide (as CN), mg/l, Max.	0.2	2.0	0.2	0.2
28.	Chloride (as Cl), mg/l, Max.	1000	1000	600	(a)
29.	Fluoride (as F), mg/l, Max.	2.0	15	—	15
30.	Dissolved Phosphates (as P), mg/l, Max.	5.0	—	—	—
31.	Sulphate (as SO4), mg/l, Max.	1000	1000	1000	—
32.	Sulphide (as S), mg/l, Max.	2.0	—	—	5.0
33.	Pesticides	Absent	Absent	Absent	Absent
34.	Phenolic compounds (as C_6H_5OH), mg/l, Max.	1.0	5.0	—	5.0
35.	Radioactive materials (a) Alpha emitters MC/ml, Max. (b) Beta emitters uc/ml, Max.	10^{-7} 10^{-6}	10^{-7} 10^{-6}	10^{-8} 10^{-7}	10^{-7} 10^{-6}

Note :-

1. All efforts should be made to remove colour and unpleasant odour as far as practicable.
2. The standards mentioned in this notification shall apply to all the effluents discharged such as industrial mining and mineral processing activities municipal sewage etc.

Table: Noise Standards

Ambient air quality standards in respect of noise

Area Code	Category of Area	Limits in dB (A) Leq	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zone	50	40

Note :

1. Day time is reckoned in between 6.00 AM and 9.00 PM
2. Night time is reckoned in between 9.00 PM and 6.00 AM
3. Silence zone is defined as areas upto 100 meters around such premises as hospitals, educational institutions and courts. The Silence zones are to be declared by the Competent Authority.
4. Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.
5. Mixed categories of areas should be declared as one of the four above mentioned categories by the Competent Authority and the corresponding standards shall apply.

Standards/Guidelines for Control of Noise Pollution from Stationary Diesel Generator (DG) Sets

(A) Noise Standards for DG Sets (15-500 KVA)

The total sound power level, Lw, of a DG set should be less than, 94+10 log10 (KVA), dB (A), at the manufacturing stage, where, KVA is the nominal power rating of a DG set.

This level should fall by 5 dB (A) every five years, till 2007, i.e. in 2002 and then in 2007.

(B) Mandatory acoustic enclosure/acoustic treatment of room for stationary DG sets (5 KVA and above)

Noise from the DG set should be controlled by providing an acoustic enclosure or by treating the room acoustically.

The acoustic enclosure/acoustic treatment of the room should be designed for minimum 25 dB(A) Insertion Loss or for meeting the ambient noise standards, whichever is on the higher side (if the actual ambient noise is on the higher side, it may not be possible to check the performance of the acoustic enclosure/acoustic treatment. Under such circumstances the performance may be checked for noise reduction upto actual ambient noise level, preferably, in the night time). The measurement for Insertion Loss may be done at different points at 0.5m from the acoustic enclosure/room, and then averaged.

The DG set should also be provide with proper exhaust muffler with Insertion Loss of minimum 25 dB(A).

(C) Guidelines for the manufacturers/users of DG sets (5 KVA and above)

1. The manufacturer should offer to the user a standard acoustic enclosure of 25 dB(A) Insertion Loss and also a suitable exhaust muffler with Insertion Loss of 25 dB(A).

2. The user should make efforts to bring down the noise levels due to the DG set, outside his premises, within the ambient noise requirements by proper siting and control measures.
3. The manufacturer should furnish noise power levels of the unlicensed DG sets as per standards prescribed under (A)
4. The total sound power level of a DG set, at the user's end, shall be within 2 dB(A) of the total sound power level of the DG set, at the manufacturing stage, as prescribed under (A).
5. Installation of a DG set must be strictly in compliance with the recommendation of the DG set manufacturer.
6. A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

Order of the Lt. Governor of Delhi in respect of D.G. Sets (5th December, 2001)

In exercise of the powers conferred by section 5 of the Environment (Protection) Act, 1986, (29 of 1986), read with the Government of India, Ministry of Home Affairs notification S.O. 667 (E) bearing No. F.No. U-11030/J/91-VTL dated 10th September, 1992, the Lt. Governor of Government of National Capital of Delhi hereby directs to all owners/users of generators sets in the National Capital Territory of Delhi as follows :-

1. that generator sets above the capacity of 5 KVA shall not be operated in residential areas between the hours of 10.00 PM to 6.00 AM;
2. that the generator sets above the capacity of 5 KVA in all areas residential/commercial/industrial shall operate only with the mandatory acoustic enclosures and other standards prescribed in the Environment (Protection) Rules, 1986;
3. that mobile generator sets used in social gatherings and public functions shall be permitted only if they have installed mandatory acoustic enclosures and adhere to the prescribed standards for noise and emission as laid down in the Environment (Protection) Rules, 1986.

The contravention of the above directions shall make the offender liable for prosecution under section 15 of the said Act which stipulates punishment of imprisonment for a term which may extend to five years with fine which may extend to one lakh rupees, or with both, and in case the failure of contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention and if still the failure or contravention continues beyond a period of one year after the date of contravention, the offender continues beyond a period of one year after the date of contravention, the offender shall be punishable with imprisonment for a term which may extend to seven years.

Order Dated: 21st June, 2002

In exercise of the powers conferred by section 5 of the Environment (Protection) Act, 1986 (29 of 1986) read with the Govt. of India, Ministry of Home Affairs notification S.O. 667(E) bearing No. U-11030/J/91-VTL dated the 10th September, 1992, the Lt. Governor Govt. of the National Capital Territory of Delhi hereby makes the following amendment/modification in his order dated the 5th December, 2001 regarding the operation of generator sets, namely:-

Amendments/modifications

In the above said order, for clause(1), the following shall be substituted, namely:-

"(1) that the generator sets above 5KVA shall not be operated in residentoal areas between the hours from 10.00 p.m. to 6.00 a.m. except generator sets of Group Housing Societies and Multi-storey residential apartments".

DIESEL GENERATOR SETS: STACK HEIGHT

The minimum height of stack to be provided with each generator set can be worked out using the following formula:

H = h + 0.2 x OKVA

H = Total height of stack in metre

h = Height of the building in metres where the generator set is installed

KVA = Total generator capacity of the set in KVA

Based on the above formula the minimum stack height to be provided with different range of generator sets may be categorized as follows:

For Generator Sets	Total Height of stack in metre
50 KVA	Ht. of the building + 1.5 metre
50-100 KVA	Ht. of the building + 2.0 metre
100- 150 KVA	Ht. of the building + 2.5 metre
150-200 KVA	Ht. of the building + 3.0 metre
200-250 KVA	Ht. of the building + 3.5 metre
250-300 KVA	Ht. of the building + 3.5 metre

Similarly for higher KVA ratings a stack height can be worked out using the above formula

Source: Evolved By CPCB

[Emission Regulations Part IV: COINDS/26/1986-87]

ANNEXURE III
Form 1 (Application Form for Obtaining EIA Clearance)

FORM 1

(I) BASIC INFORMATION

S. No.	Item	Details
1.	Name of the project/s	
2.	S.No. in the schedule	
3.	Proposed capacity/area/length/tonnage to be handled/command area/lease area/number of wells to be drilled	
4.	New/Expansion/Modernization	
5.	Existing Capacity/Area etc.	
6.	Category of Project i.e., 'A' or 'B'	
7.	Does it attract the general condition? If yes, please specify.	
8.	Does it attract the specific condition? If yes, Please specify.	
9.	Location	
	Plot/Survey/Khasra No.	
	Village	
	Tehsil	
	District	
	State	
10.	Name of the applicant	
11.	Registered Address	
12.	Address for correspondence:	
	Name	
	Designation (Owner/Partner/CEO)	
	Address	
	Pin Code	
	E-mail	
	Telephone No.	
	Fax No.	
13.	Details of alternative Sites examined, if any location of these sites should be shown on a toposheet.	Village-District-State 1. 2. 3.

S. No.	Item	Details
14.	Interlined Projects	
15.	Whether separate application of interlined project has been submitted	
16.	If yes, date of submission	
17.	If no, reason	
18.	Whether the proposal involves approval/clearance under: The Forest (Conservation) Act, 1980 The Wildlife (Protection) Act, 1972 The C.R.Z. Notification, 1991	
19.	Forest land involved (hectares)	
20.	Whether there is any litigation pending against the project and/or land in which the project is propose to be set up Name of the Court Case No. Orders/directions of the Court, if any and its relevance with the proposed project.	

(II) ACTIVITY

1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)		
1.2	Clearance of existing land, vegetation and buildings?		
1.3	Creation of new land uses?		
1.4	Pre-construction investigations e.g. bore houses, soil testing?		
1.5	Construction works?		

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.6	Demolition works?		
1.7	Temporary sites used for construction works or housing of construction workers?		
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations		
1.9	Underground works including mining or tunneling?		
1.10	Reclamation works?		
1.11	Dredging?		
1.12	Offshore structures?		
1.13	Production and manufacturing processes?		
1.14	Facilities for storage of goods or materials?		
1.15	Facilities for treatment or disposal of solid waste or liquid effluents?		
1.16	Facilities for long term housing of operational workers?		
1.17	New road, rail or sea traffic during construction or operation?		
1.18	New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?		
1.19	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?		
1.20	New or diverted transmission lines or pipelines?		
1.21	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?		
1.22	Stream crossings?		
1.23	Abstraction or transfers of water form ground or surface waters?		
1.24	Changes in water bodies or the land surface affecting drainage or run-off?		
1.25	Transport of personnel or materials for construction, operation or decommissioning?		

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
1.26	Long-term dismantling or decommissioning or restoration works?		
1.27	Ongoing activity during decommissioning which could have an impact on the environment?		
1.28	Influx of people to an area in either temporarily or permanently?		
1.29	Introduction of alien species?		
1.30	Loss of native species or genetic diversity?		
1.31	Any other actions?		

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

S.No.	Information/checklist confirmation	Yes/No	Details thereof (with approximate quantities /rates, wherever possible) with source of information data
2.1	Land especially undeveloped or agricultural land (ha)		
2.2	Water (expected source & competing users) unit: KLD		
2.3	Minerals (MT)		
2.4	Construction material – stone, aggregates, sand / soil (expected source – MT)		
2.5	Forests and timber (source – MT)		
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)		
2.7	Any other natural resources (use appropriate standard units)		

3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

S.No	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water supplies)		
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)		
3.3	Affect the welfare of people e.g. by changing living conditions?		
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,		
3.5	Any other causes		

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes		
4.2	Municipal waste (domestic and or commercial wastes)		
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)		
4.4	Other industrial process wastes		
4.5	Surplus product		
4.6	Sewage sludge or other sludge from effluent treatment		
4.7	Construction or demolition wastes		
4.8	Redundant machinery or equipment		

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
4.9	Contaminated soils or other materials		
4.10	Agricultural wastes		
4.11	Other solid wastes		

5. Release of pollutants or any hazardous, toxic or noxious substances to air (kg/hr)

S.No	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources		
5.2	Emissions from production processes		
5.3	Emissions from materials handling including storage or transport		
5.4	Emissions from construction activities including plant and equipment		
5.5	Dust or odours from handling of materials including construction materials, sewage and waste		
5.6	Emissions from incineration of waste		
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)		
5.8	Emissions from any other sources		

6. Generation of Noise and Vibration, and Emissions of Light and Heat:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers		
6.2	From industrial or similar processes		
6.3	From construction or demolition		
6.4	From blasting or piling		
6.5	From construction or operational traffic		
6.6	From lighting or cooling systems		
6.7	From any other sources		

7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

S.No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials		
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)		
7.3	By deposition of pollutants emitted to air into the land or into water		
7.4	From any other sources		
7.5	Is there a risk of long term build up of pollutants in the environment from these sources?		

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

S.No	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances		
8.2	From any other causes		
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudburst etc)?		

9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

S. No.	Information/Checklist confirmation	Yes/No	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
9.1	Lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g.: ▪ Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.) ▪ housing development ▪ extractive industries ▪ supply industries ▪ other		
9.2	Lead to after-use of the site, which could have an impact on the environment		
9.3	Set a precedent for later developments		
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects		

(III) ENVIRONMENTAL SENSITIVITY

S.No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value		
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests		
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration		
4	Inland, coastal, marine or underground waters		
5	State, National boundaries		
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas		
7	Defence installations		
8	Densely populated or built-up area		
9	Areas occupied by sensitive man-made land uses *(hospitals, schools, places of worship, community facilities)*		
10	Areas containing important, high quality or scarce resources *(ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)*		
11	Areas already subjected to pollution or environmental damage. *(those where existing legal environmental standards are exceeded)*		
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (*earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions*)		

(IV) PROPOSED TERMS OF REFERENCE FOR EIA STUDIES

"I hereby given undertaking that the data and information given in the application and enclosure are true to the best of my knowledge and belief and I am aware that if any part of the data and information submitted is found to be false or misleading at any stage, the project will be rejected and clearance give, if any to the project will be revoked at our risk and cost.

Date:_____
Place:_____

Signature of the applicant
With Name and Full Address
(Project Proponent / Authorized Signatory)

NOTE:

1. The projects involving clearance under Coastal Regulation Zone Notification, 1991 shall submit with the application a C.R.Z. map duly demarcated by one of the authorized, agencies, showing the project activities, w.r.t. C.R.Z. and the recommendations of the State Coastal Zone Management Authority. Simultaneous action shall also be taken to obtain the requisite clearance under the provisions of the C.R.Z. Notification, 1991 for the activities to be located in the CRZ.
2. The projects to be located within 10km of the National Parks, Sanctuaries, Biosphere Reserves, Migratory Corridors of Wild Animals, the project proponent shall submit the map duly authenticated by Chief Wildlife Warden showing these features vis-à-vis the project location and the recommendations or comments of the Chief Wildlife Warden thereon."

ANNEXURE IV
CRITICALLY POLLUTED AREAS AS IDENTIFIED BY CPCB

Details of Critically Polluted Industrial Areas and Clusters / Potential Impact Zone in terms of the Office Memorandum no. J-11013/5/2010-IA.II(I) dated 13.1.2010

S. No.	Critically Polluted Industrial Area and CEPI	Industrial Clusters/ Potential Impact Zones
1.	**Ankeshwar (Gujarat)** **CEPI-88.50(Ac_Wc_Lc)**	GIDC Ankeshwar and GIDC, Panoli
2	**Vapi (Gujarat)** **CEPI-88.09(Ac_Wc_Lc)**	GIDC Vapi
3	**Ghaziabad (Uttar Pradesh)** **CEPI-87.37(Ac_Wc_Lc)**	**Sub-cluster A** • Mohan nagar industrial area • Rajinder nagar industrial area • Sahibabad industrial area **Sub-cluster B** • Pandav nagar industrial area • Kavi nagar industrial area • Bulandshahar road industrial area • Amrit nagar • Aryanagar industrial area **Sub-cluster C** • Merrut road industrial are **Sub-cluster D** • Loni industrial area • Loni Road industrial area • Roop nagar industrial area **Sub-cluster E** • Hapur Road industrial area • Dasna • Philkura **Sub-cluster F** (Other scattered industrial areas) • South side of GT road • Kavi Nagar • Tronica city • Anand Nagar • Jindal Nagar • Prakash Nagar • Rural industrial estate
4	**Chandrapur (Maharashtra)** **CEPI-83.88 (Ac_Wc_Lc)**	Chandrapur (MIDC Chandrapur, Tadali, Ghuggus, Ballapur)
5	**Kobra (Chhatisgarh)** **CEPI-83.00 (Ac_Ws_Lc)**	a) Industrial areas and their townships of NTPC, BALCO, CSEB (East) & CSEB (West) b) Korba town
6	**Bhiwadi (Rajasthan)** **CEPI-82.91 (Ac_Wc_Ls)**	a) RIICO industrial areas Phase I to IV b) Bhiwadi town c) Other surrounding industrial areas: Chopanki, Rampura Mundana, Khuskhera Phase I to III
7	**Angul Talcer(Orissa)** **CEPI-82.09 (Ac_Wc_Lc)**	a) MCL Coal mining area, Augul – Talcer region b) Industrial area (60 km x 45 km) Following blocks of Augul district: - Kohina block - Talcher block - Angul block - Chhendipada block

		- Banarpal block And Odapada block of Dhenkamal district
8	**Vellore (North Arcot) (Tamil Nadu)** **CEPI-81.79 (Ac_Wc_Lc)**	Ranipet, SIPCOT industrial complex
9	**Singrauli (Uttar Pradesh)** **CEPI-81.73 (Ac_Wc_Ls)**	Sonebhadra (UP) • Dala-Tola • Obra • Renukoot • Anpara • Renusagar • Kakri • Dudhichuwa • Bina • Khadia • Shakti nagar • Rihand nagar • Bijpur Sigrauli (Madhya Pradesh) Vindhyachal nagar and Jaynat, Nigahi, Dudhichua, Amlohri & Jhingurdah townships
10	**Ludhiana (Punjab)** **CEPI-81.66 (Ac_Wc_Ls)**	Ludhiana municipal limits covering industrial clusters: • Focal point along with NH-I- Total eight phase • Industrial area-B- from sherpur chowk to Gill road & Gill road to Miller Kotla road (left side of road) • Mixed industrial area – right side of Gill road • Industrial area –C (near Juglana village) • Industrial area A & extension: area between old GT road and Ludhiana bypass road • Industrial estate: near Dholwal chowk • Mixes industrial area (MIA) Miller gunj • MIA – bypass road • Bahdur industrial area • Tejpur industrial complex
11	**Nazafgarh drain basin, Delhi** **CEPI-79.54 (As_Wc_Lc)**	Industrila areas: Anand Parvat, Naraina, Okhla and Wazirpur
12	**Noida (Uttar Pradesh)** **CEPI-78.90 (Ac_Wc_Lc)**	Territorial Jurisdiction of: • Noida Phase-1 • Noida Phase-2 • Noida Phase-3 • Surajpur industrial area • Greater Noida industrial area • Village- Chhaparaula
13	**Dhanbad (Jharkhand)** **CEPI-78.63 (Ac_Ws_Lc)**	Four blocks of Dhanbad district: • Sadar (Dhanbad Municipality) • Jharia (Jharia Municipality, Sindri industrial area) • Govindpur (Govindpur industrial estate) • Nirsa
14	**Dombivalli (Maharashtra)** **CEPI-78.41 (Ac_Wc_Ls)**	MIDC Phase- I, Phase- II
15	**Kanpur (Uttar Pradesh)** **CEPI-78.09 (Ac_Wc_Ls)**	Industrial areas: • Dada nagar • Panki • Fazalganj

		• Vijay nagar • Jajmau
16	**Cuddalore (Tamil Nadu)** **CEPI-77.45 (As_Wc_Lc)**	SIPCOT industrial complex, Phase I & II
17	**Aurangabad (Maharashtra)** **CEPI-77.44 (Ac_Wc_Ls)**	MIDC Chikhalthana, MIDC Waluj, MIDC Shendra, and Paithan road industrial area
18	**Faridabad (Haryana)** **CEPI-77.07 (Ac_Ws_Lc)**	• Sector 27-A, B, C, D • DLF phase- 1, sector 31,32 • DLF phase- 2, sector 35 • Sector 4, 6, 24, 27, 31, 59 • Industrial area Hatin • Industrial model township
19	**Agra (Uttar Pradesh)** **CEPI-76.48 (As_Wc_Ls)**	Nunihai industrial estate, Rambag nagar, UPSIDC industrial area, and Runukata industrial area
20	**Manali (Tamil Nadu)** **CEPI-76.32 (Ac_Ws_Ls)**	Manali industrial area
21	**Haldia (West Bengal)** **CEPI-75.43 (As_Wc_Ls)**	5 km wide strip (17.4 x 5.0 km) of industrial area on the southern side of the confluence point of Rivers Hugli and Rupnarayan, covering Haldia municipal area & Sutahata block – I and II
22	**Ahmedabad (Gujarat)** **CEPI-75.28 (Ac_Ws_Ls)**	• GIDC Odhav • GIDC Naroda
23	**Jodhpur (Rajasthan)** **CEPI-75.19 (As_Wc_Ls)**	• Industrial areas including Basni areas (phase-I & II), industrial estate, light & heavy industrial areas, industrial areas behind new power house, Mandore, Bornada, Sangariya and village Tanwada & Salawas. • Jodhpur city
24	**Greater Cochin (Kerala)** **CEPI-75.08 (As_Wc_Ls)**	Eloor-Edayar industrial belt, Ambala Mogal industrial areas
25	**Mandi Gobind Garh (Punjab)** **CEPI-75.08 (Ac_Ws_Lc)**	Mandi Govindgarh municipal limit and khanna area
26	**Howrah (West Bengal)** **CEPI-74.84 (As_Ws_Lc)**	a) Liluah-Bamangachhi region, Howrah b) Jalan industrial complex-1, Howrah
27	**Vatva (Gujarat)** **CEPI-74.77 (Ac_Wc_Ls)**	GIDC Vatva, Narol industrial area (Villages Piplaj, Shahwadi, Narol)
28	**Ib Valley (Orissa)** **CEPI-74.00 (Ac_Ws_Ls)**	Ib Valley of Jharsuguda (Industrial and mining area)
29	**Varansi-Mirzapur (Uttar Pradesh)** **CEPI-73.79 (As_Wc_Ls)**	• Industrial estate, Mirzapur • Chunar • Industrial estate, Chandpur, Varansi • UPSIC, industrial estate, Phoolpur • Industrial area, Ramnagar, Chandauli
30	**Navi Mumbai (Maharashtra)** **CEPI-73.77 (Ac_Ws_Ls)**	TTC industrial area, MIDC, Navi Mumbai (including Bocks-D, C, EL, A, R, General, Kalva)
31	**Pali (Rajasthan)**	a) Existing industrial areas: Mandia road, Puniyata road, Sumerpur

	CEPI-73.73 (As_Wc_Ls)	b) Pali town
32	**Mangalore (Karnataka)** **CEPI-73.68 (Ac_Ws_Ls)**	Baikampady industrial area
33	**Jharsuguda (Orissa)** **CEPI-73.34 (Ac_Ws_Ls)**	Ib valley of Jharsuguda (Industrial and mining area)
34	**Coimbatore (Tamil Nadu)** **CEPI-72.38 (Ac_Ws_Ln)**	SIDCO, Kurichi industrial Clusters
35	**Bhadravati (Karnataka)** **CEPI-72.33 (Ac_Ws_Ln)**	KSSIDC Industrial area, Mysore paper mill & VISL township complex
36	**Tarapur (Maharashtra)** **CEPI-72.01 (Ac_Ws_Ls)**	MIDC Tarapur
37	**Panipat (Haryana)** **CEPI-71.91 (As_Ws_Ls)**	Panipat municipal limit and its industrial clusters
38	**Indore (Madhya Pradesh)** **CEPI-71.26 (As_Ws_Ls)**	Following 09 industrial area: • Sanwer road • Shivaji nagar • Pologround • Laxmibai nagar • Scheme no.71 • Navlakha • Pipliya • Palda • Rau • Inodre city • Other surrounding industrial areas: Manglia, Rajoda, Asrawad, Tejpur Gadwadi
39	**Bhavnagar (Gujarat)** **CEPI-70.99 (As_Ws_Ls)**	GIDI Chitra, Bhavnagar
40	**Vishakhapatnam (Andhra Pradesh)** **CEPI-70.82 (As_Ws_Ls)**	Bowl area (the area between Yarada hill range in the south to Simhachalam hill range in the north and sea on the east and the present NH-5 in the west direction)
41	**Junagarh (Gujarat)** **CEPI-70.82 (As_Ws_Ls)**	Industrial areas: • Sabalpur • Jay Bhavani • Jay Bhuvneshwari • GIDC Junagarh (I&II)
42	**Asansole (West Bengal)** **CEPI-70.20 (As_Ws_Ls)**	Bumpur area surrounding IISCO
43	**Patancheru - Bollaram (Andhra Pradesh)** **CEPI-70.07 (As_Ws_Ls)**	Industrial area: • Patancheru • Bollaram

Note:

Names of identified industrial clusters/potential impact zones are approximate location based on rapid survey and assessment and may alter partially subject to the detailed field study and monitoring. Detailed mapping will

be made available showing spatial boundaries of the identified industrial clusters including zone of influence/ buffer zone, after in depth field study.

ANNEXURE V
Pre-Feasibility Report: Points for Possible Coverage

Table 1: Points for Possible Coverage in Pre-feasibility Report

S. No.	Contents	Points of Coverage in Pre-feasibility Report
I.	**Executive summary**	▪ Details on prima facie idea of the project.
II.	**Project Details**	
	Need/Justification of the Project	▪ Current demand scenario of the project ▪ Alternatives to meet the demand ▪ Post project scenario on residual demand
	Capacity of CETP	▪ How much quantity of wastewater can be treated? ▪ Continuity of wastewater generation, quality and quantity from registered member industries ▪ Optimization of CETP designed capacity
	Process technology	▪ Analysis of all available/advanced technologies, etc. ▪ Analysis of various possible configurations for each technology or a combination of these technologies from available manufactures ▪ Broad specifications for the CETP (s) including but not limited to: - Project outputs and technologies along with process flow diagrams for each alternative - Equipment with redundancy - Details of plant equipment - General plant layout
	Resources	▪ Water - Water requirement for process, utilities, domestic, gardening etc. - Source of construction water and potable water - Source of circulating/consumptive water - Quality of raw water, treated water - Water budget calculations and effluent generation - Approved water allocation quota (drinking, irrigation and industrial use) and surplus availability - Feasible ways of bringing water to site indicating constraints if any. - Lean season water availability and allocation source in case main source not perennial. ▪ Manpower ▪ Infrastructure ▪ Electrical power ▪ Construction material like sand, brick, stone chips, borrow earth etc.
	Rejects (Pollution potential)	▪ Air emissions ▪ Water pollution ▪ Solid / hazardous waste ▪ Noise ▪ Odour
	Technical profile	▪ Construction details - Estimated duration - Number of construction workers including migrating workers - Construction equipment - Vehicular traffic - Source, mode of transportation and storage of

		construction material ▪ Traffic that would arise during different phases of the project and transportation mechanism to handle such traffic ▪ New facilities needed ▪ Technical parameters of the plant & equipments to be used ▪ Product storage and associated transportation system ▪ Product demand & supply position data on regional basis
	Project schedule	▪ Outline project implementation and procurement arrangement including contract packaging ▪ Project implementation schedule showing various activities
	Future prospects	▪ Ascertain the costs and benefits of the proposed project for project life ▪ Technical and logistic constraints/ requirements of project sustainability
III.	**Selection of site based on least possible impacts**	
i.	**Choice of site selection**	
	Major techno-economic feasibility considerations	▪ Land availability & its development ▪ Product demand around the selected site ▪ Access to site for transportation of equipments/construction machinery, material, *etc*. ▪ Raw material availability and its transportation ▪ Water availability and consumptive use ▪ Product transportation ▪ Infrastructure availability at selected site ▪ Inter-state issue, if any
	Incompatible landuse and ecologically sensitive attributes with respect to identified suitable sites	▪ If any incompatible land-use attributes fall within the study area, the following details has to be provided: - Public water supply areas from rivers/surface water bodies, from groundwater - Scenic areas/tourism areas/hill resorts - Religious places, pilgrim centers that attract over 10 lakh pilgrims a year - Protected tribal settlements (notified tribal areas where industrial activity is not permitted); CRZ - Monuments of national significance, World Heritage Sites - Cyclone, Tsunami prone areas (based on last 25 years); - Airport areas - Any other feature as specified by the State or local government and other features as locally applicable, including prime agricultural lands, pastures, migratory corridors, etc. ▪ If ecologically sensitive attributes fall within the study area, please give details. Ecologically sensitive attributes include - National parks - Wild life sanctuaries Game reserve - Tiger reserve/elephant reserve/turtle nesting ground - Breeding grounds - Core zone of biosphere reserve - Habitat for migratory birds - Mangrove area

		- Tropical forests - Important lakes - Endangered species of flora and fauna, *etc*.
	Social aspects	▪ Corporate responsibilities ▪ Employments and infrastructure added in the vicinity of the plant ▪ Status of land availability, current and post project land use variation ▪ Social sensitivity and likely project affected people
ii.	**Details of selected site**	
	Land details	▪ Land requirement and availability ▪ Land ownership details such as Government, private, tribal, non-tribal, etc. ▪ Total area of the project/site ▪ Prevailing land cost details
	Location	▪ Geographical details - Longitude & latitude, village, taluka, district, state ▪ Approach to site – roads, railways and airports ▪ Distance from nearest residential and industrial areas ▪ Distance from nearest water bodies such as river, canal, dam, etc ▪ Distance from ecologically sensitive areas ▪ In case of flood prone areas, HFL of the site ▪ In case of seismic areas, seismic zone, active faults, occurrence on earthquakes, etc. ▪ Proximity from infrastructural facilities
	Physical characteristics	▪ Demography ▪ Meteorological data ▪ Landuse pattern such as agricultural, barren, forest, *etc.* and details thereof ▪ Topography of the area ▪ Drainage patterns ▪ Soil condition and soil investigation results ▪ Ground profile and levels
IV.	**Anticipated impacts based on project operations on receiving environment**	▪ Population ▪ Flora and fauna ▪ Water ▪ Soil ▪ Air ▪ Climate ▪ Landscape, *etc.*
V.	**Proposed broad mitigation measures which could effectively be internalized as project components to have environmental and social acceptance of the proposed site**	▪ Preventive measures ▪ Source control measures ▪ Mitigation measures at the receiving environment, *etc*.
VI.	**An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the developer in compiling the required information.**	

The above listing is not exhaustive. Thus the proponent may provide additional necessary information, felt appropriate, to include in the pre-feasibility study report in support of selecting the site for the proposed developmental activities. The Concerned EAC/SEAC during scrutiny, may specifically ask for any additional information/data required to substantiate the requirement to prescribe the ToR for EIA studies. However, it is to make clear that all the required further information by EAC/SEAC may be mentioned in one single letter, within the prescribed time.

ANNEXURE VI
Types of Monitoring and Network Design Considerations

TYPES OF MONITORING AND NETWORK DESIGN CONSIDERATIONS

A. Types of Monitoring

Monitoring refers to the collection of data using a series of repetitive measurements of environmental parameters (or, more generally, to a process of systematic observation). The environmental quality monitoring programme design will be dependent upon the monitoring objectives specified for the selected area of interest. The main types of EIA monitoring activities are:

- Baseline monitoring is the measurement of environmental parameters during the pre-project period for the purpose of determining the range of variation of the system and establishing reference points against which changes can be measured. This leads to the assessment of the possible (additional available) assimilative capacity of the environmental components in pre-project period w.r.t. the standard or target level.
- Effects monitoring is the measurement of environmental parameters during project construction and implementation to detect changes which are attributable to the project to provide the necessary information to:
  - verify the accuracy of EIA predictions; and
  - determine the effectiveness of measures to mitigate adverse effects of projects on the environment.
  - Feedback from environmental effect monitoring programs may be used to improve the predictive capability of EIAs and also determine whether more or less stringent mitigation measures are needed
- Compliance monitoring is the periodic sampling or continuous measurement of environmental parameters to ensure that regulatory requirements and standards are being met.

Compliance and effects monitoring occurs during the project construction, operation, and abandonment stages. The resources and institutional set-up should be available for the monitoring at these stages. All large-scale construction projects will require some construction stage monitoring. To control the environmental hazards of construction as specified in the EIA, a monitoring program should be established to ensure that each mitigation measure is effectively implemented. There are numerous potential areas for monitoring during operations.

The scope of monitoring topics discussed in this chapter is limited to Baseline and Effects monitoring. In addition, this chapter will also discuss the Compliance monitoring during the construction phase. Post-project monitoring requirements are discussed in the EMP.

Before any field monitoring tasks are undertaken there are many institutional, scientific, and fiscal issues that must be addressed in the implementation of an environmental monitoring program. Careful consideration of these issues in the design and planning stages will help avoid many of the pitfalls associated with environmental monitoring programs. Although these issues are important but the discussions here are confined to the monitoring network design component.

B. Network Design

Analysis of Significant Environmental Issues

At the outset of planning for an environmental monitoring network, the EIA manager may not know exactly what should be monitored, when monitoring should begin, where it should monitor, which techniques should be employed, and who should take responsibility for its conduct. Because there are usually a number of objective decisions associated with network design to be made, it is important to start with an analysis of environmental issues. The scoping phase of an EIA is designed to identify and focus on the major issues. Scoping should provide a valuable source of information on the concerns that need to be addressed by the monitoring network design. These are project specific as well as specific to the environmental setting of the location where the project is proposed to be located

Hence, the network designs are associated with questions like:

- What are the expected outputs of the monitoring activity?
- Which problems do we need to address to? *etc*.

Defining the output will influence the design of the network and optimize the resources used for monitoring. It will also ensure that the network is specially designed to optimize the information on the problems at hand

What to Monitor?

The question of what to monitor is associated with the identification of VECs.

VECs are generally defined as environmental attributes or components of the environment that are valued by society as identified during the scoping stage of the project. They are determined on the basis of perceived public concerns. For example, changes to water quality and quantity could have implications on fish by affecting habitat, food supply, oxygen, and contaminant uptake. Similarly, employment and business, and economies are both VECs that serve as pathways.

The choice of VECs is also related to the perceived significant impact of the project implementation on important environmental components. In general, the significance or importance of environmental components is judged based on:

- legal protection provided (for example, rare and endangered species)
- political or public concerns (for example, resource use conflicts and sustainable development)
- scientific judgment (for example, ecological importance); or
- commercial or economic importance

However, in addition to their economic, social, political or ecological significance, the chosen VEC should also have unambiguous operational ease, be accessible to prediction and measurement; and be susceptible to hazard. Once the VECs are defined, the VECs may be directly measured (for example, extent of habitat for an endangered species). In cases where it is impossible or impractical to directly measure the VECs, the chosen measurement endpoints or environmental indicators must correspond to, or be predictive of assessment endpoints.

The chosen environmental indicators must be: 1) measurable; 2) appropriate to the scale of disturbance/ contamination; 3) appropriate to the impact mechanism; 4) appropriate

and proportional to temporal dynamics; 5) diagnostic; and 6) standardized; as well as have: 1) a low natural variability; 2) a broad applicability; and 3) an existing data series.

Where, How and How Many Times to Monitor?

These are the other components of Monitoring Network Design. These questions are best answered based on local field conditions, capacity and resources available, prevailing legal and regulatory priorities, *etc*. For this screening or reconnaissance Surveys of the study area also necessary. This may also include some simple inexpensive measurements and assimilative/dispersion modeling. The data will give some information on the prevailing special and temporal variations, and the general background air pollution in the area. The number of monitoring stations and the indicators to be measured at each station in the final permanent network may then be decided upon based on the results of the screening study as well as on the knowledge of the sources of the proposed development and prevailing local environmental/meteorological conditions. The best possible definition of the air pollution problem, together with the analysis of the resources: personnel, budget and equipment available, represent the basis for the decision on the following questions:

- What spatial density (number) of sampling stations is required? How many samples are needed and during what period (sampling (averaging) time and frequency)?
- Where should the stations be located?
- What kind of equipment should be used?
- What additional background information is needed?
  - meteorology
  - topography
  - population density
  - emission sources and emission rates
  - effects and impacts
- How will the data be made available/communicated?

C. Site Selection

This normally means that for designing a monitoring programme in an (study) area which might have an impact, several monitoring stations are needed for characterizing the baseline conditions of the impacted area. When considering the location of individual samplers, it is essential that the data collected are representative for the location and type of area without the undue influence from the immediate surroundings. In any measurement point in the study area the total ambient concentration is the representative of:

- natural background concentration
- regional background
- impact of existing large regional sources

To obtain the information about the importance of these different contributions it is therefore necessary to locate monitoring stations so that they are representative for different impacts. In addition to the ambient pollution data, one would often need other data governing the variations such as meteorological data for air pollution, to identify and quantify the sources contributing to the measurements.. When considering the location of individual samplers, it is essential that the data collected are representative for the location and type of area without undue influence from the immediate surroundings.

ANNEXURE VII
Guidance for Assessment of Baseline Components and Attributes

Guidance for Assessment of Baseline Components and Attributes*

Attributes	Sampling		Measurement Method	Remarks	Applications to CETP Projects
	Network	**Frequency**			
A. Ambient Air					
▪ Meteorological ▪ Wind speed ▪ Wind direction ▪ Dry bulb temperature ▪ Wet bulb temperature ▪ Relative humidity ▪ Rainfall	Minimum 1 site in the project impact area requirements Other additional site(s) are require depending upon the model applied or site sensitivities	Min: 1 hrly observations from continuous records	Mechanical / automatic weather station Rain gauge As per India Meteorological Department (IMD) Standards As per IMD	IS 5182 Part 1-20 Sit-specific primary data is essential Secondary data from IMD, New Delhi for the nearest IMD station	
Pollutants ▪ SPM ▪ RPM ▪ SO2 ▪ NOx ▪ H2S ▪ NH3 ▪ HC ▪ VOCs ▪ Odour (parameters to be proposed by the proponent, in draft ToR, which will be reviewed and approved by EAC/SEAC)	5-10 locations in the project impact area	24 hrly twice a week 8 hrly twice a week 24 hrly twice a week	▪ Gravimetric (High – Volume) ▪ Gravimetric (High – Volume with Cyclone) ▪ EPA Modified West & Gaeke method ▪ Arsenite Modified Jacob & Hochheiser ▪ NDIR technique ▪ Methylene-blue ▪ Nessler's Method ▪ Infra Red analyzer ▪ Specific Ion meter	**Monitoring Network** Minimum 2 locations in upwind side, more sites in downwind side / impact zone All the sensitive receptors need to be covered **Measurement Methods** As per CPCB standards for NAQM, 1994	Parameters & frequency are defined in points of coverage for EIA studies based on influent (type of wastewater) & treatment process technology, location-nature/activities within of air basin.

Attributes	Sampling		Measurement Method	Remarks	Applications to CETP Projects
	Network	**Frequency**			
B. Noise					
Hourly equivalent noise levels	Same as for Air Pollution along with others Identified in study area	At least one day continuous in each season on a working and non-working day	Instrument : Sensitive Noise level meter (preferably recording type)	Min: IS: 4954- 1968 as adopted by CPCB	For CETP projects DG sets, boilers incase of spray dryers etc,, pumps, motors/aerators etc. are concerned sources of noise
Hourly equivalent noise levels	In plant (1.5 m from machinery or high emission processes)	Same as above for day and night	Instrument : Noise level meter	CPCB / OSHA	
Hourly equivalent noise levels	Highways (within 500 meters from the road edge)	Same as above for day and night	Instrument : Noise level meter	CPCB / IS : 4954-1968	
C. Water					
Parameters for water quality ▪ pH, temp, turbidity, magnesium hardness, total alkalinity, chloride, sulphate, nitrate, fluoride, sodium, potassium , salinity ▪ Total nitrogen, total phosphorus, DO, BOD, COD, Phenol ▪ Heavy metals ▪ Total coliforms, faecal coliforms ▪ Phyto plankton	Set of grab samples during pre and post-monsoon for ground and surface water for the whole study zone. For laboratory analysis, the samples should be preserved appropriately	Diurnal and season-wise	Samples for water quality should be collected and analyzed as per: IS: 2488 (Part 1-5) methods for sampling and testing of industrial effluents Standard methods for examination of water and waste water analysis published by American Public Health Association. International standard practices for benthos and		Parameters are defined in points of coverage for EIA studies based on water treatment technology and location-nature/ activities within the study area and nature of waste water receiving body-river, lake, coastal discharges

Attributes	Sampling		Measurement Method	Remarks	Applications to CETP Projects
	Network	**Frequency**			
▪ Zooplankton ▪ Fish & other aquatic flora & fauna ▪ (relevant parameters are to be given in points of coverage for EIA studies based on nature of project and anticipated impacts)			aquatic flora & fauna		etc. For example CETP located in coastal zone (waste water discharged through marine out-falls), the coastal water quality and health of costal flora and fauna all along coast line with extended impacted zone need to be monitored. Besides the requirements of Water Quality Model should also be addressed
For Surface Water Bodies					

Attributes	Sampling		Measurement Method	Remarks	Applications to CETP Projects
	Network	**Frequency**			
▪ Total Carbon ▪ PH ▪ Dissolved Oxygen ▪ Biological Oxygen ▪ Demand ▪ Ammonia ▪ Boron ▪ Sodium Absorption ratio ▪ Electrical Conductivity etc.	Monitoring locations should include up-stream, on site, down stream of proposed discharge point. Besides sampling should cover width of the river in case water quality modeling is proposed. Standard methodology for collection of surface water (BIS standards) At least one grab sample per location per season	Yield & impact on water sources to be measured during critical season River Stretch within project area be divided in grids (say 1 km length and 1/3 width) and samples should be from each grid at a time when the wastewater discharged by other sources of pollution is expected to be maximum	Samples for water quality should be collected and analyzed as per: IS: 2488 (Part 1-5) methods for sampling and testing of industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.	Historical data should be collected from relevant offices such as central water commission, state and central ground water board, Irrigation dept.	For two surface water (rivers and lakes) bodies besides water quality parameters as mentioned above, the location specific network design will also be guided by the model used. For rivers and lakes QUEL2E should suffice which require relatively less information even for two dimensional model applications.
Parameters for wastewater characterization					

Attributes	Sampling		Measurement Method	Remarks	Applications to CETP Projects
	Network	**Frequency**			
▪ Temp, colour, odour, turbidity, TSS, TDS, PH , alkalinity as CaCO3, p value, M value, tatal hardness as CaCO3, chloride as cl, sulphate as S04, Nitrate as NO3, Floride as F, Phosphate as P04, Chromium as Cr (Hexavalent, total) Ammonical Nitrogen as N, TKN, % sodium, BOD at 20 C, COD, DO, total residual chlorine as Cl2, oil and grease, sulphide, phenolic compound	Implant Source depending upon the different waste streams the parameters can be optimized Grab and composite sampling representing avg of different process operations as well as worst emission scenario should be represented	Different operational cycles as well as raw material variations should be reflected in the analysis	Samples for water quality should be collected and analyzed as per: IS: 2488 (Part 1-5) methods for sampling and testing of industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.	All plant sources categorized as: ▪ Different Process waste streams as well as run-off conditions ▪ ETP wastewater ▪ Domestic/ sanitary wastewater	Although waste water characteristics of CETP discharges are not very critical but still high TDS emissions may impact the aquatic biota (particularly in coastal area and lacks. For impact assessment the required water quality modeling should be performed
D. Land Environment					
▪ Soil ▪ Particle size distribution ▪ Texture ▪ pH ▪ Electrical conductivity ▪ Cation exchange capacity ▪ Alkali metals ▪ Sodium Absorption Ratio (SAR) ▪ Permeability ▪ Porosity	One surface sample from each landfill and/or hazardous waste site (if applicable) and prime villages, (soil samples be collected as per BIS specifications) in the study area	Season-wise	Collected and analyzed as per soil analysis reference book, M.I.Jackson and soil analysis reference book by C.A. Black	The purpose of impact assessment on soil (land environment) is to assess the significant impacts due to leaching of wastes or accidental releases and contaminating	

Attributes	Sampling		Measurement Method	Remarks	Applications to CETP Projects
	Network	**Frequency**			
Land use / Land Scape					
▪ Location code ▪ Total project area ▪ Topography ▪ Drainage (natural) ▪ Cultivated, forest plantations, water bodies, roads and settlements	At least 10 points along with plant boundary and general major land use categories in the study area. `	Drainage once in the study period and land use categories from secondary data (local maps) and satellite imageries	Global positioning system Topo-sheets Satellite Imageries (1:25,000) Satellite Imageries (1:25,000)	Drainage within the plant area and surrounding is very important for storm water impacts. From land use maps sensitive receptors (forests, parks, mangroves etc.) can be identified	
E. Solid Waste					
Quantity ▪ Based on waste generated from per unit production ▪ Per capita contribution ▪ Collection, transport and disposal system ▪ Process Waste ▪ Quality (oily, chemical, biological)	For green field units it is based on secondary data base of earlier plants.	Process wise or activity wise for respective raw material used. Domestic waste depends upon the season also	Guidelines IS 9569 : 1980 IS 10447 : 1983 IS 12625 : 1989 IS 12647 : 1989 IS 12662 (PTI) 1989		
Quality ▪ General segregation into biological/organic/inert/hazardous ▪ Loss on heating pH EC ▪ Calorific value, metals etc.	Grab and Composite samples	Process wise or activity wise for respective raw material used. Domestic waste depends upon the season also	Analysis IS 9334 : 1979 IS 9235 : 1979 IS 10158 : 1982		

Attributes	Sampling		Measurement Method	Remarks	Applications to CETP Projects
	Network	**Frequency**			
Hazardous Waste					
▪ Permeability And porosity ▪ Moisture pH ▪ Electrical conductivity ▪ Loss on ignition ▪ Phosphorous ▪ Total nitrogen ▪ Cation exchange capacity ▪ Particle size distribution ▪ Heavy metal ▪ Ammonia ▪ Flouride	Grab and Composite samples. Recyclable components have to analyzed for the recycling requirements	Process wise or activity wise for respective raw material used.	Analysis IS 9334 : 1979 IS 9235 : 1979 IS 10158 : 1982	Impacts of hazardous waste should be performed critically depending on the waste characteristics and place of discharge. For land disposal the guidelines should be followed and impacts of accidental releases should be assessed	
F. Biological Environment Aquatic					
▪ Primary productivity ▪ Aquatic weeds ▪ Enumeration of ▪ phytoplankton, zooplankton and benthos ▪ Fisheries ▪ Diversity indices ▪ Trophic levels ▪ Rare and endangered species ▪ Sanctuaries / closed areas / CRZ ▪ Terrestrial ▪ Vegetation – species, list, economic importance, forest produce, medicinal value	Considering probable impact, sampling points and number of samples to be decided on established guidelines on ecological studies based on site eco-environment setting within 10/25 km radius from the proposed site Samples to	Season changes are very important	Standards techniques (APHA et. Al. 1995, Rau and Wooten 1980) to be followed for sampling and measurement	Seasonal sampling for aquatic biota One season for terrestrial biota, in addition to vegetation studies during monsoon season Preliminary assessment Microscopic analysis of plankton and meiobenthos, studies of macrofauna, aquatic vegetation and application of	

Attributes	Sampling		Measurement Method	Remarks	Applications to CETP Projects
	Network	**Frequency**			
▪ Importance value index (IVI) of trees ▪ Wild animals	collect from upstream and downstream of discharge point, nearby tributaries at down stream, and also from dug wells close to activity site			indices, viz. Shannon, similarity, dominance IVI etc Point quarter plot-less method (random sampling) for terrestrial vegetation survey.	
Avifauna ▪ Rare and endangered species ▪ Sanctuaries / National park / Biosphere reserve	For forest studies, chronic as well as short-term impacts should be analyzed warranting data on micro climate conditions			Secondary data to collect from Government offices, NGOs, published literature Plankton net Sediment dredge Depth sampler Microscope Field binocular	
G. Socio Economic					
▪ Demographic structure ▪ Infrastructure resource base ▪ Economic resource base ▪ Health status: Morbidity pattern ▪ Cultural and aesthetic attributes	Socio-economic survey is based on proportionate, stratified and random sampling method	Different impacts occurs during construction and operational phases of the project	Primary data collection through R&R surveys (if require) or community survey are based on personal interviews and questionnaire	Secondary data from census records, statistical hard books, toposheets, health records and relevant official records available with Govt. agencies	

* Project Specific concerned parameters needs to be identified by the project proponent and shall be incorporated in the draft ToR, to be submitted to the Authority for the consideration and approval by the EAC/SEAC.

ANNEXURE VIII
Sources of Secondary Data

Annexure VIIA: Potential Sources of Data For EIA

	Information	Source
	Air Environment	
1.	Meteorology- Temperature, Rainfall, Humidity, Inversion, Seasonal Wind rose pattern (16 point compass scale), cloud cover, wind speed, wind direction, stability, mixing depth	⑨ Indian Meteorology Department, Pune
2.	Ambient Air Quality- 24 hourly concentration of SPM, RPM, SO_2, NO_x, CO	⑨ Central Pollution Control Board (CPCB), ⑨ State Pollution Control Board (SPCB), ⑨ Municipal Corporations ⑨ Ministry of Environment and Forests (MoEF) ⑨ State Department of Environment (DoEN)
	Water Environment	
3.	Surface water- water sources, water flow (lean season), water quality, water usage, Downstream water users Command area development plan Catchment treatment plan	⑨ Central Water Commission (CWC), ⑨ Central Pollution Control Board (CPCB), ⑨ State Pollution Control Board (SPCB), Central Water and Power Research Institute (CWPRS), Pune ⑨ State Irrigation Department ⑨ Hydel Power generation organizations such as NHPC, State SEBs
4.	Ground Water- groundwater recharge rate/withdrawal rate, ground water potential groundwater levels (pre monsoon, post monsoon), ground water quality, changes observed in quality and quantity of ground water in last 15 years	⑨ Central Ground Water Board (CGWB) ⑨ Central Ground Water Authority (CGWA) ⑨ State Ground Water Board (SGWB) ⑨ National Water Development Authority (NWDA)
5.	Coastal waters- water quality, tide and current data, bathymetry	⑨ Department of Ocean Development, New Delhi ⑨ State Maritime Boards ⑨ Naval Hydrographer's Office, Dehradun ⑨ Port Authorities ⑨ National Institute of Oceanography (NIO), Goa
	Biological Environment	
6.	Description of Biological Environment- inventory of flora and fauna in 7 km radius, endemic species, endangered species, Aquatic Fauna, Forest land, forest type and density of vegetation, biosphere, national parks, wild life sanctuaries, tiger reserve, elephant reserve, turtle nesting ground, core zone of biosphere reserve, habitat of migratory birds, routes of migratory birds	⑨ District Gazetteers ⑨ National Remote Sensing Agency (NRSA), Hyderabad ⑨ Forest Survey of India, Dehradun ⑨ Wildlife Institute of India ⑨ World Wildlife Fund ⑨ Zoological Survey of India ⑨ Botanical Survey of India ⑨ Bombay Natural History Society, (BNHS), Mumbai ⑨ State Forest Departments ⑨ State Fisheries Department ⑨ Ministry of Environment and Forests ⑨ State Agriculture Departments ⑨ State Agriculture Universities
	Land Environment	
7.	Geographical Information-Latitude, Longitude, Elevation (above MSL)	⑨ Toposheets of Survey of India, Pune ⑨ National Remote Sensing Agency (NRSA), Hyderabad ⑨ Space Application Centre (SAC), Ahmedabad

	Information	Source
8.	Nature of Terrain, topography map indicating contours (1:2500 scale)	⑨ Survey of India Toposheets ⑨ National Remote Sensing Agency (NRSA), Hyderabad ⑨ State Remote Sensing Centre, ⑨ Space Application Centre (SAC), Ahmedabad
9.	Hydrogeology- Hydrogeological report (in case of ground water is used/area is drought prone/wastewater is likely to discharged on land) Geomorphological analysis (topography and drainage pattern) Geological analysis (Geological Formations/Disturbances- geological and structural maps, geomorphological contour maps, structural features, including lineaments, fractures, faults and joints) Hydrogeological analysis (disposition of permeable formations, surface-ground water links, hydraulic parameter determination etc) Analysis of the natural soil and water to assess pollutant absorption capacity	⑨ NRSA, Hyderbad ⑨ Survey of India Toposheets ⑨ Geological Survey of India ⑨ State Geology Departments ⑨ State Irrigation Department ⑨ Department of Wasteland Development, Ministry of Rural Areas ⑨ National Water Development Authority (NWDA)
10.	Nature of Soil, permeability, erodibility classification of the land	⑨ Agriculture Universities ⑨ State Agriculture Department ⑨ Indian Council for Agriculture Research ⑨ State Soil Conservation Departments ⑨ National Bureau of Soil Survey and Landuse Planning ⑨ Central Arid Zone Research Institute (CAZRI), Jodhpur
11.	Landuse in the project area and 10 km radius of the periphery of the project	⑨ Survey of India- Toposheets ⑨ All India Soil and Landuse Survey; Delhi ⑨ National Remote Sensing Agency (NRSA), Hyderabad ⑨ Town and County Planning Organisation ⑨ State Urban Planning Department ⑨ Regional Planning Authorities (existing and proposed plans) ⑨ Village Revenue Map- District Collectorate ⑨ Directorate of Economics and Statistics-State Government ⑨ Space Application Centre, Ahmedabad
12.	Coastal Regulation Zones- CRZMP, CRZ classification, Demarcation of HTL and LTL*	⑨ Urban Development Department ⑨ State Department of Environment ⑨ State Pollution Control Board ⑨ Space Application Centre* ⑨ Centre for Earth Sciences Studies, Thiruvanthapuram* ⑨ Institute of Remote Sensing, Anna University Chennai* ⑨ Naval Hydrographer's Office, Dehradun* ⑨ National Institute of Oceanography, Goa* ⑨ National Institute of Ocean Technology, Chennai ⑨ Centre for Earth Science Studies

* *Agencies authorized for approval of demarcation of HTL and LTL*

	Information	Source
	Social	
13.	Socioeconomic - population, number of houses and present occupation pattern within 7 km from the periphery of the project	⑨ Census Department ⑨ District Gazetteers- State Government ⑨ District Statistics- District Collectorate ⑨ International Institute of Population Sciences, Mumbai (limited data) ⑨ Central Statistical Organisation
14.	Monuments and heritage sites	District Gazetteer Archeological Survey of India, INTACH District Collectorate Central and State Tourism Department State Tribal and Social Welfare Department
	Natural Disasters	
15.	Seismic data (Mining Projects)- zone no, no of earthquakes and scale, impacts on life, property existing mines	⑨ Indian Meteorology Department, Pune ⑨ Geological Survey of India
16.	Landslide prone zone, geomorphological conditions, degree of susceptibility to mass movement, major landslide history (frequency of occurrence/decade), area affected, population affected	⑨ Space Application Centre
17.	Flood/cyclone/droughts- frequency of occurrence per decade, area affected, population affected	⑨ Natural Disaster Management Division in Department of Agriculture and Cooperation ⑨ Indian Meteorological Department
	Industrial	
18.	Industrial Estates/Clusters, Growth Centres	⑨ State Industrial Corporation ⑨ Industrial Associations ⑨ State Pollution Control Boards ⑨ Confederation Indian Industries (CII) ⑨ FICCI
19.	Physical and Chemical properties of raw material and chemicals (Industrial projects); fuel quality	⑨ Material and Safety Data Sheets ⑨ ENVIS database of Industrial Toxicological Research Centre, Lucknow ⑨ Indian Institute Petroleum
20.	Occupational Health and Industrial Hygiene- major occupational health and safety hazards, health and safety requirements, accident histories	⑨ Central Labour Institute, Mumbai ⑨ Directorate of Industrial Safety ⑨ ENVIS Database of Industrial Toxicological Research Centre, Lucknow ⑨ National Institute of Occupational Health, Ahmedabad
21.	Pollutant release inventories (Existing pollution sources in area within 10 km radius)	⑨ Project proponents which have received EC and have commenced operations
22.	Water requirement (process, cooling water, DM water, Dust suppression, drinking, green belt, fire service)	⑨ EIA Reports ⑨ National and International Benchmarks

Annexure VIIB: Summary of Available Data with Potential Data Sources for EIA

	Agency	Information Available
1.	Archaeological Survey of India Department of Culture Government of India Janpath, New Delhi - 110011 Asi@del3.vsnl.net.in	⑨ Inventory of monuments and sites of national importance- Listing and documentation of monuments according to world heritage, pre historic, proto historic and secular, religious places and forts
2.	Botanical Survey Of India P-8, Brabourne Road Calcutta 700001 Tel#033 2424922 Fax#033 2429330 Email: envis@cal2.vsnl.net.in. . RO - Coimbatore, Pune, Jodhpur, Dehradun, Allahabad, Gantok, Itanagar, Port Blair	⑨ Photodiversity documentation of flora at National, State and District level and flora of protected areas, hotspots, fragile ecosystems, sacred groves etc ⑨ Identification of threatened species including endemics, their mapping, population studies ⑨ Database related to medicinal plants, rare and threatened plant species ⑨ Red data book of Indian plants (Vol 1,2, and 3) ⑨ Manual for roadside and avenue plantation in India
3.	Bureau of Indian Standards Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002 Tel#3230131, 3233375, 3239402 (10 lines) Fax : 91 11 3234062, 3239399, 3239382 Email- bis@vsnal.com	⑨ Bureau of Indian Standards Committees on Earthquake Engineering and Wind Engineering have a Seismic Zoning Map and the Wind Velocity Map including cyclonic winds for the country
4.	Central Water Commission (CWC) Sewa Bhawan, R.K.Puram New Delhi - 110066 cmanoff@niccwc.delhi.nic.in RO- Bangalore, Bhopal, Bhubaneshwar, Chandigarh, Coimbatore/Chennai, Delhi, Hyderabad, Lucknow, Nagpur, Patna, Shillong, Siliguri and Vadodara	⑨ Central Data Bank -Collection, collation and Publishing of Hydrological, Hydrometeorological, Sediment and Water Quality data-. ⑨ Basin wise Master Plans ⑨ Flood atlas for India ⑨ Flood Management and Development and Operation of Flood Forecasting System- CWC operate a network of forecasting stations Over 6000 forecasts are issued every year with about 95% of the forecasts within the permissible limit. ⑨ Water Year Books, Sediment Year Books and Water Quality Year Books. ⑨ Also actively involved in monitoring of 84 identified projects through National, State and Project level Environmental Committees for ensuring implementation of environmental safeguards
5.	Central Ground Water Board (HO) N.H.IV, New CGO Complex, Faridabad - 121001 RO - Guwahati, Chandigarh, Ahemadabad, Trivandrum, Calcutta, Bhopal, Lucknow, Banglore, Nagpur, Jammu, Bhubneshwar, Raipur, Jaipur, Chennai, Hyderabad, Patna	⑨ surveys, exploration, monitoring of ground water development

[16] *Based on web search and literature review*

6.	Central Pollution Control Board Parivesh Bhawan, CBD-cum-Office Complex East Arjun Nagar, DELHI - 110 032 INDIA E-mail : cpcb@alpha.nic.in	⑨ National Air Quality Monitoring Programme ⑨ National River Water Quality Monitoring Programme- Global Environment Monitoring , MINARS ⑨ Zoning Atlas Programme ⑨ Information on 17 polluting category industries (inventory, category wise distribution, compliance, implementation of pollution control programmes
7.	Central Arid Zone Research Institute, Jodhpur Email : cazri@x400.nicgw.nic.in Regional Centre at Bhuj in Gujarat	⑨ AGRIS database on all aspects of agriculture from 1975 to date ⑨ Also have cell on Agriculture Research Information System; ⑨ Working on ENVIS project on desertification ⑨ Repository of information on the state of natural resources and desertification processes and their control ⑨ The spectrum of activities involves researches on basic resource inventories; monitoring of desertification, rehabilitation and management of degraded lands and other areas
8.	Central Inland Capture Fisheries Research Institute, Barrackpore-743101, Tel#033-5600177 Fax#033-5600388 Email : cicfri@x400.nicgw.nic.in	⑨ Data Base on Ecology and fisheries of major river systems of India. Biological features of commercially important riverine and estuarine fish species. Production functions and their interactions in floodplain wetlands. ⑨ Activities - Environmental Impact Assessment for Resource Management ; Fisheries Resource surveys
9.	Central Institute of Brackish Water Aquaculture 141, Marshalls Road, Egmore , Chennai - 600 008, Tel# 044-8554866, 8554891, Director (Per) 8554851 Fax#8554851,	⑨ Repository of information on brackish water fishery resources with systematic database of coastal fishery resources for ARIS ⑨ Agricultural Research Information System (ARIS) database covers State wise data on soil and water quality parameters, land use pattern, production and productivity trends, ⑨ Social, economic and environmental impacts of aquaculture farming, ⑨ Guidelines and effluent standards for aquaculture farming
10.	Central Marine Fisheries Research Institute (CMFRI), Cochin	⑨ Assessing and monitoring of exploited and un-exploited fish stocks in Indian EEZ ⑨ Monitoring the health of the coastal ecosystems, particularly the endangered ecosystems in relation to artisanal fishing, mechanised fishing and marine pollution ⑨ The institute has been collecting data on the catch and effort and biological characteristics for nearly half a century based on scientifically developed sampling scheme, covering all the maritime States of the country ⑨ The voluminous data available with the institute is managed by the National Marine Living Resources Data Centre (NMLRDC)
11.	Central Water and Power Research Station, Pune Tel#020-4391801-14; 4392511; 4392825 Fax #020-4392004,4390189	⑨ Numerical and Physical models for hydro-dynamic simulations
12.	Central Institute of Road Transport, Bhosari, Pune 411 026, India. Tel : +91 (20) 7125177, 7125292, 7125493, 7125494	⑨ Repository of data on all aspects of performance of STUs and a host of other related road transport parameters

13.	Department of Ocean Development	⑨ Assessment of environment parameters and marine living resources (primary and secondary) in Indian EEZ (Nodal Agency NIO Kochi) ⑨ Stock assessment, biology and resource mapping of deep sea shrimps, lobsters and fishes in Indian EEZ (Nodal agency-Fisheries Survey of India) ⑨ Investigations of toxical algal blooms and benthic productivity in Indian EEZ (Nodal agency- Cochin University of Science and technology) ⑨ Coastal Ocean Monitoring and Prediction System (COMAP) - monitoring and modelling of marine pollution along entire Indian coast and islands. Parameters monitored are temp, salinity, DO, pH, SS, BOD, inorganic phosphate, nitrate, nitrite, ammonia, total phosphorus, total nitrite, total organic carbon, petroleum hydrocarbons, pathogenic vibros, pathogenic E.coli, shigella, salmonella, heavy metals (Cd, Hg, Pb) and pesticide residues (DDT, BHC, Endosulfan). Monitoring is carried out along the ecologically sensitive zones and urban areas (NIO Mumbai- Apex coordinating agency). ⑨ Sea Level Measurement Programe (SELMAM)- sea level measurement at selected stations (Porbandar, Bombay, Goa, Cochin, Tuticorin, Madras, Machilipatnam, Visakhapatnam, Paradeep, Calcutta and Kavaratti (Lakshadweep Island)) along Indian coast and islands using modern tide gauges ⑨ Detailed coastal maps through Survey of India showing contour at 1/2 a metre interval in the scale of 1:25000. (Nellore- Machhalipatnam work already over) ⑨ Marine Data Centre (MDC) IMD for Ocean surface meteorology, GSI for marine geology, SOI for tide levels, Naval Hydrographic Office for bathymetry, NIO Goa for physical chemical and biological oceanography, NIO Mumbai for marine pollution, CMFRI for coastal fisheries, Institute of Ocean Management Madras for coastal geomorphology ⑨ DOD has setup Indian National Centre for Ocean Information Services (INCOIS) at Hyderabad for generation and dissemination of ocean data products (near real time data products such as sea surface temperature, potential fishing zones, upwelling zones, maps, eddies, chlorophyll, suspended sediment load etc). MDC will be integrated with INCOIS ⑨ Integrated Coastal and Marine Area Management (ICMAM) programme - GIS based information system for management of 11 critical habitats namely Pichavaram, Karwar, Gulf of Mannar, Gulf of Khambat, Gulf of Kutch, Malvan, Cochin, Coringa mangroves, Gahirmata, Sunderbans and Kadamat (Lakshadeep) ⑨ Wetland maps for Tamil Nadu and Kerala showing the locations of lagoons, backwaters, estuaries, mudflats etc (1:50000 scale) ⑨ Coral Reef Maps for Gulf of Kachch, Gulf of Mannar, Andaman and Nicobar and Lakshadeep Islands (1:50,000 scale) indicating the condition of corals, density etc
14.	Environment Protection Training and Research Institute Gachibowli, Hyderabad - 500 019, India Phone: +91-40-3001241, 3001242, 3000489 Fax: +91-40- 3000361 E-mail: info@eptri.com	⑨ Environment Information Centre- has appointed EPTRI as the Distributed Information Centre for the Eastern Ghats region of India. EIC Collaborates with the Stockholm Environment Institute Sweden Database on Economics of Industrial Pollution Prevention in India Database of Large and Medium Scale Industries of Andhra Pradesh Environmental Status of the Hyderabad Urban Agglomeration Study on 'water pollution-health linkages' for a few Districts of A.P

		⑨ Environment Quality Mapping Macro level studies for six districts in the State of Andhra Pradesh Micro level studies for two study zones presenting the permissible pollutant load and scoping for new industrial categories Zonation of the IDA, Parwada which helped APIIC to promote the land for industrial development Disaster management plan for Visakhapatnam Industrial Bowl Area
15.	Forest Survey of India (FSI) Kaulagarh Road, P.O., IPE Dehradun - 248 195 Tel# 0135-756139, 755037, 754507 Fax # 91-135-759104 E-Mail : fsidir@nde.vsnl.net.in fsihq@nde.vsnl.net.in RO- Banglore, Calcutta, Nagpur and Shimla	⑨ State of Forest Report (Biannual) ⑨ National Forest Vegetation Map (Biannual exercise) (on 1: 1 million scale) ⑨ Thematic mapping on 1:50,000 scale depicting the forest type, species composition, crown density of forest cover and other landuse National ⑨ Basic Forest Inventory System ⑨ Inventory survey of non forest area ⑨ Forest inventory report providing details of area estimates, topographic description, health of forest, ownership pattern, estimation of volume and other growth parameters such as height and diameter in different types of forest, estimation of growth, regeneration and mortality of important species, volume equation and wood consumption of the area studied
16.	Geological Survey of India 27 Jawaharlal Nehru Road, Calcutta 700 016, India Telephone +91-33-2496941 FAX 91-33-2496956 gsi_chq@vsnl.com	⑨ Environmental hazards zonation mapping in mineral sector ⑨ Codification of base line information of geo-environmental appreciation of any terrain and related EIA and EMP studies ⑨ Lineament and geomorphological map of India on 1:20,000 scale. ⑨ Photo-interpreted geological and structural maps of terrains with limited field checks.
17.	Indian Council of Agriculture Research, Krishi Bhawan, New Delhi, Tel#011-338206 – ICAR complex, Goa- Agro metrology – Central Arid Zone Research Institute- Agro forestry – Central Soil salinity Research Institute, – Indian Institute of Soil Science – Central Soil and Water Conservation Research and Training Institute – National Bureau of Soil Survey and Landuse Planning	⑨ A total of 80,000 profiles at 10 kms grid across the country were analyzed to characterize the soils of India. ⑨ Detailed soil maps of the Country (1:7 million), State (1:250,000) and districts map (1:50,000) depicting extent of degradation (1:4.4 millions) have been prepared. ⑨ Thematic maps depicting soil depth, texture drainage, calcareousness, salinity, pH, slope and erosion have been published ⑨ Agro-climate characterization of the country based on moisture, thermal and sunshine regimes ⑨ Agro-ecological zones (20) and sub-zones (60) for the country were delineated based on physiography, soils, climate, Length of Growing Period and Available Water Content, and mapped on 1:4.4 million scale. ⑨ Digitization of physiography and soil resource base on 1:50,000 scale for 14 States have been completed. ⑨ .Soil fertility maps of N,P,K,S and Zn have also been developed ⑨ Water quality guidelines for irrigation and naturally occurring saline/sodic water ⑨ Calibration and verification of ground water models for predicting water logging and salinity hazards in irrigation commands
18.	Indian Bureau of Mines Indira Bhawan, Civil Lines Nagpur Ph no - 0712-533 631, Fax- 0712-533 041	⑨ National mineral inventory for 61 minerals and mineral maps ⑨ Studies on environmental protection and pollution control in regard to the mining and mineral beneficiation operations ⑨ Collection, processing and storage of data on mines, minerals and mineral-based industries, collection and maintenance of world mineral intelligence, foreign mineral legislation and other related matters

19.	Indian Meteorology Department Shivaji nagar, Pune 41100 RO- Mumbai, Chennai, Calcutta, New Delhi, Nagpur, Guwahati	⑨ Meteorological data ⑨ Background air quality monitoring network under Global Atmospheric Watch Programme (operates 10 stations) ⑨ Seismicity map, seismic zoning map; seismic occurrences and cyclone hazard monitoring; list of major earthquakes ⑨ Climatological Atlas of India , Rainfall Atlas of India and Agroclimatic Atlas of India ⑨ Monthly bulletin of Climate Diagnostic Bulletin of India ⑨ Environmental Meteorological Unit of IMD at Delhi to provide specific services to MoEF
20.	INTACH Natural Heritage, 71 Lodi Estate, New Delhi-110 003 Tel. 91-11-4645482, 4632267/9, 4631818, 4692774, 4641304 Fax : 91-11-4611290 E-mail : nh@intach.net	⑨ Listing and documentation of heritage sites identified by municipalities and local bodies (Listing excludes sites and buildings under the purview of the Archaeological Survey of India and the State Departments of Archaeology)
21.	Industrial Toxicology Research Centre Post Box No. 80, Mahatma Gandhi Marg, Lucknow-226001, Phone: +91-522-221856,213618,228227; Fax : +91-522 228227 Email: itrc@itrcindia.org	⑨ Activities include health survey on occupational diseases in industrial workers, air and water quality monitoring studies, ecotoxicological impact assessment, toxicity of chemicals, human health risk assessment ⑨ Five databases on CD-ROM in the area of environmental toxicology viz: TOXLINE, CHEMBANK, POISINDEX, POLTOX and PESTBANK. The Toxicology Information Centre provides information on toxic chemicals including household chemicals ⑨ ENVIS centre and created a full-fledged computerized database (DABTOC) on toxicity profiles of about 450 chemicals
22.	Indian Institute of Forest Management Post Box No. 357, Nehru Nagar Bhopal - 462 003 Phone # 0755-575716, 573799, 765125, 767851 Fax # 0755-572878	⑨ Consultancy and research on joint forest management (Ford Foundation, SIDA, GTZ, FAO etc)
23.	Indian Institute of Petroleum Mohkampur , Dehradun, India, 248005 0135- 660113 to 116 0135- 671986	⑨ Fuel quality characterisation ⑨ Emission factors
24.	Ministry of Environment and Forest	⑨ Survey of natural resources ⑨ National river conservation directorate ⑨ Environmental research programme for eastern and western ghats ⑨ National natural resource management system ⑨ Wetlands conservation programme- survey, demarcation, mapping landscape planning, hydrology for 20 identified wetlands National ⑨ wasteland identification programme
25.	Mumbai Metropolitan Regional Development Authority	⑨ Mumbai Urban Transport Project ⑨ Mumbai Urban Development Project ⑨ Mumbai Urban Rehabilitation Project ⑨ Information on MMR; statistics on councils and corporations Regional ⑨ Information Centre- Basic data on population, employment, industries and other sectors are regularly collected and processed

26.	Municipal Corporation of Greater Mumbai	⑨ Air Quality Data for Mumbai Municipal Area ⑨ Water quality of lakes used for water supply to Mumbai
27.	Ministry of Urban Development Disaster Mitigation and Vulnerability Atlas of India Building Materials & Technology Promotion Council G-Wing,Nirman Bhavan, New Delhi-110011 Tel: 91-11-3019367 Fax: 91-11-3010145 E-Mail: bmtpc@del2.vsnl.net.in	⑨ Identification of hazard prone area ⑨ Vulnerability Atlas showing areas vulnerable to natural disasters ⑨ Land-use zoning and design guidelines for improving hazard resistant construction of buildings and housing ⑨ State wise hazard maps (on cyclone, floods and earthquakes)
28.	Natural Disaster Management Division in Department of Agriculture and Cooperation	⑨ Weekly situation reports on recent disasters, reports on droughts, floods, cyclones and earthquakes
29.	National Bureau Of Soil Survey & Land Use Planning P.O. Box No. 426, Shankar Nagar P.O., Nagpur-440010 Tel#91-712-534664,532438,534545 Fax#:91-712-522534 RO- Nagpur, New Delhi, Banglore, Calcutta, Jorhat, Udaipur	⑨ NBSS&LUP Library has been identified as sub centre of ARIC (ICAR) for input to AGRIS covering soil science literature generated in India ⑨ Research in weathering and soil formation, soil morphology, soil mineralogy, physicochemical characterisation, pedogenesis, and landscape-climate-soil relationship. ⑨ Soil Series of India- The soils are classified as per Soil Taxonomy. The described soil series now belong to 17 States of the country. ⑨ Landuse planning- watershed management, land evaluation criteria, crop efficiency zoning ⑨ Soil Information system is developed state-wise at 1:250,000 scale. Presently the soil maps of all the States are digitized, processed and designed for final output both digital and hardcopy. The thematic layers and interpreted layers of land evaluation (land capability, land irrigability and crop suitability), Agro-Ecological Zones and soil degradation themes are prepared. ⑨ Districts level information system is developed for about 15 districts at 1: 50, 000 scale. The soil information will be at soil series level in this system. Soil resource inventory of States, districts water-sheds (1:250,000; 1:50,000; 1:10,000/8000)
30.	National Institute of Ocean Technology, Velacherry-Tambaram main road Narayanapuram Chennai, Tamil Nadu Tel#91-44-2460063 / 2460064/ 2460066/ 2460067 Fax#91-44-2460645	⑨ Waste load allocation in selected estuaries (Tapi estuary and Ennore creek) is one the components under the Integrated Coastal and Marine Area Management (ICMAM) programme of the Department of Ocean Development ICMAM is conducted with an IDA based credit to the Government of India under the Environmental Capacity Building project of MoEF (waste assimilation capacity of Ennore creek is over) ⑨ Physical oceanographic component of Coastal & Ocean monitoring Predictive System (COMAPS) a long term monitoring program under the Department of Ocean Development ⑨ Identification of suitable locations for disposal of dredge spoil using mathematical models & environmental criteria ⑨ EIA Manual and EIA guidelines for port and harbour projects
31.	National Institute of Oceanography, Goa RO- Mumbai, Kochi	⑨ Coastal Ocean Monitoring and Predictions(COMAP)-Monitoring of coastal waters for physicochemical and biological parameters including petroleum hydrocarbons, trace metals, heavy metals, and biomass of primary (phytoplankton) and secondary (zooplankton, microbial and benthic organisms) ⑨ Marine Biodiversity of selected ecosystem along the West Coast of India

32.	National Botanical Research Institute, Post Box No 436 Rana Pratap Marg Lucknow- 226001, Tel: (+91) 522 271031-35 Fax: (+91) 522 282849, 282881 Lucknow	⑨ Dust filtering potential of common avenue trees and roadside shrubs has been determined, besides studies have also been conducted on heavy-metals accumulation potential of aquatic plants supposedly useful as indicators of heavy metal pollution in water bodies and capable of reducing the toxic metals from water bodies. ⑨ Assessment of bio-diversity of various regions of India
33.	National Geophysical Research Institute, Uppal Road, Hyderabad Telephone:0091-40-7171124, FAX:0091-40-7171564	⑨ Exploration, assessment and management of ground water resources including ground water modelling and pollution studies
34.	National Environmental Engineering Research Institute, Nagpur RO- Mumbai, Delhi, Chennai, Calcutta, Ahmedabad, Cochin, Hyderabad, Kanpur	⑨ National Air Quality Monitoring (NAQM) for CPCB ⑨ Database on cleaner technologies of industrial productions
35.	National Hydrology Institute, Roorkee RO- Belgaum (Hard Rock Regional Centre), Jammu (Western Himalayan Regional Centre), Guwahati (North Eastern Regional Centre), Kakinada (Deltaic Regional Centre), Patna (Ganga Plains North Regional Centre), and Sagar (Ganga Plains South)	⑨ Basin studies, hydrometeorological network improvement, hydrological year book, hydrological modelling, regional flood formulae, reservoir sedimentation studies, environmental hydrology, watershed development studies, tank studies, and drought studies.
36.	National Institute Of Urban Affairs, India Habitat Centre, New Delhi	⑨ Urban Statistics Handbook
37.	National Institute of Occupational Health Meghaninagar, Ahmedabad RO- Banglore, Calcutta	⑨ epidemiological studies and surveillance of hazardous occupations including air pollution, noise pollution, agricultural hazards, industrial hazards in organised sectors as well as small scale industries, carcinogenesis, pesticide toxicology, etc ⑨ WHO collaborative centre for occupational health for South East Asia region and the lead institute for the international programme on chemical safety under IPCS (WHO)
38.	NRSA Data Centre Department of Space, Balanagar, Hyderabad 500 037 Ph- 040-3078560 3078664 sales@nrsa.gov.in	⑨ Satellite data products (raw data, partially processed (radiometrically corrected but geometrically uncorrected), standard data (radiometrically and geometrically corrected), geocoded data(1:50,000 and 1:25000 scale), special data products like mosaiced, merged and extracted) available on photographic (B?W and FCC in form of film of 240 mm X 240mm or enlargements/paper prints in scale varying between 1:1M and 1:12500 and size varying between 240mm and 1000mm) and digital media (CD-ROMs, 8 mm tapes)
39.	Rajiv Gandhi National Drinking Water Mission	⑨ Database for groundwater using remote sensing technology (Regional Remote Sensing Service Centre involved in generation of ground water prospect maps at 1:50,000 scale for the State of Kerala, Karnataka, AP, MP and Rajasthan for RGNDWM)
40.	Space Application Centre Value Added Services Cell (VASC) Remote Sensing Application Area Ahmedabad 380 053 079-676 1188	⑨ National Natural Resource Information System ⑨ Landuse mapping for coastal regulation zone (construction setback line) upto 1:12500 scale ⑨ Inventory of coastal wetlands, coral reefs, mangroves, seaweeds ⑨ Monitoring and condition assessment of protected coastal areas

	Fax- 079-6762735	⑨ Wetland mapping and inventory ⑨ Mapping of potential hotspots and zoning of environmental hazards ⑨ General geological and geomorphological mapping in diverse terrain ⑨ Landslide risk zonation for Tehre area
41.	State Pollution Control Board	⑨ State Air Quality Monitoring Programme ⑨ Inventory of polluting industries ⑨ Identification and authorization of hazardous waste generating industries ⑨ Inventory of biomedical waste generating industries ⑨ Water quality monitoring of water bodies receiving wastewater discharges ⑨ Inventory of air polluting industries ⑨ Industrial air pollution monitoring ⑨ Air consent, water consent, authorization, environment monitoring reports
42.	State Ground Water Board	
43.	Survey of India	⑨ Topographical surveys on 1:250,000 scales, 1:50,000 and 1:25,000 scales ⑨ Digital Cartographical Data Base of topographical maps on scales 1:250,000 and 1:50,000 ⑨ Data generation and its processing for redefinition of Indian Geodetic Datum ⑨ Maintenance of National Tidal Data Centre and receiving/ processing of tidal data of various ports. ⑨ Coastal mapping along the Eastern coast line has been in progress to study the effect of submergence due to rise in sea-level and other natural phenomenon. Ground surveys have been completed for the proposed coastal region and maps are under printing. ⑨ District planning maps containing thematic information (135 maps) have been printed out of 249 maps covering half the districts of India. Districts planning maps for remaining half of the area are being processed by National Atlas and Thematic Mapping Organisation (NATMO)
44.	Town and Country Planning Organisation	⑨ Urban mapping - Thematic maps and graphic database on towns (under progress in association with NRSA and State town planning department)
45.	Wildlife Institute of India Post Bag No. 18, Chandrabani Dehradun - 248 001, Uttaranchal Tel#0135 640111 -15, Fax#0135 640117 email : wii@wii .	⑨ Provide information and advice on specific wildlife management problems. ⑨ National Wildlife Database
46.	Zoological Survey of India Prani Vigyan Bhawan 'M' Block, New Alipore Calcutta - 700 053 Phone # 91-33-4786893, 4783383 Fax # 91-33-786893 RO - Shillong, Pune, Dehradun, Jabalpur, Jodhpur, Chennai, Patna, Hyderabad, Canning, Behrampur, Kozikode, Itanagar, Digha, Port Bliar, Solan	⑨ Red Book for listing of endemic species ⑨ Survey of faunal resources

ANNEXURE IX
Impact Prediction Tools

Table 1: Choice of Models for Impact Modeling: Noise Environment *

Model	Application
FHWA (Federal Highway Administration)	Noise Impact due to vehicular movement on highways
Dhwani	For predictions of impact due to group of noise sources in the industrial complex (multiple sound sources)
Hemispherical sound wave propagation Air Port	Fore predictive impact due to single noise source For predictive impact of traffic on airport and rail road

Table 2: Choice of Methods for Impact Modeling: Land Environment *

Model	Application	Remarks
Digital Analysis Techniques	Provides land use / land cover distribution	
Ranking analysis for soil suitability criteria	Provides suitability criteria for developmental conversation activities	Various parameters viz. depth, texture, slope, erosion status, geomorphology, flooding hazards, GW potential, land use etc. are used.

Table 3: Choice of Models for Impact Modeling: Water Environment *

Model	Application	Remarks
QUAL-II E	Wind effect is insignificant, vertical dispersive effects insignificant applicable to streams Data required Deoxygenation coefficients, re-aeration coefficients for carbonaceous, nitrogenous and benthic substances, dissolved oxygen deficit	Steady state or dynamic model
	The model is found excellent to generate water quality parameters Photosynthetic and respiration rate of suspended and attached algae	
	Parameters measured up to 15 component can be simulated in any combination, e.g. ammonia, nitrite, nitrate, phosphorous, carbonaceous BOD, benthic oxygen demand, DO, coliforms, conservative substances and temperature	
DOSAG-3, USEPA: (1-D) RECEIV – II, USEPA	Water quality simulation model for streams & canal A general Water quality model	Steady-state
Explore –I, USEPA	A river basin water quality model	Dynamic, Simple

Model	Application	Remarks
		hydrodynamics
HSPE, USEPA	Hydrologic simulation model	Dynamic, Simple hydrodynamics
RECEIVE-II, USEPA	A general dynamic planning model for water quality management	
Stanford watershed model	This model simulates stream flows once historic precipitation data are supplied The major components of the hydrologic cycle are modeled including interception, surface detention, overland inflow, groundwater, evapo-transpiration and routing of channel flows, temperature, TDS, DO, carbonaceous BOD coliforms, algae, zooplanktons, nitrite, nitrate, ammonia, phosphate and conservative substances can be simulated	
Hydrocomp model	Long-term meteorological and wastewater characterization data is used to simulate stream flows and stream water quality	Time dependant (Dynamic)
Stormwater Management model (SWMM)	Runoff is modeled from overland flow, through surface channels, and through sewer network Both combined and separate sewers can be modeled. This model also enables to simulate water quality effects to stormwater or combined sewer discharges. This model simulates runoff resulting from individual rainfall events.	Time Dependent
Battelle Reservoir model	Water body is divided into segments along the direction of the flow and each segment is divided into number of horizontal layers. The model is found to generate excellent simulation of temperature and good prediction of water quality parameters. The model simulates temperature, DO, total and benthic BOD, phytoplankton, zooplankton, organic and inorganic nitrogen, phosphorous, coliform bacteria, toxic substances and hydrodynamic conditions.	Two Dimensional multi-segment model
TIDEP (Turbulent diffusion temperature model reservoirs)	Horizontal temperature homogeneity Coefficient of vertical turbulent diffusion constant for charge of area with depth negligible coefficient of thermal exchange constant Data required wind speed, air temperature, air humidity, net incoming radiation, surface water temperature, heat exchange coefficients and vertical turbulent diffusion coefficients.	Steady state model
BIOLAKE	Model estimates potential fish harvest from a take	Steady state model
Estuary models/ estuarial Dynamic model	It is simulates tides, currents, and discharge in shallow, vertically mixed estuaries excited by ocean tides, hydrologic influx, and wind action Tides, currents in estuary are simulated	Dynamic model

Model	Application	Remarks
Dynamic Water Quality Model	It simulates the mass transport of either conservative or non-conservative quality constituents utilizing information derived from the hydrodynamic model Bay-Delta model is the programme generally used. Up to 10 independent quality parameters of either conservative or non-conservative type plus the BOD-DO coupled relationship can be handled	Dynamic model
HEC -2	To compute water surface profiles for stead7y, gradually: varying flow in both prismatic & non-prismatic channels	
SMS	Lake circulation, salt water intrusion, surface water profile simulation model	Surface water Modeling system Hydrodynamic model
RMA2	To compute flow velocities and water surface elevations	Hydrodynamic analysis model
RMA4	Solves advective-diffusion equations to model up to six non-interacting constituents	Constituent transport model
SED2D-WES	Model simulates transport of sediment	Sediment transport model
HIVEL2D	Model supports subcritical and supercritical flow analysis	A 2-dimensional hydrodynamic model
MIKE-II, DHI	Model supports, simulations of flows, water quality, and sediment transport in estuaries, rives, irrigation systems, channels & other water bodies	Professional Engineering software package

Table 4: Choice of Methods for Impact Modeling: Biological Environment *

Name	Relevance	Applications	Remarks
Flora			
Sample plot methods	Density and relative density Density and relative dominance	Average number of individuals species per unit area Relative degree to which a species predominates a community by its sheer numbers, size bulk or biomass	The quadrant sampling technique is applicable in all types of plant communities and for the study of submerged, sessile (attached at the base) or sedentary plants
	Frequency and relative frequency importance value	Plant dispersion over an area or within a community	Commonly accepted plot size: 0.1 m^2- mosses, lichens & other mat-like plants
		Average of relative density, relative dominance and relative frequency	0.1 m^2- herbaceous vegetation including grasses

Name	Relevance	Applications	Remarks
			10.20 m^2 – for shrubs and saplings up to 3m tall, and
			100 m^2 – for tree communities
Transects & line intercepts methods	Cover	Ratio of total amount of line intercepted by each species and total length of the line intercept given its cover	This methods allows for rapid assessment of vegetation transition zones, and requires minimum time or equipment of establish
	Relative dominance	It is the ratio of total individuals of a species and total individuals of all species	Two or more vegetation strata can be sampled simultaneously
Plot-less sampling methods	Mean point plant Mean area per plant	Mean point – plant distance Mean area per plant	Vegetation measurements are determined from points rather than being determined in an area with boundaries
	Density and relative density		Method is used in grass-land and open shrub and tree communities
	Dominance and relative dominance		It allows more rapid and extensive sampling than the plot method
	Importance value		Point- quarter method is commonly used in woods and forests.
Fauna			
Species list methods	Animal species list	List of animal communities observed directly	Animal species lists present common and scientific names of the species involved so that the faunal resources of the area are catalogued
Direct Contact Methods	Animal species list	List of animals communities observed directly	This method involves collection, study and release of animals
Count indices methods (Roadside and aerial count methods)	Drive counts Temporal counts	Observation of animals by driving them past trained observers	Count indices provide estimates of animal populations and are obtained from signs, calls or trailside counts or roadside counts
	Call counts	Count of all animals passing a fixed point during some stated interval of time	These estimates, through they do not provide absolute population numbers, Provide an index of the various species in an area
			Such indices allow comparisons through the seasons or between sites or habitats
Removal methods	Population size	Number of species captured	Removal methods are used to obtain population estimates of small

Name	Relevance	Applications	Remarks
			mammals, such as, rodents through baited snap traps
Market capture methods	Population size estimate (M)	Number of species originally marked (T) Number of marked animals recaptured (t) and total number of animals captured during census (n) N = nT/t	It involves capturing a portion of the population and at some later date sampling the ratio of marked to total animals caught in the population

Table 5: Choice of Methods for Impact Predictions: Socio-economic Aspects *

Relevance		
Name	**Application**	**Remarks**
Extrapolative Methods	A prediction is made that is consistent with past and present socio-economic data, e.g. a prediction based on the linear extrapolation of current trends	
Intuitive Forecasting (Delphi techniques)	Delphi technique is used to determine environmental priorities and also to make intuitive predictions through the process of achieving group consensus	Conjecture Brainstorming Heuristic programming Delphi consensus
Trend extrapolation and correlation	Predictions may be obtained by extrapolating present trends Not an accurate method of making socio-economic forecasts, because a time series cannot be interpreted or extrapolated very far into the future with out some knowledge of the underlying physical, biological, and social factors	Trend breakthrough precursor events correlation and regression
Metaphors and analogies	The experience gained else where is used to predict the socio-economic impacts	Growth historical simulation commonsense forecasts
Scenarios	Scenarios are common-sense forecasts of data. Each scenario is logically constructed on model of a potential future for which the degrees of "confidence" as to progression and outcome remain undefined	Common-sense
Dynamic modeling (Input-Out model)	Model predicts net economic gain to the society after considering all inputs required for conversion of raw materials along with cost of finished product	
Normative Methods	Desired socio-economic goals are specified and an attempt is made to project the social environment backward in time to the present to examine whether existing or planned resources and environmental programmes are adequate to meet the goals	Morphological analysis technology scanning contextual mapping - functional array - graphic method Mission networks and functional arrays decision

Relevance		
Name	**Application**	**Remarks**
		trees & relevance trees matrix methods scenarios

*** NOTE**: (i) If a project proponent prefer to use any model other than listed, can do so, with prior concurrence of concerned appraisal committee. (ii) Project-specific proposed prediction tools need to be identified by the project proponent and shall be incorporated in the draft ToR to be submitted to the Authority for the consideration and approval by the concerned EAC/SEAC.

ANNEXURE X

Form through which the State Governments/Administration of the Union Territories Submit Nominations for SEIAA and SEAC for the Consideration and Notification by the Central Government

Form for Nomination of a professional/expert as Chairperson / Member / Secretary of the SEIAA / EAC / SEAC						
1	Name (in block letters)					
2	Address for communication					
3	Age & Date of Birth (Shall be less than 67 years for the members and 72 years for the Chairman)					
4	Area of Expertise (As per Appendix VI)					
5	Professional Qualifications (As per Appendix VI)	Qualification(s)		University	Year of passing	Percentage of marks
6	Work experience (High light relevant experience as per Appendix VI)	Position	Years of association			Nature of work. If required, attach separate sheets
			From	to	Period in years	
7	Present position and nature of job	Serving Central / State Government Office?			Yes/No	
		Engaged in industry or their associations?			Yes/No	
		Associated with environmental activism?			Yes/No	
		If no is the answer for above three, please specify the present position and name of the organization				
8	Whether experienced in the process of prior environmental clearance?	Yes/No. If yes, please specify the experience in a separate sheet (Please restrict to 500 words)				
9	Whether any out-standing expertise has been acquired?	Yes/ No If yes, please provide details in a separate sheet (Please restrict to 500 words).				
10	Any other relevant information?	May like to attach separate sheets (Research projects, consultancy projects, publications, memberships in associations, trainings undergone, international exposure cum experience etc.)				

The Government of……is pleased to forward the Nomination of Dr./Sh. ……..…. for the position of Chairperson / Member / Secretary of the SEIAA / SEAC / EAC to the Ministry of Environment & Forests, the Government of India for the Notification.

(Authorized Signature with Seal)

ANNEXURE XI
Composition of EAC/SEAC

Composition of the EAC/SEAC

The Members of the EAC shall be Experts with the requisite expertise and experience in the following fields /disciplines. In the event that persons fulfilling the criteria of "Experts" are not available, Professionals in the same field with sufficient experience may be considered:

- Environment Quality Experts: Experts in measurement/monitoring, analysis and interpretation of data in relation to environmental quality
- Sectoral Experts in Project Management: Experts in Project Management or Management of Process/Operations/Facilities in the relevant sectors.
- Environmental Impact Assessment Process Experts: Experts in conducting and carrying out Environmental Impact Assessments (EIAs) and preparation of Environmental Management Plans (EMPs) and other Management plans and who have wide expertise and knowledge of predictive techniques and tools used in the EIA process
- Risk Assessment Experts
- Life Science Experts in floral and faunal management
- Forestry and Wildlife Experts
- Environmental Economics Expert with experience in project appraisal

ANNEXURE XII

Best Practices & Latest Technologies available and reference

Best Practices & Latest Technologies available and reference

A worldwide trend toward acceptance of the concept of reuse is currently observable, as water shortages have intensified. This has led to an increase in the use of dual water systems52 and satellite reclamation systems.53 At the same time, however, potential microbial and chemical water contamination, especially from new trace contaminants, has become a growing source of concern, and consequently direct potable reuse of reclaimed water is likely to remain impracticable.

In response to these increasing concerns, new technologies offering significantly higher removal rates are being designed and implemented. These technologies include pressure-driven membranes, carbon adsorption, advanced oxidation, ion exchange and air stripping systems. Membrane technologies, which were formerly restricted to water desalination applications, are now being tested for the production of high quality water for indirect potable reuse, and are expected to become the predominant treatment technologies in the near future.

In the field of sludge reclamation and reuse technologies, increased attention is being devoted to the production of sludge that is clean, has less volume and can be safely reused. Developments in this area have been slower than in the field of waste-water treatment, but a number of new technologies have emerged, including high-solids centrifuges, egg-shaped digesters and powerful heat dryers. Other developments include temperature-phased anaerobic digestion and auto-thermal aerobic digestion processes, which destroy volatile solids more effectively and yield enhanced production of class A biosolids.

Sludge landfilling and incineration continue to decrease due to stricter regulations and increased public awareness. The current trend is in the direction of more reuse opportunities through the production of class A biosolids. Volume reduction with a view to decreased disposal requirements is also an ongoing concern.

New technologies have made growing numbers of water treatment alternatives available. Cost may be
a major determining factor, especially in developing countries. Cost estimation is a difficult and even costly undertaking in itself, because of the large number of parameters involved and the fact that those parameters are usually unclear until the design process is well under way.

Historical data are very useful in generating preliminary cost estimates. When these data are sufficiently detailed, they are also useful for the purpose of deriving cost equations that reflect system cost variations according to basic system parameters, including capacity. These equations form the basis of several computer software tools for water treatment cost estimation that are now available.

As the cost of membrane modules declines, membrane techniques become progressively more viable, especially for large-capacity systems. In fact, all membrane systems yield economies of scale up to five mgd capacity. However, system designers must bear in mind that downmarket membrane systems will generally entail higher maintenance costs and will be difficult to expand and upgrade. A balance must be struck, depending on system requirements and projected lifetime.

Effluent and sludge possess high fertilizing value. Agricultural countries should consider the reuse of effluent and sludge for farmland irrigation, thus benefiting twice over. Effluent reuse programmes must be regulated, subsidized and efficiently marketed in order to win wider use and acceptance.

Natural treatment systems are very promising, especially for rural areas and other locations where large areas of inexpensive land are available. Great cost reductions are possible with systems such as rapid infiltration and aerated lagoons, compared to other mechanical water treatment systems of similar environmental effectiveness. ESCWA member countries are encouraged to pursue the construction of such systems.

Waste-water discharge to sewer and controlled waters is costly where charges are imposed by regulatory bodies. Dischargers are therefore encouraged to reduce waste-water volume while improving its quality. Under these conditions, waste-water reduction and treatment techniques can be highly lucrative.

Pollutant trading is a policy that has been successfully applied in different locations in the United States. This policy has resulted in great reductions in total treatment costs while achieving even higher levels of environmental benefit.

Ground water recharge is a costly undertaking that is feasible only when the cost of other water sources is very high. The environmental benefits associated with reduced demand for surface water may be the deciding factor governing selection of this technique.

In conclusion, economic criteria often determine which water treatment technology is deployed. The economic assessment of a particular technology must take several criteria into account including: affordability, cost, cost-effectiveness, labour and willingness to pay. Failure to consider all these aspects may lead to an inappropriate choice of treatment technology. It is also desirable for technology assessment be based on a broad set of sustainability criteria that include, in addition to the economic criteria referred to above, environmental, socio-cultural and functional criteria.

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