STANDARDS/MANUALS/ GUIDELINES FOR SMALL HYDRO DEVELOPMENT

1.9
General–
Environment Impact Assessment

Sponsor:

Ministry of New and Renewable Energy
Govt. of India

Lead Organization:

Alternate Hydro Energy Centre
Indian Institute of Technology Roorkee

December, 2012

Contact:
Dr Arun Kumar
Alternate Hydro Energy Centre,
Indian Institute of Technology Roorkee,
Roorkee - 247 667, Uttarakhand, India
Phone : Off.(+91 1332) 285821, 285167
Fax : (+91 1332) 273517, 273560
E-mail : aheciitr.ak@gmail.com, akumafah@iitr.ernet.in

DISCLAIMER

The data, information, drawings, charts used in this standard/manual/guideline has been drawn and also obtained from different sources. Every care has been taken to ensure that the data is correct, consistent and complete as far as possible.

The constraints of time and resources available to this nature of assignment, however do not preclude the possibility of errors, omissions etc. in the data and consequently in the report preparation.

Use of the contents of this standard/manual/guideline is voluntarily and can be used freely with the request that a reference may be made as follows:

AHEC-IITR, "1.9 General – Environment Impact Assessment", standard/manual/ guideline with support from Ministry of New and Renewable Energy, Roorkee, December 2012.

PREAMBLE

There are series of standards, guidelines and manuals on electrical, electromechanical aspects of moving machines and hydro power from Bureau of Indian Standards (BIS), Rural Electrification Corporation Ltd (REC), Central Electricity Authority (CEA), Central Board of Irrigation & Power (CBIP), International Electromechanical Commission (IEC), International Electrical and Electronics Engineers (IEEE), American Society of Mechanical Engineers (ASME) and others. Most of these have been developed keeping in view the large water resources/ hydropower projects. Use of the standards/guidelines/manuals is voluntary at the moment. Small scale hydropower projects are to be developed in a cost effective manner with quality and reliability. Therefore a need to develop and make available the standards and guidelines specifically developed for small scale projects was felt.

Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee initiated an exercise of developing series of standards/guidelines/manuals specifically for small scale hydropower projects with the sponsorship of Ministry of New and Renewable Energy, Government of India in 2006. The available relevant standards / guidelines / manuals were revisited to adapt suitably for small scale hydro projects. These have been prepared by the experts in respective fields. Wide consultations were held with all stake holders covering government agencies, government and private developers, equipment manufacturers, consultants, financial institutions, regulators and others through web, mail and meetings. After taking into consideration the comments received and discussions held with the lead experts, the series of standards/guidelines/manuals are prepared and presented in this publication.

The experts have drawn some text and figures from existing standards, manuals, publications and reports. Attempts have been made to give suitable reference and credit. However, the possibility of some omission due to oversight cannot be ruled out. These can be incorporated in our subsequent editions.

This series of standards / manuals / guidelines are the first edition. We request users to send their views / comments on the contents and utilization to enable us to review for further upgradation.

Standards/ Manuals/Guidelines series for Small Hydropower Development

General	
1.1	Small hydropower definitions and glossary of terms, list and scope of different Indian and international standards/guidelines/manuals
1.2 Part I	Planning of the projects on existing dams, Barrages, Weirs
1.2 Part II	Planning of the Projects on Canal falls and Lock Structures.
1.2 Part III	Planning of the Run-of-River Projects
1.3	Project hydrology and installed capacity
1.4	Reports preparation: reconnaissance, pre-feasibility, feasibility, detailed project report, as built report
1.5	Project cost estimation
1.6	Economic & Financial Analysis and Tariff Determination
1.7	Model Contract for Execution and Supplies of Civil and E&M Works
1.8	Project Management of Small Hydroelectric Projects
1.9	Environment Impact Assessment
1.10	Performance evaluation of Small Hydro Power plants
1.11	Renovation, modernization and uprating
1.12	Site Investigations
Civil works	
2.1	Layouts of SHP projects
2.2	Hydraulic design
2.3	Structural design
2.4	Maintenance of civil works (including hydro-mechanical)
2.5	Technical specifications for Hydro Mechanical Works
Electro Mechanical works	
3.1	Selection of Turbine and Governing System
3.2	Selection of Generators and Excitation Systems
3.3	Design of Switchyard and Selection of Equipment, Main SLD and Layout
3.4	Monitoring, control, protection and automation
3.5	Design of Auxiliary Systems and Selection of Equipments
3.6	Technical Specifications for Procurement of Generating Equipment
3.7	Technical Specifications for Procurement of Auxiliaries
3.8	Technical Specifications for Procurement and Installation of Switchyard Equipment
3.9	Technical Specifications for monitoring, control and protection
3.10	Power Evacuation and Inter connection with Grid
3.11	operation and maintenance of power plant
3.12	Erection Testing and Commissioning

PERSONS INVOLVED

1. Dr Arun Kumar, CSO & Principal Investigator ,AHEC,IIT, Roorkee
2. Dr S K Singal, SSO & Investigator,AHEC,IIT, Roorkee

Drafting Group

1. Dr U C Chaubey, WRDM, IIT Roorkee
2. Mr Vinay Shankar, Gurgaon
3. Dr GCS Gaur, Dehradun

Consultation Group

1. Dr Arun Kumar,AHEC,IIT, Roorkee
2. Dr S K Singal,AHEC,IIT, Roorkee
3. Prof. O.D. Thapar, Consultant, AHEC, IIT, Roorkee
4. Mr. A.K. Chopra, MNRE,GOI, New Delhi
5. Mr. S.V. Dinkar, Consultant, Pune
6. Mr. Himanshu Tiwari, UJVNL, Dehradun
7. Mr. A.K. Singh,UJVNL, Dehradun
8. Mr. P.K. Singhal, UPJVNL, Lucknow
9. Mr. V.K. Sharma, THDC, Rishikesh
10. Mr. U Ukhal, HPPCL, Himachal Pradesh
11. Mr. Pradeep Dube, Tanushree Hydropower Consultants, Noida

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ANNEXURES

1.0 ENVIRONMENTAL IMPACTS AND NEED FOR ENVIRONMENT IMPACT ASSESSMENT OF SMALHYDROPOWER PROJECTS

1.1 INTRODUCTION

Like all energy and water management works, hydropower projects including small scale have negative and positive environmental and social impacts. Hydropower may have significant environmental impacts at local and regional level but also provides advantages at macro ecological level. With respect to social impacts, hydropower projects may lead to relocation of communities living within or nearby reservoir and works. Seen differently, a properly designed hydropower project may, however, be a driving mechanism for socio-economic development through sharing of benefits.

Compared to large scale hydropower, small scale HP typically takes less time and efforts to construct and integrate with local environment. However large scale HP project of 500 MW in a remote area on a river may have few negative impacts compared to cumulative impacts of 500 of 1 MW or 100 of 5 MW each small scale hydro projects.

Environmental Impact Assessment (EIA) study provides information based on adequate data and scientific analysis. Such information is to be placed in the public domain and is subject to critical review by public. As a scientific analysis of the environmental constraints, the EIA constitutes an important part of pre-project study which helps in improving project standard.

EIA study is aimed at protecting the environment by integrating the environmental issues in the planning process.

An overview of the main energy and water management services and distinctive environmental characteristics in relation to the different HP project types are presented in the Table 1.

1.2 REFERENCES

R1 www.envfor.nic.in; Ministry of Environment and Forests, Govt. of India.

R2 Environmental, Health, and Safety General Guidelines, World Bank Group www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

R3 Egre D and Milewski (2002); The diversity of hydropower project, Energy Policy, 20(14), pp1225-1230

R4 IEA (2000). Hydropower and the Environment: Present Context and Guidelines for Future Action. Volume II: Main Report. Implementing Agreement for Hydropower Technologies and Programmes, Annex III, International Energy Agency, Paris, France, 172 pp. Available at: www.ieahydro.org/reports/HyA3S5V2.pdf.

R5 Kumar, A., T. Schei, A. Ahenkorah, R. Caceres Rodriguez, J.-M. Devernay, M. Freitas, D. Hall, Å. Killingtveit, Z. Liu, 2011: Hydropower. In IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation [O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, C. von Stechow (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

R6 MoEF. 2001. Environmental Impact Assessment – A Manual, Impact Assessment Division, Ministry of Environment and Forests, Government of India.

R7 DOED. 2002. Manual for Preparing Environmental Management Plan (EMP) for Hydropower Projects. Department of Electricity Development, Kathmandu.
R8 MoEF. 2006. Environmental Impact Assessment Notification – 2006 of Ministry of Environment and Forests (MoEF), Government of India.
R9 MoEF. 1981. Guidelines for River Valley Projects, Ministry of Environmental & Forests, Government of India.
R10 CWC 1992, Guidelines for Sustainable Water Resources Development and Management, Central Water Commission, Government of India.
R11 CWC 2010, Guidelines for preparation of detailed project report of irrigation and multipurpose projects, Central Water Commission, Govt. of India, Delhi
R12 Indian Standard IS 15832 : 2008. Glossary of Technical Terms Related to Environmental Impact, Bureau of Indian Standards, New Delhi 110002
R13 Indian Standard IS 15442: 2004: Parameters for environmental impact assessment of water resources project. Bureau of Indian Standards, New Delhi 110002.
R14 Indian Standard IS 15845: 2009; Environmental Management Plan for Hydropower/Irrigation/Flood Control/ Multipurpose River Valley Projects. Bureau of Indian Standards, New Delhi 110002

Table 1 : Types of hydropower projects, their main services and distinctive environmental and social characteristics (adapted from IEA 2000 and Egré and Milewski, 2002)

HPP Type	Energy and water management services	Main environmental and social characteristics
All	Renewable electricity generation Increased water management options	Barrier for fish migration and navigation and sediment transport Physical modification of riverbed and shorelines
Run-of-river	Limited flexibility and increased variability in electricity generation output profile Water quality (but no water quantity) management	Unchanged river flow when powerhouse in dam toe; when localized further downstream reduced flow between intake and powerhouse
Reservoir (Storage)	Storage capacity for energy and water Flexible electricity generation output Water quantity and quality management; groundwater stabilization; water supply and flood management	Alteration of natural and human environment by impoundment, resulting in impacts on ecosystems and biodiversity and communities Modification of volume and seasonal patterns of river flow, changes in water temperature and quality, land use change-related GHG emissions
Multipurpose	As for reservoir HPPs; Dependent on water consumption of other uses	As for reservoir HPP; Possible water use conflicts; Driver for regional development
Pumped storage	Storage capacity for energy and water; net consumer of electricity due to pumping No water management options	Impacts confined to a small area; often operated outside the river basin as a separate system that only exchanges the water from a nearby river from time to time

1.3 ENVIRONMENTAL IMPACTS OF SMALL HYDROPOWER PROJECTS

Physical components of small hydropower project (SHP) may be seen at Fig. 1. A hydropower scheme entails change in use of land and water. Magnitude of such change depends on the selected site configuration. An illustrative site configuration is shown below. The environmental impacts of SHPs are positive (favourable) and negative (undesirable) both in nature.

The environmental impacts of small hydropower project may be summarized as given in Table 2:

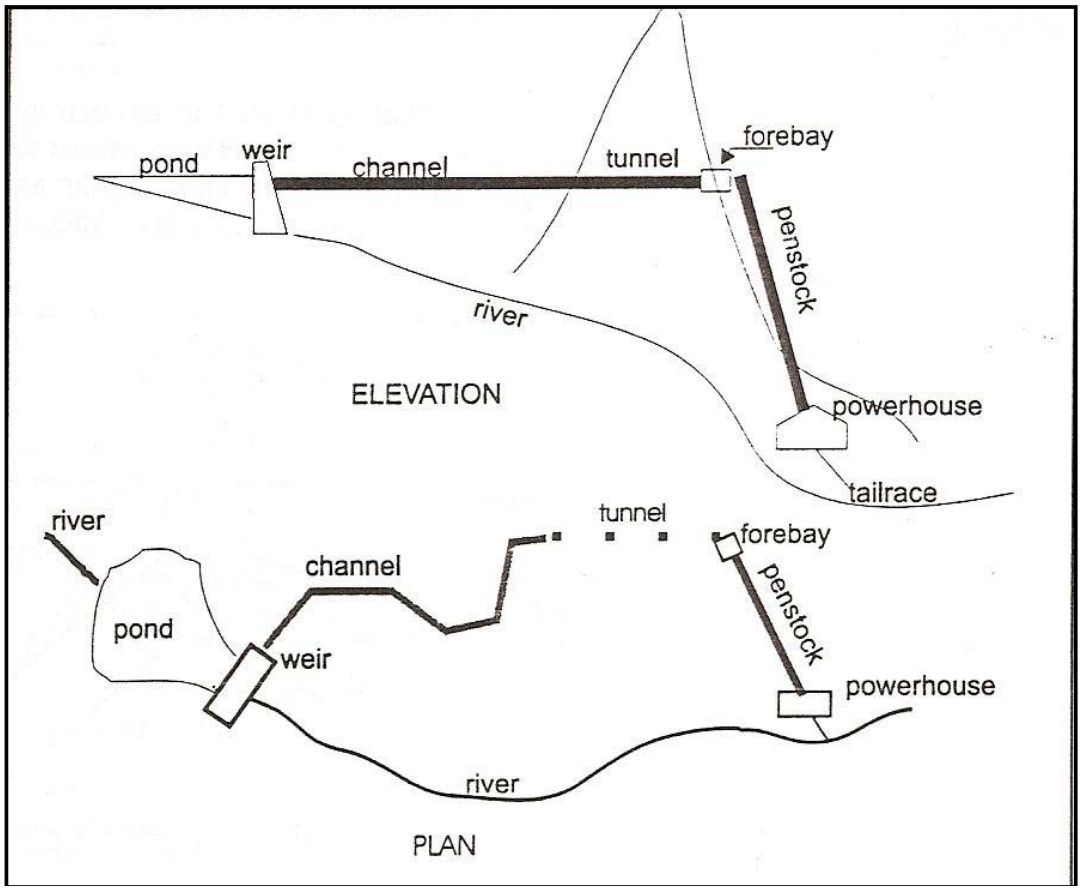

Fig. 1 : Physical Components of Small Hydropower Project

1.4 POSITIVE IMPACTS

Positive environmental impacts of hydropower projects are somehow ignored as a routine probably due to the fact that these projects are conveniently regarded as demanding an environmental price. It is equally important to highlight and quantify (to the extent possible) positive environmental impacts of SHPs.

Table 2 : Environmental Impacts of Small Hydropower Projects

Activity	Probable Adverse Impacts
Construction of components of project such as diversion, desilting tank, feeder and power channel / tunnel, forebay, penstock, power house, tailrace, switchyard and roads etc. road, dam, surface power house and switch yard, diversion tunnel, channel	1. Reservoir sedimentation, though not significant in RoR projects 2. Deterioration of water quality, more because of new settlements coming up resulting in wastewater generation which is easily manageable. 3. Air and noise pollution and disturbance to flora and fauna by work force during construction 4. Visual intrusion caused by construction activity 5. Soil erosion due to removal of vegetation and excavation of construction material 6. Alteration in ground water flow regime 7. Alteration in the course of river – Loss of land forms 8. Flow of sediments into stream – Air pollution due to air borne dust and fugitive emissions – Noise pollution 9. Shocks of blasting – damage to existing structures due to blasting – loss to biological environment
Stream diversion through channel and conduit	1. Loss of habitat of fish and other aquatic flora and fauna 2. Decrease in carrying capacity of stream 3. Depletion in ground water recharge where diversion is taken off from effluent stream 4. Loss of aesthetic beauty of river, waterfalls and other recreational activities
Ponding	1. Flow disruption 2. Channel degradation during generation or spilling and flushing of silt from dam 3. Trapped nutrients and sediments, Changed water temperature – not significant 4. Changes in land uses: (a) submergence of agricultural and forest land (b) submergence of human settlement and displacement of population (c) submergence of monuments/sites of historic importance (d) loss of white water recreation Note – Changes in land use is usually insignificant in ROR SHPs and is mainly in Reservoir based projects 5. Change in aquatic plant life and fish species much smaller in ROR SHPs 6. High evaporation rate-Insignificant in ROR SHPs 7. Sedimentation adversely affects fish spawning areas by burying them 8. Provides increased habitat for mosquitoes and snails which are vectors of diseases like malaria, yellow fever, dengue, encephalitis and schistosomiasis
Construction of transmission line	1. Damaging flora due to right of way clearing 2. Endangering the lives of fauna 3. Visual intrusion
Operation of hydropower station	1. Increase in pollution concentration in the downstream due to release of pollutants from residential areas, hydropower

Activity	Probable Adverse Impacts
	plant. This pollution can and should be controlled by installing wastewater treatment systems 2. Released water containing low dissolved oxygen - insignificant 3. Fish mortality from turbine passage 4. Sonic impact: noise level may increase
Peaking operation of power station	1. Damage to fish spawning ground and nesting ground for water fowls and other aquatic birds 2. Erosion of banks – insignificant in ROR SHPs 3. Affects recreational facilities due to fluctuating water level 4. Exposure of drawdown zone creates visual intrusion

1.4.1 Positive Socio-Economic Impacts

1. Improvement in living standard of local people
2. Improvement in socio economic status of peoples in the vicinity.
3. Generation of employment opportunities locally. Direct employment during construction and indirect employment in allied activities.
4. Increased earnings from supplies to imported labour and employees.
5. Motivation of higher literacy
6. Check on migration from villages to towns, thereby checking urban concentration of population
7. Increased tourism potential – water sports, boating, fishing and site seeing etc.
8. Creation of reservoir increases potential for fish and fisheries (catch and income)
9. Project related infrastructure (roads, health facilities, education facilities helps the local people as well as project affected people. Net improvement in community health and education.
10. Improvement of agricultural produce through lift irrigation which requires energy.
11. Multiplier effect of electricity on economy of the area especially in remote areas such as agro-industrial units
12. No transmission loss due to commercial availability of power at customers' door step
13. It is significant for off-grid, rural, remote area applications in far flung isolated communities having no chances of grid extension for years to come. It is operationally flexible, suitable for peaking support to the local grid as well as for standalone applications in isolated remote areas.
14. It helps in checking deforestation which is taking place to meet food, fodder and fuel demands in rural, remote areas.
15. Small hydro does not require much expertise to build and operate. Components of small hydro projects are simple and fairly visible at site.They can become centre of education.
16. In specific cases SHPs are eligible for carbon credits through reduction in CO_2 emission and adding sink for CO_2 via plantation schemes.

1.4.2 Positive Ecological/Environmental Impacts

1. Clean and renewable source of energy. SHPs result in saving of non-renewable fuel resources such as coal, liquid fuels and gases.
2. It is a benign source of power generation, harnessing only gravitational potential of water to make it yield energy in a continuum

3. Decrease of pollution in the area (hydro replacing diesel generation, electricity replacing polluting energy sources)
4. Increased water surface creates habitat for aquatic life in or near the reservoir. Receiving waters create dry mudflats which provide feeding sites for migratory birds and breeding habitat for resident species.
5. Improved ground water table enhancing greenery all around
6. Improvement towards vegetation and plantation associated with the project (compensatory afforestation) and thus providing sink for CO_2 emission
7. Improved habitat
8. Lake shore environment in otherwise dry areas
9. Modification of micro climate due to storage and regulation of water to a more or less uniform pattern. This also leads to a somewhat stabilizing impact on local environment influencing flora and fauna – aquatic as well as terrestrial.
10. SHPs are environmentally friendlier than conventional large hydro plants due to:
    a. Non-involvement of setting up of large dams and thus not associated with problems of deforestation, submergence or rehabilitation
    b. Non-polluting and environmentally benign. It is one of the least CO2 emission responsible power sources, even by considering full energy chain right from the impact of production of plant equipment etc.
    c. Least impact on flora and fauna (aquatic and terrestrial) and biodiversity due to localised nature of activities
11. There may be overall improvement in biodiversity due to creation of habitats.
12. Under CSR, developers pay more attention towards improving the local environment including socio economic environment.
13. Due to small scale operations the degenerated slopes get reclaimed in lesser period.
14. Ecological imbalances also get re-established in shorter span.

1.5 REQUIREMENT OF EIA FOR SMALL HYDROPOWER PROJECTS

EIA is an activity designed to identify, predict and describe in appropriate terms the primary and secondary changes in environment due to a proposed action(policies, plans, programmes and projects). EIA is required not only for a particular hydropower project but also for a set of projects (existing and proposed) under a plan or a programme.

The MOEF Gazette Notification dated 14th September, 2006 specifies screening criteria for new projects and for expansion/modernization of existing projects. According to the MOEF specification, a small hydropower project (capacity<25 MW) does not require environmental clearance from the regulating authority. However, there are conditions under which EIA and environmental clearance may become necessary. These conditions are

a) If the project is located in side or within 10 km distance from boundary of
    i) Protected area under wild life (protection) Act
    ii) Critically protected area
    iii) Notified ecosensitive area
    iv) International boundary

b) If expansion or modernization of existing unit results in increase in plant capacity beyond 25 MW threshold limit. The MOEF notification detailed 14th September 2006 states:

All applications seeking prior environmental clearance for expansion with increase in the production capacity beyond the capacity for which prior environmental clearance has been granted under this notification or with increase in either lease area or production capacity in the case on mining projects or for the modernization of an existing unit with increase in the total production capacity beyond the threshold limit prescribed in the Schedule to this notification through change in process and or technology or involving a change in the product-mix shall be made in Form I and they shall be considered by the concerned Expert Appraisal Committee or State Level Expert Appraisal Committee within sixty days, who will decide on the due diligence necessary including preparation of EIA and public consultations and the application shall be appraised accordingly for grant of environmental clearance.

c) If the cumulative impacts of proposed project in conjunction with existing or proposed hydropower projects in vicinity are expected to be significant.

d) If the funding agency specifies EIA as a precondition for funding of the project. For example, an international funding agency may specify such condition.

e) Project proponent of a single SHP is in no position to carry out a Cumulative Impact Assessment of projects in cascade on a river/tributary/stream. It is the State Government, which needs to get CIA done and take a policy decision as to the no of projects and the capacities of each that will be permitted in cascade on a river/tributary/stream.

1.6 NEED OF GUIDELINES FOR EIA OF SMALL HYDROPOWER PROJECTS

A series of standards, guidelines and manuals have been brought out by various agencies dealing with environmental impact assessment of large river valley/hydropower projects. However, such literature for small hydropower projects is not available. There is an urgent need to develop and adopt simplified guidelines for SHPs.

Guidelines have been issued by Ministry of Environment and Forests (MOEF) for diversion of forest land for non-forest purposes and for EIA of river valley projects. These guidelines are exhaustive covering wide range of environmental subjects. Small hydropower projects may not require same type of scrutiny as that required by large projects. Further, in-depth study of some of environmental aspects may not be necessary.

Basic physical character of SHP and the local factors influencing the environment are to some extent similar to those of large projects but in most cases they are much smaller and sometimes some impacts could be insignificant.; Further there are certain positive impacts (socio-economic and environmental) unique to small hydropower. Several of the positive socio-economic impacts are intangible in nature (i.e. not quantifiable) and yet could be significant. Intangibility does not imply insignificance.

There is an urgency to accelerate development of small hydro and remove regional imbalances in economic development. Private sector has a big role to play in development of SHPs. Standards and guidelines are required to help concerned agencies in carrying out EIA in a systematic and scientific manner and thus avoiding delay in clearance of the projects and in educating the locals around the project.

Keeping the above in view, these guidelines have been prepared to address needs of SHPs. The following aspects are covered in this manual:

- various acts and decision making process as followed in India for obtaining environmental clearance.
- baseline data required as per environmental indicators
- the EIA methodology
- procedure for water and air and air quality monitoring and auditing
- methods and procedures for engaging stake holders
- monitoring and auditing plan
- environmental management plan (mitigation measures)
- the preparation of terms of references and good practice criteria

2.0 ENVIRONMENTAL ACTS AND PROCEDURES FOR CLEARANCE OF HYDROPOWER PROJECTS IN INDIA

2.1 ENVIRONMENTAL ACTS

Adequate provisions for protection of environment and forests are made in the Constitution of India. Article 47 provides for protection and improvement of health. Article 48(A) is directed towards protection and improvement of environment and protection of forest and wildlife. Article 51(A) says it is the duty of every citizen to protect and improve natural environment. Following the UN Conference on Human Environment (Stockholm, 1972), a constitutional amendment (42, 1976) inserted relevant provisions for environment protection in Constitution in Part IV – Directive Principles and Part IVA – Fundamental Duties.

In order to ensure sustainable development from water resources angle the Government of India has enacted various Acts and Legislations. Prominent among these is the Environment (Protection) Act, 1986 through which the Government has acquired wide powers for protecting the environment. Some other acts related to Water and Environment are Water (Prevention and Control of Pollution) (Cess) Act, 1977 (amended in 1991), Forest Conservation Act, 1980, Environmental Impact Assessment (EIA) Notification of MOEF 2006 and the Ministry of Environment and Forest's Notification of January 1977 constituting the Central Ground Water Authority (CGWA).

The Water (Prevention and Control of Pollution) Act, 1974 seeks to maintain or restore "wholesomeness of water" and the Central and State Pollution Control Boards have been established under this Act. According to the Water Cess Act, 1997, both Central and State Governments have to provide funds to the Boards for implementing this Act. The Forest Conservation Act, 1980 provides for compensatory afforestation to make up for the diversion of forestland to non-forest use. The Environment (Protection) Act, 1986 was enacted in 1986 for the protection and improvement of human environment. The various acts are summarised in Table 3.

The Government of India has constituted "Water Quality Assessment Authority" (WQAA) vide MoEF/Nc. J-15011/8/2000-NRCD dated 29th May, 2001 under the chairmanship of Secretary, MOEF, exercising the powers under the Environment (Protection) Act, 1986. This authority exercises the powers and functions under the said Act for several functions. Some of these, relevant to hydropower projects, are given below:

- To direct various agencies to standardize methods for water quality monitoring
- To ensure quality of data generation of utilization thereof
- To take measures so as to ensure proper treatment of waste water with a view to restoring the water quality of the rivers and water bodies to meet the designated best uses
- To maintain minimum discharge for sustenance of aquatic life forms in a riverine system
- To promote rain water harvesting
- To utilize self assimilation capacities at the critical river stretches
- To constitute/set up state level Water Quality Review Committees (WQRCs) to coordinate the works to be assigned to such committees
- To deal with any environmental issues concerning surface and ground water quality referred to it by central Government or the State Government relating to the respective areas, for maintaining and/or restoration of quality to sustain designated best-uses.

Table 3 : Key Environmental Legislations and Guidelines

Name	Scope and objective	Key areas	Operational agencies/key players
Water Prevention and Control of Pollution Act, 1974, 1988	To provide for the prevention and control of water pollution and enhancing the quality of water	Controls sewage and industrial effluent discharges	Central and State Pollution Control Boards
Air Prevention and Control of Pollution Act 1981, 1987	To provide for the prevention and control of air pollution	Controls emissions of air pollutants	Central and State Pollution Control Boards
Forest Conservation Act, 1980, 1988	To consolidate acquisition of common property such as forests; halt India's rapid deforestation and resulting Environmental degradation	Regulates access to natural resources, state has a monopoly right over land; categorize forests Restriction on de-reservation and using forest for non-forest purpose	State government And Central government
Wildlife Protection Act, 1980	To protect wildlife	Creates protected areas (national parks/sanctuaries) categorize wildlife which are protected	Wildlife advisory boards; Central Zoo Authorities
Environment Protection Act, 1986	To provide for the protection and improvement of Environment	An umbrella legislation; supplements pollution laws	Central government nodal agency MoEF; can delegate powers to state department of Environment
Environmental Clearance Notification, 2006 of MoEF (GOI)	Environmental Impact Assessment of Projects; Environment Management Plans	Environmental Protection	Project Developer, State and Central Governments.
National Policy on R&R, 2003 of Min. of Rural Development, GOI	Resettlement and Rehabilitation of project affected people	Social Issues	State Government

2.2 PROCEDURE FOR OBTAINING ENVIRONMENTAL CLEARANCE

Before January, 1994, it was an administrative requirement for the mega projects to obtain environmental clearance from the MOEF, Government of India. However, in order to assess the impacts of the developmental projects/activities on the environment, MOEF issued a gazette notification on the EIA on January 27, 1994 (as amended on May 04, 1994) and made environmental clearance statutory for all the projects located in ecologically sensitive/fragile areas as notified by the Government of India from time to time, besides various categories of the projects as specified in the schedule of the notification. These also include water resource development (WRD) project. MOEF has issued a revised gazette notification on 14th September, 2006 superseding the earlier notification of January 27, 1994. The new gazette notification is based on National Environment Policy which was approved by Union Cabinet on 18th May, 2006. Environmental Clearance is required to be obtained in accordance with the provisions of the notification.

A flow chart depicting procedure of environmental clearance is given in Fig. 2. Flow chart depicting appraisal procedure is shown in Fig. 3.

2.3 CATEGORIES OF HYDROPOWER PROJECTS

2.3.1 Category A: A hydropower project will fall in Category A if any one of the following conditions is satisfied:

i. Installed Capacity is greater or equal to 50 MW (Installed capacity≥ 50 MW)
ii. Installed Capacity is less than 50 MW but 25 MW or more (25MW <Installed capacity ≤ 50 MW) and is located wholly or partially within 10 km from boundary of

   a) notified protected area notified under Wild Life (Protection) Act, 1972 or
   b) notified ecosensitive / fragile areas. These could include areas such as the Doon Valley, wild life sanctuaries, national parks wetlands, mangroves, biosphere reserves or,,
   c) critically polluted area as notified by Central Pollution Control Board from time to time, or
   d) interstate boundaries, or
   e) international boundaries

2.3.2 Category B: A hydropower project will fall in Category B if one or more of the following conditions are satisfied

i. Installed Capacity is 25MW or more but is less than 50 MW(25MW <Installed capacity ≤ 50 MW)
ii. Installed capacity is less than 25 MW but the project is located wholly or partially within 10 km from
   a) the boundary of notified protected area notified under Wild Life (Protection) Act, 1972 or
   b) the boundary of notified eco-sensitive / fragile areas. These could include areas such as the Doon Valley, wild life sanctuaries, national parks wetlands, mangroves, biosphere reserves or,,
   c) the boundary of critically polluted area as notified by Central Pollution Control Board from time to time, or

d) interstate boundaries, or
e) international boundaries

2.3.3 Further Categorisation of Hydropower Projects in Category 'B':

a) Category 'B1': Comprises projects whose EIA is required to be conducted
b) Category 'B2':Comprises projects whose EIA is not required to be conducted and Appraisal is done by the State Expert Appraisal Committee (SEAC) on the basis of information furnished in Form 1 prescribed in the MoEF notification of September 2006on EIA.

2.4 REQUIREMENTS FOR ENVIRONMENTAL CLEARANCE

The gazette notification dated 14th September, 2006 stipulates two regulatory authorities to deal with environmental clearance for all new projects and expansion / modernization of existing projects.

Central Government in Ministry of Environment and Forests	for Category A projects
State Level Environmental Impact Assessment Authority (SEIAA)	for Category B projects

The Regulatory Authority (RA) will provide environmental clearance based on recommendation of expert appraisal committee (EAC). In the absence of a duly constituted SEIAA or state level EAC, a category B project shall be treated as a category A project.

2.5 GENERAL CONDITIONS

Any project or activity specified in category B will be treated as category A if located in whole or in part within 10km from the boundary of (i) protected area notified under Wild Life (Protection) Act, 1972 (ii) critically polluted areas as notified by Central Pollution Control Board from time to time, (iii) notified ecosensitive area, (iv) interstate boundaries and international boundaries

Projects located in ecologically sensitive/fragile area (e.g. Doon Valley in Uttaranchal and Aravali range in Rajasthan etc.) as notified by the Government of India from time to time may also be required to obtain environmental clearance compulsorily irrespective of the size, cost. All the projects located in/near wildlife sanctuaries, national parks, wetlands, mangroves, biosphere reserve also need environmental clearance.

As mentioned at para 2.4, a small hydropower project (<25 MW) will require environmental clearance from competent authority if:

(i) it is located inside or in vicinity of ecologically sensitive fragile area or protected are notified under Wild Life (Protection) Act, 1972
(ii) the project in conjunction with existing or proposed hydropower projects may have cumulative adverse impacts.
(iii) the project is for expansion or modernisation of existing unit with increase in production capacity beyond the 25 MW threshold limit.
(iv) the project is funded by an agency which requires EIA as a condition for funding.

2.6 DOCUMENTS REQUIRED WITH THE PROJECT PROPOSAL

It is mandatory to submit the following documents along with project proposal before starting any activity at the project site:

a) Environmental Appraisal Questionnaire as prescribed in Appendix I – Form I of EIA notification (MOEF, 2006)
b) Feasibility/project report (1 copy)
c) Final EIA report (20 hard copies and one soft copy)
d) Final layout plan (20 copies)
e) Video tape or CD of the public hearing proceedings

2.7 STAGES IN ENVIRONMENTAL CLEARANCE

Figure 2 depicts procedure for environmental clearance. Any person who desires to establish a project of any category (A or B) shall submit an application to the Department of Environment (MOEF)/State Government dealing with the environment. The application shall be made in prescribed form.

The environmental clearance process for new projects will comprise a maximum of four stages, all of which may not apply to particular cases as set forth below in this notification. These four stages in sequential order are:-

i. Stage (I) – Screening

It is only for category B projects and activities. In case of Category 'B' projects or activities, this stage will entail the scrutiny of an application seeking prior environmental clearance by the concerned State level Expert Appraisal Committee (SEAC) for determining whether or not the project or activity requires further environmental studies for preparation of an Environmental Impact Assessment (EIA) for its appraisal prior to the grant of environmental clearance depending up on the nature and location specificity of the project. Purpose is to determine whether or not project requires EIA report (termed B1 type project). If EIA is not required then it is B2 type project. MOEF will issue guidelines from time to time for categorization as B1 and B2.

ii. Stage (II) – Scoping

- Category A: Expert appraisal committee
- Category B_1: State level expert appraisal committee

Scoping refers to the process by which the Expert Appraisal Committee in the case of Category 'A' projects or activities, and State level Expert Appraisal Committee in the case of Category 'B1' projects or activities, including applications for expansion and/or modernization and/or change in product mix of existing projects or activities, determine detailed and comprehensive Terms Of Reference (TOR) addressing all relevant environmental concerns for the preparation of an Environment Impact Assessment (EIA) Report in respect of the project or activity for which prior environmental clearance is sought. The Expert Appraisal Committee or State level Expert Appraisal Committee concerned shall determine the Terms of Reference on the basis of the information furnished in the prescribed application form including Terns of Reference (TOR) proposed by the applicant, a site visit by a sub- group of

Expert Appraisal Committee or State level Expert Appraisal Committee concerned only if considered necessary by the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned, Terms of Reference suggested by the applicant if furnished and other information that may be available with the Expert Appraisal Committees or State Level Expert Appraisal Committee concerned. All projects and activities listed as Category 'B' shall not require Scoping and will be appraised on the basis of application form 1 and the conceptual plan.

For category A, hydroelectric project item 1(c) (i) of schedule of TOR shall be conveyed along with clearance for preconstruction activities.

i. Stage (III) – Public consultation

Public Consultation refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate.

It is required for category A and B1 project with some exceptions e.g. modernization of irrigation projects, expansion of roads and B2 type and projects, projects concerning national defence and security. MOEF (2006) has specified procedure for conduct of public hearing.

Purpose is to take into account concerns of local affected persons and others who have plausible stake in environmental impacts. Based on this, appropriate changes in the draft EIA and EMP shall be made. Applicant may submit a supplementary report to draft EIA for appraisal.

ii. Stage (IV) – Appraisal

Figure 2.2 depicts the procedure for project appraisal. Appraisal means the detailed scrutiny by the Expert Appraisal Committee or State Level Expert Appraisal Committee of the application and other documents like the Final EIA report, outcome of the public consultations including public hearing proceedings, submitted by the applicant to the regulatory authority concerned for grant of environmental clearance. This appraisal shall be made by Expert Appraisal Committee or State Level Expert Appraisal Committee concerned in a transparent manner in a proceeding to which the applicant shall be invited for presenting the findings of EIA and EMP and furnishing necessary clarifications in person or through an authorized representative. On conclusion of this proceeding, the Expert Appraisal Committee or State Level Expert Appraisal Committee concerned shall make categorical recommendations to the regulatory authority concerned either for grant of prior environmental clearance on stipulated terms and conditions, or rejection of the application for prior environmental clearance, together with reasons for the same.

2.8 STEP-BY- STEP PROCEDURE FOR ENVIRONMENTAL CLEARANCE FOR SMALL HYDROPOWER PROJECTS

Since these Standards / Guidelines / Manual have focus on SHPs, it will be helpful to summarise the procedure and describe it to step-by-step so that it can be observed without

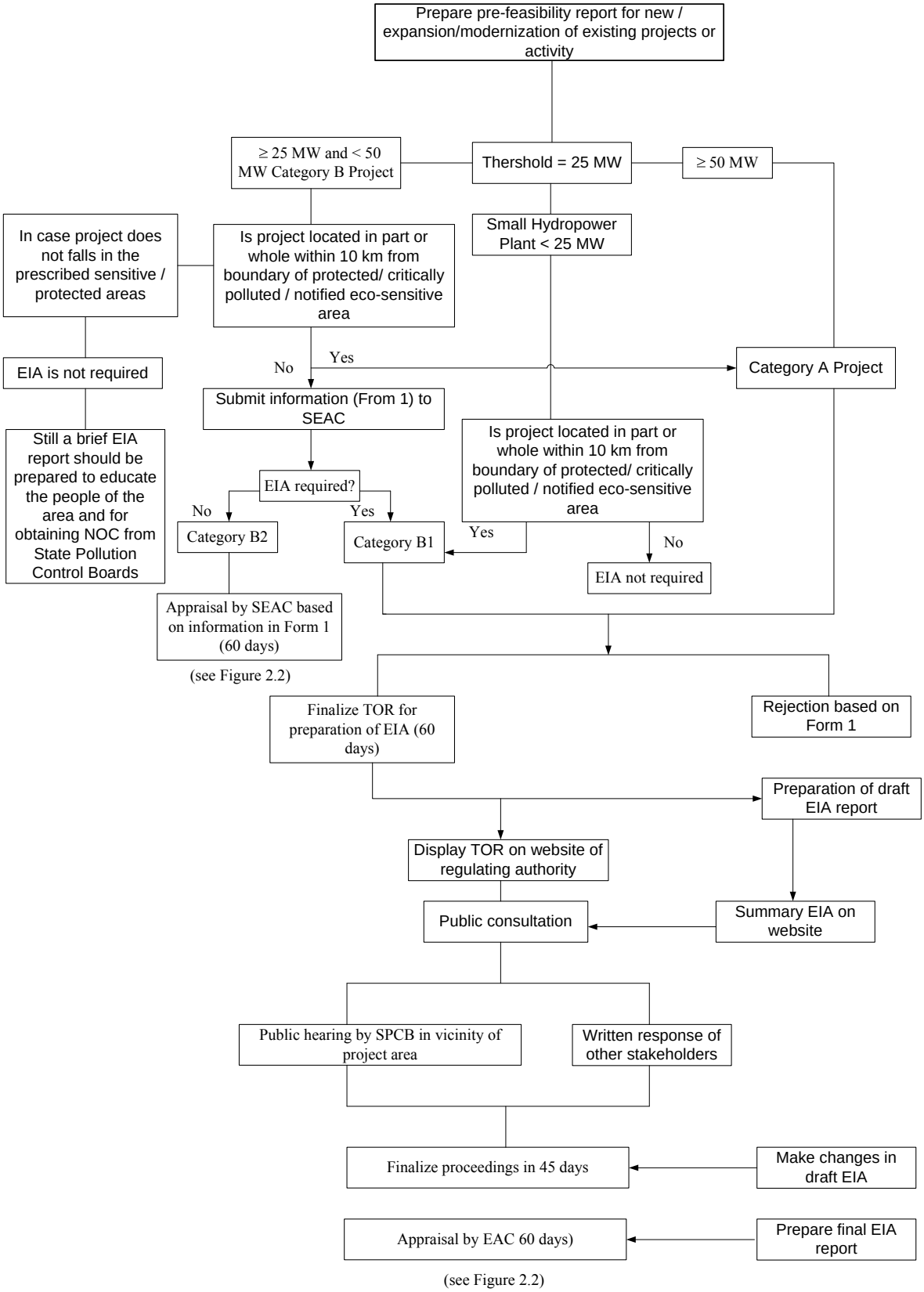

Fig. 2 : Flow chart describing procedure of environmental clearance

much difficulty. It is relevant to point out that the provisions given above apply to SHPs also but EIA is required to be conducted only if certain conditions are encountered as discussed.

The steps are given below:

I. After a licence for putting up a SHP has been obtained, a Project Report should be prepared.

II. The project report would contain maps on the largest possible available scale showing all the components, layout of the project including the boundaries of pondage of water, weir, channel, tunnel, forebay, penstock, powerhouse and tailrace,

III. On the basis of the Project Report, the project proponent should determine whether the project falls within Category 'B' as defined in para 2.3.2 above. If it is so, the project requires Environmental Clearance from the State Environment Impact Assessment Authority (SEIAA).

IV. Whether a SHP project is required to undergo EIA or not, the Environmental Appraisal Questionnaire as prescribed in Appendix I – Form I of EIA notification (MOEF, 2006) *reproduced here as annexure III & IV* should be filled up and an application made to the State Level Expert Appraisal Committee (SEAC), which will decide whether the project requires an Environmental Impact Assessment to be prepared. This will be done on the basis of the criteria in III above or any Guidelines issued by the MoEF from time to time. The SEAC will inform its decision. A project requiring EIA to be prepared is categorised B 1 and if it does not so require, it will fall in Category B2.

V. Of the four stages of EIA described at para 2.7 viz., Policy, Plan, Programme and Project, the EIA of SHP projects belongs to the level of Project.

VI. For projects requiring EIA to be conducted, the project proponent is required to propose 'Terms of Reference' (TOR) for the EIA. The SEAC is expected to finalise them within 60 days. The TORs are required to be displayed on the website of the Regulator. See details at Annexure V.

VII. Draft EIA report should be prepared and submitted to the Regulator namely the State Level Environment Impact Assessment Authority (SEIAA) who shall display it on their website. Environment Management Plan is part of the Environment Impact Assessment. It should be ensured that EMP is prepared and is submitted along with the EIA report.

VIII. The draft EIA report is then required to undergo public consultation in accordance with the details provided at para 2.7(iii). For this consultation, the stakeholders need to be identified.

a) A notice for environmental public hearing is issued by the State Pollution Control Board (SPCB) mentioning its date, time and place. Accordingly, a public hearing is held for ascertaining concerns of local affected persons who can submit their responses in writing also.

b) Responses from persons having a plausible stake should also be obtained.

IX. The proceedings of the Public Hearing are required to be finalised within 45 days.

X. Appropriate changes are made in the draft EIA report and the amended draft is submitted to SEAC which appraises the EIA report.

XI. All Small Hydropower Projects falling in Category 'B', including expansion and modernization of existing projects require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC) as to be constituted for in this notification. In the absence of a duly constituted SEIAA or SEAC, a Category 'B' project shall be treated as a Category 'A' project;

These have been summarised at annexure I.

APPRAISAL

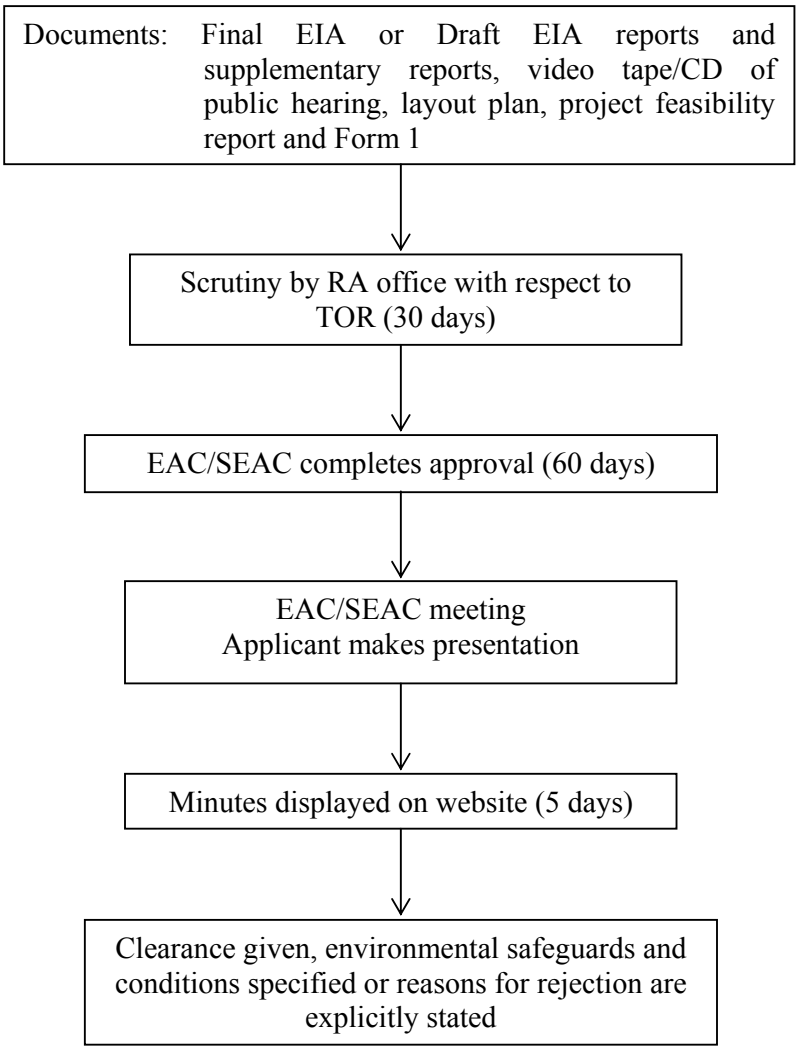

Fig. 3 : Flow chart describing Appraisal procedure by Regulatory Authority (RA)

3.0 BASELINE DATA

Baseline data is required to describe environmental and socio-economic status of project site and project impact area for pre-project condition. It consists of primary data (field tests, surveys, measurements) and secondary data (published information, unpublished

information available with various agencies). Much of the required secondary data/information is often available within the various government agencies. Primary data related to the environmental attributes like air, noise level, water quality and soil are collected from field studies. A structured questionnaire is used for collection of primary information on socio-economic aspects. Ecological information is collected from field studies as well as secondary sources. A summary of environmental attributes related parameters and source of information is given in Table 4.

Table 4 : Environmental Attributes Parameters and Source of Information

S. No.	Attribute	Parameter	Source
LAND ENVIRONMENT			
1	Land Use	Land use pattern	District Planning Map and GIS based information
2	Soil	Soil Characteristics Soil erosivity in catchment area	Field studies, GIS based information
3	Geology	Geological Status	Project Pre-Feasibility Report
4	Seismology	Seismic Hazard	Pre-Feasibility Report
WATER ENVIRONMENT			
5	Water Resources	Catchment Area, Flow, Design	Project Pre-Feasibility Report
6	Water Quality	Physical, Chemical and Biological parameters	Field studies
7	Hydrology	Drainage area and pattern	Project Pre-Feasibility Report
8	Ambient Air Quality	SPM, RPM, SO2, NOx and CO	Field Studies
9	Meteorology	Temperature and Relative humidity	Field Studies
		Temperature, Relative humidity, Rainfall, Wind Speed and Wind Direction	India Meteorological Department
10	Noise	Noise levels in dB (A)	Field Studies
BIOLOGICAL ENVIRONMENT			
11	Ecology	Flora & Fauna Diversity	Field Studies, Information from Forest department and Literature Study
12	Aquatic Ecology	Density & diversity of aquatic species	Field studies, Fisheries Department, Literature review
SCIO-ECONOMIC			
13	Socio-economic aspects	Socio-economic characteristic of the affected area	Field Studies, Literature review.

The baseline study should cover three seasons (pre monsoon, monsoon and winter seasons) and should be conducted in the study area comprising of project area to be acquired for various project components and area within 10 km radius from main project components (diversion weir, power house).

3.1 LAND ENVIRONMENT

3.1.1 Land Use

Land use and land cover patterns are important in environmental impact assessment study from the point of view that land use describes the present use such as agriculture, settlement etc. and land cover describes the material on it such as forest, vegetation, rocks or building etc. Land cover of the 10 km radius study area with reference to the site can be derived using latest cloud free satellite imageries. The data is geo-referenced using SOI 1:50000 scale topo-sheets with the help of standard data preparation techniques in GIS software such as ERDAS IMAGINE. Interpretation of the geo-referenced data is done using standard enhancement techniques and ground truthing. The land use is explained in terms of type and areal extent i.e. dense vegetation, medium vegetation and sparse vegetation which refers to the crown cover density of >40%, 10-40% and <10% respectively. The major components may be as follows:

(a) Land details for various project components (in ha)
(b) Agriculture: (i) Irrigated (ii) Un-irrigated (iii) Cropping pattern
(c) Forest type (with density of vegetation)
(d) Homestead land
(e) Grazing land
(f) Fallow
(g) Marshes
(h) Water bodies
(i) Road
(j) Railway
(k) Bridges
(l) Airport

3.1.2 Drainage Pattern

(a) Characteristics of drainage in the area including its geomorphology
(b) Data regarding flash floods, frequency of occurrence
(c) Ground water strata
(d) Springs

3.1.3 Soils

The locations for collection of soil samples should be well distributed to represent the spatial variation in project area. The soil samples are to be analysed for the following parameters:

(a) Land capability classification (for agricultural land)
    (i) Physical properties of soil (soil texture, porosity, particle size distribution)
    (ii) Chemical properties of soil (pH, electrical conductivity, cations, anions)
    (iii) N, P, K content

3.1.4 Catchment Profile (Directly Draining)

(a) Drainage pattern
(b) Watershed characteristics
    (i) Size

(ii) Shape
(iii) Relief
(iv) Slope
(v) Drainage
(vi) Pattern and density

(c) Ground water potential and runoff behaviour
(d) Sediment/silt yield data
(e) Existing cropping pattern
(f) Migrant behaviour of human and livestock population

3.1.5 Geomorphology/Geology

(a) Data with reference to the entire project area (rock type, slopes, strata, minerals etc.)
(b) Seismic zones/classification
(c) Data pertaining to occurrence of earthquakes

3.2 AIR AND WATER ENVIRONMENT

3.2.1 Water Quality Parameters

To generate baseline data for existing water quality in the project area, water samples (composite) should be collected and analysed for examination of water and wastewater as per the standard procedure such as given in Protocol for Water Quality Monitoring (http://www.cwc.nic.in/main/HP/download/ProtocolforWaterQualityMonitoring.pdf) or the relevant code of the Bureau of Indian Standards (BIS). Environmental standards prescribed by central pollution control board are given at annexure II. The water samples are to be assessed for the following parameters:

(a) Physico-chemical – pH, temperature, conductivity, dissolved oxygen, TDS and TSF, turbidity, total alkalinity, total hardness, chloride, iron, nitrate, phosphate, BOD, COD
(b) Bacteriological – E coli, coliform
(c) Depending upon the pollution source – concerned heavy metals namely mercury, arsenic etc. also to be analysed
(d) Base line data:
    (i) Pre-construction: Two season data i.e. high flow and lean flow
    (ii) Post-construction: Water quality parameters upstream of the project site to be compared with the quality downstream of the project site

3.2.2 Hydrological Data

(a) Monthly discharge data at dam site
(b) Lean season flow (m^3/s)
    (i) upstream of project site
    (ii) downstream of the project site
(c) Water required for (m^3/s)
    (i) power generation
    (ii) irrigation
    (iii) domestic/industrial use
(d) Ground water profile pre-monsoon/post-monsoon

3.2.3 Meteorology

3.2.3.1 Seasonal-monitored (Micro Meteorology) data (monthly basis)

(i) Temperature (in ^{0}C)
- (a) Maximum
- (b) Minimum
- (c) Mean

(ii) Mean rainfall (in mm)

(iii) Wind speed (km/h)
- (a) Maximum
- (b) Minimum
- (c) Mean

(iv) Windrose diagram for winter, summer, rainy season and annual

(iv) Humidity (mean monthly)

(v) Evaporation (observed class A pan evaporation or estimated using appropriate method)

3.2.4 Air Quality

(a) Season wise/air quality (SPM, NOX, SO2, CO)
(b) Construction material required (Table 5)
(c) Dust emissions
- (i) Quarry sites
- (ii) Haulage roads
- (iii) Construction activity
- (iv) Stone crusher

Table 5 : Construction material required

List of construction materials to be used at all stages of construction	Quantity (tonnes/month) Peak Average	Source of material	Means of transportation (source to storage site) with justification
Cement			
Stone			
Steel			
Sand			
Other			

AAQ should be mentioned as per CPCB prescribed standards and the results should be compared with the ambient air quality standards of CPCB.

3.2.5 Noise

(a) Major sources of noise in the project area (stationary and mobile)
(b) Level at source (dB)
(c) Level at project boundary (dB)

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Aquatic

Aquatic ecosystem to be studied over an area at least between 2km upstream of the project site and at least 2 km downstream of the project site. The study should include the following:

(a) Fish species of commercial value
(b) Resident species
(c) Migratory species, their spawning ground, fish morphology, anatomy, feeding pattern, breeding pattern etc.

Aquatic ecological analysis may be made following the methods outlined in Wetzel and Likens (1991) and APHA (1998). Periphyton, phytoplankton, macrobenthos and zooplankton should be studied for frequency, density, abundance and diversity indices.

3.3.2 Terrestrial

An inventory of flora, listing of rare, endangered, economically important and medicinal plant species should be prepared and their frequency, abundance and density should be determined. Quadrate method is generally used for sampling.

3.3.2.1 Flora

(a) Major forest products and dependability of the local communities on these such as fuel wood, edible species, construction material etc.
(b) Forest type
(c) Trees, shrubs, herbs
(d) Rare and endangered species
(e) Endemic species
(f) Economically important species

3.3.2.2 Fauna

(a) Aerial distance of National Park/Sanctuary/Biosphere Reserve etc., if any in the vicinity, from the project site
(b) Rare, threatened and endangered species
(c) Endemic species
(d) Species of special interest to local population and tourists
(e) Migratory route of animals, if any, in the project area

3.4 BIOLOGICAL ENVIRONMENT

3.4.1 Demographic Profile (gender based details of the population)

(a) Rural/urban
(b) Population density
(c) SC/ST and others
(d) Literacy
(e) Employment and occupation

(f) Economic status (land holding/house holding)

3.4.2 Details of Villages to be Affected

(a) Total no. of villages
(b) Total no. of families
    (i) Tribal
    (ii) Others
(c) Total population
    (i) Tribal
    (ii) Others

3.4.3 Village wise Land Details

(a) Name of village
(b) Total land
(c) Land coming under project area
(d) Main occupation of villagers
    (i) Agriculture
    (ii) Service
    (iii) Labourers
    (iv) Business

3.4.4 Details of Families to be Displaced

Name of village	Population					
	Land oustees only		Homestead oustees only		Land and homestead oustees	
	Tribal	Others	Tribal	Others	Tribal	Others

3.4.5 Infra Structure Development

(a) Education
(b) Industrial development
(c) Drinking water
(d) Communication
(e) Roads
(f) Electricity
(g) Sanitation

3.4.6 Cultural Sites

(a) Places of worship
(b) Archeological sites/monuments
(c) Anthropological sites

3.4.7 Health Profile

(a) Existing health

(b) Screening of the facilities urgent labour
   (i) No. of persons to be employed for construction (average and during peak period)
   (ii) No. of persons to be employed from the affected population
   (iii) Details of temporary labour colonies

(c) Disease surveillance
   (i) Endemic health problem
   (ii) Epidemic prevention and control
   (iii) Probability of the occurrence of malaria etc.

4.0 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

As a scientific and technical analysis of the environmental impacts, the EIA constitutes an important part of the project studies.

4.1 LEVELS OF EIA

The potential scope of a comprehensive EIA system is considerable and can include appraisal of policies, plans, programmes and projects. Even if policies were not environmental in nature, they might still have severe environmental implications.

Policy EIA attempts to assess the environmental and health implications of national policies? For example, agricultural policies may cause severe ecological impacts or energy policies will influence the demand for natural resources and affect industrial development.

Plan EIA would seek to identify key environmental factors affecting land use such as agricultural land quality and resources exploitation. EIAs could assist in the identification of preferred areas where certain types of development might be encouraged.

Programme EIA would be prepared for a series of like projects, such as in a river basin development scheme in which different hydropower projects including SHPs may be constructed at different times.

Project EIA would be undertaken when local environmental issues are particularly important for individual projects. Most EIA experience is related to projects (Project EIA); very few plan EIAs have been undertaken.

4.2 EIA PROCEDURE

The key activities are screening, scoping and assessment which will be discussed in detail in following paras. These steps require intensive interaction between the human resources and information resources available for a proposed project.

Finally, an EIA has to be organized to address certain specific topics. Most EIAs cover the following features:

- Description of the proposed project,

- Description of the proposed location or study area, including information about physical resources, ecological resources, human and economic development and existing quality of life
- Alternatives considered (including no-action),
- Potential impacts and benefits including evaluation of each alternative considered,
- Mitigation of adverse effects,
- Irreversible and irretrievable commitment of resources,
- Identification of temporary, short-term and long-term effects,
- Disposition of reviews comments,
- Summary, conclusions and recommendations,
- Monitoring,
- Addition of other features or topics particular to the proposed project.

4.2.1 Screening

Screening is a procedure which aims to identify, as early as possible, those projects with potentially significant impacts that should therefore be subjected to EIA. According to MoEF guidelines, Category 'B' projects or activities are subjected to scrutiny by concerned State Level Expert Appraisal Committee for determining whether or not the project or activity requires an EIA. Those requiring EIA are termed as B1 project and those not requiring EIA are termed as B2 project. For categorization of projects into B1 or B2, the MoEF shall issue appropriate guidelines from time to time. A number of approaches to screening can be identified. These are discussed below:

4.2.1.1 Thresholds

Thresholds may be developed on the basis of size, cost or pollution levels. For example, in India, a policy has been established (MoEF, 2006) that all hydropower projects with installed capacity less than 25 MW, except those mentioned in para 2.3.2, would not be subject to prior environmental clearance by competent authority. This approach, unfortunately, neglects the implications of several small hydropower developments in vicinity, each below the threshold, but which in combination may cause significant adverse impacts and thus should be subject to EIA.

4.2.1.2 Locational criteria

Locational criteria usually involve designation of sensitive areas, for example nature preserves, national parks, historical/religious sites and biospheres. Thus any project or activity in category B will be treated as category A if located in whole or part within 10 km from the boundary of protected areas/critically polluted areas/notified ecosensitive areas etc.

4.2.1.3 Positive and negative lists

The approach is based upon a list of proposed projects for which an EIA is always required (positive list) and a list for which no EIS is required (negative list). Initially, some work is needed to justify the inclusion of one project and the exclusion of another.

Example: individual industries located in notified ecosensitive zone (positive list)/biotech parks (negative list)

4.2.1.4 Initial environmental evaluation

An initial environmental evaluation (IEE) approach requires considerably more understanding of a project and its environs than the approaches described previously. IEEs operate on a project-by-project basis and consequently it is impossible to make generalizations as to which project will be subject to an EIA. However, the RA is an essential precursor to an IEE since it provides sufficient information on pollution loads and levels to allow decision to be made on the need for an EIA.

4.2.2 Scoping (Depth of Analysis)

Scoping is the procedure used to determine the "terms of reference" of an EIA (see Annexure V) and concentrates on identifying those issues which require in-depth analysis. Scoping has the following specific objectives:

- To identify the major environmental issues that must be assessed in the EIA.
- To determine the range of alternatives to the project which should be examined.
- To determine the boundary for the study in a geographical context.
- To establish a procedure for the preparation of an EIS and its format.

Scoping often involves contact between those proposing a development and the public, and it is a procedure that allows interested persons to state their concerns before an EIA is undertaken (see para 2.7 (iii)).

4.3 METHODS FOR IMPACT IDENTIFICATION AND ASSESSMENT

Although there are many types of EIA methods, only checklists, matrices, network and overlays manuals are discussed here. These represent the most widely used methods.

4.3.1 Checklists

The checklists method lists local environmental factors, which are likely to be affected where a development is planned. This list can contain broad categories of factors, for example, flora, fauna, hydrological regimes, surface water bodies and the atmosphere. Conversely, it can be extensive and detailed. An example of checklist is given Table 6.

Another useful type of checklist is the "questionnaire", which presents a series of questions relating to the impact of a project. Checklists are used to provide answers to specific questions relating to the particular project being assessed. Once an initial question has been answered in the affirmative, additional questions investigate the nature of particular impacts in detail.

4.3.2 Interaction matrices

A development of basic checklists is the interaction matrix. The most well known is the Leopold matrix development for the U.S. Geological Survey (Leopold et al, 1971). The matrix consists of a horizontal list of development activities displayed against a vertical list of environmental factors. The matrix is used to identify impacts by systematically checking each

development activity against each environmental parameter. If it were thought that a particular development activity were to affect an environmental component, a mark is placed in the cell which occurs at the intersection of the activity and the environmental component. It should be noted that the matrix can be expanded to cover the construction and operational phases of various components on horizontal scale or more than one alternative can be represented on the horizontal scale. An illustrative example is shown in Table 6.

Table 6 : Example: Checklist of Impacts of a Hydropower Project

S. No.	Project Phase / Environmental Impact	Impact		No Change	Short Term	Long Term
		Positive	Negative			
A.	***Impacts due to Project Location***					
1	*Displacement of People*			*		
2	*Loss of Land / Change in Land Use*		*			*
3	*Encroachment into Forest Land / Loss of Forest Produce*		*		*	
4	*Encroachment into Nature Reserves & Wildlife*			*		
5	*Loss of Historical/Cultural Monuments*			*		
6	*Loss of Infrastructure*			*		
7	*Erosion and Silt Risks*		*		*	
8	*Disruption of Hydrological Balance*			*		
B.	***Impacts due to Project Construction***					
9	*Soil Erosion at Construction Sites*		*		*	
	Muck Generation		*		*	
	Transportation of muck and construction material		*		*	
10	*Deforestation*		*		*	
11	*Human Health*		*		*	
12	*Water Quality*		*		*	
13	*Cultural Hazards*		*		*	
14	*Air and Noise Pollution*		*		*	
C.	***Impacts due to Project Operation***					
15	*Reservoir Evaporation Losses*			*		
16	*Deforestation*		*			*
17	*Effect on Wildlife*			*		
18	*Change in Water Quality & Risk of Eutrophication*			*		
19	*Increased Incidences of Water Borne Diseases*			*		

S. No.	Project Phase / Environmental Impact	Impact		No Change	Short Term	Long Term
		Positive	Negative			
20	*Impact on Fish and Aquatic Life*			*		
21	*Public Health*	*				*
22	*Drainage*			*		
D.	***Positive Impacts***					
23	*Clean and renewable source of energy*	*				*
24	*Employment Opportunities*	*			*	*
25	*Catchment Area Treatment*	*				*
26	*Recreation and Tourism Potential*	*				*
27	*Additional Habitat for Aquatic Wildlife / Wetland Species*	*				*
28	*Fisheries & Aquaculture potential*	*				*
29	*Benefits to Economy*	*				*
30	*Reduction in Air Pollution*	*				*
31	*Reduction in Greenhouse gas Emissions*	*				*
32	*Increased Infrastructure*	*				*

After the initial identification of impacts, it is possible to use the same matrix to indicate those impacts considered to be the most important. In the original Leopold matrix, scores from a 1 to10 scale can be assigned to describe the importance and magnitude of individual impacts. Importance refers to the significance of an impact and magnitude to its scale and extent. Leopold-type matrices are easy to use and perhaps the most widely employed and successful of all EIA methods.

4.3.3 Overlays

The overlays approach to impact assessment involves the use of a series of transparencies. The study area is subdivided into convenient geographical units, based on uniformly spaced grid points, topographic features or differing land uses. Within each unit, the assessor collects information on environmental factors and human concerns, through various sources/techniques. The concerns are assembled into a set of factors, each having a common basis and regional maps (overlays) are drawn for each factor. The degree of impact or importance of each factor is represented by varying the degree of shading with light shading indicating low impact and heavy shading the highest impact. The overlays are then stacked one on the other using the same reference points and the total degree of shading is visually observed. Those areas on the maps with the highest shading are thus the most acceptable alternatives. Because of the reduction in light transparency with each overlay, only about 10 maps or overlays can be used.

This method is easily adaptable for use with a computer which may be programmed to perform the tasks of aggregating the predicted impacts for each geographical subdivision and of searching for the area least affected. Automated procedure can be used for selecting

sequence of unit areas for routing highways, canal network, pipelines, and other corridors. The computer method is more flexible, an advantage whenever the reviewer suggests that the system of weights be changed.

The overlay approach can accommodate both qualitative and quantitative data. For example, water is often shaded blue while land elevation can be shown by contour lines. There are, however, limits to the number of different types of data that can be comprehended in one display. A computerized version thus has greater flexibility. Although in this case, too, the individual cartographic displays may be too complex to follow in sequence, the final maps (optimum corridors for each alternative, and comparisons amongst alternative) are readily prepared and understood.

4.4 SOCIO-ECONOMIC ASSESSMENT

A hydropower project generally requires construction of the diversion barrage, headrace tunnel, powerhouse etc. Construction of the project facilities would require acquisition of land, out of which part may be the government/forest land and the remaining private land owned by the individuals. Expropriation of private lands may cause social disruption and economic loss for the project affected families/people. The workers, who will be migrating into the project area during construction, and subsequently post completion of the project when there could be some urbanization, would also cause certain demographic and social changes as well as economic changes,.

A survey should be undertaken to study and understand the socio economic conditions of these project-affected households and to examine the impact of the proposed project thereupon.

Social Impact Analysis should cover the following:

Pressure on existing infrastructure/resources: Creation of the project infrastructure like roads, electric supply would also be available for the project affected people.

Incidence of water related diseases: The aggregation of labour, discharge of uncontrolled wastewater and formation of stagnant water would result in occurrence/spread of diseases like malaria, cholera etc. This could, however, be controlled through promulgating proper regulations and their enforcement.

Cultural conflicts: People in the project area have distinct habits of food and clothing along with deep religious faiths celebrating their festivals with great enthusiasm. Hence, chances of cultural conflicts between the local people and the migratory population arise.

Cost of living and inflation: Minor increase in cost of living and inflation may be experienced in the project area as a result of increased commercial activities.

Resettlement, Rehabilitation and Social Response Program (SRP) of the Project

Ministry of Rural Development, Government of India have published the National Policy on Resettlement and Rehabilitation for Project Affected Families (NPRR-2003) in February, 2004 which gives guidelines for resettlement and rehabilitation of project affected

families. If the number of affected families is much less than 250, then the NPRR-2003 is not compulsorily applicable.

5.0 PREPARATION OF ENVIRONMENTAL IMPACT ASSESSMENT DOCUMENT & ITS SUMMARY

Environmental Impact Assessment Notification – 2006 of the Ministry of Environment and Forests (MoEF), Government of India provides a generic structure of Environmental Impact Assessment document in Appendix III. Summary of the Environmental Impact Assessment Report is required to be prepared and the generic structure is given in Appendix III A. These may be used appropriately to prepare the EIA report and its summary. The MoEF notification is available on the website of the Ministry.

ANNEXURE I

STEP BY STEP ACTIVITIES FOR SEEKING ENVIRONMENTAL CLEARANCE FOR HYDROPOWER PROJECTS

1. Institutional Mechanism

   a. Category A:
      - Expert Appraisal Committee has advisory Role
      - Regulatory Authority is MoEF – takes Final Decision Making

   b. Category B:
      - State Level Expert Appraisal Committee (SEAC) recommendatory role
      - State Level Environment Impact Assessment Authority (SEIAA) takes decisions.

2. For Small Hydropower Projects of Category 'B'.

   i. Project Proponent (PP) prepares a Detailed Project Report of the SHP.
   ii. PP prepares an application for Environmental Clearance (EC) in Form I attached to the 2006 notification of the MoEF. Submit to SEAC.
   iii. The Project will be either in Category B1 or B2. B1 projects require EIA. B2 do not require EIA.
   iv. If project category is B2, SEAC will either reject the application or grant EC.
   v. If project category is B1, SEAC will finalise Terms of Reference for the EIA, taking into consideration the draft TORs submitted along with the application in Form 1.
   vi. The TORs will be published on the website of the SEIAA.
   vii. A draft EIA report will be prepared.
   viii. Publish the draft EIA report on the website.
   ix. Public Consultation
      a. SPCB organises a public hearing and proceedings are finalsed.
      b. Written responses are obtained from other stakeholders.
   x. Changes are made in the EIA report
   xi. SEAC appraises the EIA report and makes its recommendations to the SEIAA for their final decision.

3. Hydropower Projects in Category A

The flow chart will be similar to the chart for Category B projects except that SEAC will be replaced by EAC and the SEIAA will be replaced by MoEF.

ANNEXURE II

ENVIRONMENTAL STANDARDS PRESCRIBED BY CENTRAL POLLUTION CONTROL BOARD

NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	**Time**	**Concentration in g/m^3**		
		Industrial area	**Residential, rural & other areas**	**Sensitive area**
Sulphur Dioxide (SO2)	Annual Avg. 24 Hours	80- 120	60- 80	15- 30
Oxides of Nitrogen as NO2	Annual Avg. 24 Hours	80- 120	60- 80	15- 30
Suspended Particulate Matter (SPM)	Annual Avg. 24 Hours	360- 500	140- 200	70- 100
Respirable Particulate (RPM) Matter size<10µm	Annual Avg. 24 Hours	120- 150	60- 100	50- 75
Lead (Pb)	Annual Avg. 24 Hours	1.0- 1.5	0.75- 1.00	0.50- 0.75
Carbon Monoxide (CO)	8 Hours 1 Hour	5000- 10000	2000- 4000	1000- 2000

NATIONAL AMBIENT NOISE STANDARDS

Category of zones		
		LEQ in db(a)
	Day *	**Night**
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence Zone **	50	40

***** Day Time is from 6.00 AM to 9.00 PM.
** Silence Zone is defined as an area up to 100m around premises of Hospitals, Educational Institutions and Courts.Use of vehicle horn, loudspeaker and bursting of crackers is banned in these zones.

EFFLUENT DISCHARGE STANDARDS (INLAND SURFACE WATER)

S. NO.	PARAMETER	UNIT	STANDARD
1	Colour& Odor	--	All efforts should be made to remove colour and unpleasant odor as far as practicable.
2	Suspended Solids, Max	mg/l	100
3	Particle size of Suspended Solids	--	Shall pass 850 micron IS Sieve
4	pH value	--	5.5 to 9.0
5	Temperature, Max	oC	Shall not exceed 5°C above the receiving water temperature
6	Oil and grease, Max	mg/l	10
7	Total residual chlorine, Max.	mg/l	1.0
8	Ammonical nitrogen (as N), Max.	mg/l	50
9	Total Kjeldah nitrogen (as N), Max	mg/l	100
10	Free ammonia (as NH3), Max.	mg/l	5
11	Biochemical Oxygen Demand (5 days at 20°C), Max	mg/l	30
12	Chemical Oxygen Demand Max.	mg/l	250
13	Arsenic (as As), Max.	mg/l	0.2
14	Mercury (as Hg), Max.	mg/l	0.01
15	Lead (as Pb), Max.	mg/l	0.1
16	Cadmium (as Cd), Max.	mg/l	2.0
17	Hexavalent chromium (as Cr+6), Max.	mg/l	0.1
18	Total Chromium (as Cr) Max.	mg/l	2.0
19	Copper (as Cu), Max.	mg/l	3.0
20	Zinc (as Zn), Max.	mg/l	5.0
21	Selenium (as Se), Max.	mg/l	0.05
22	Nickel (as Ni), Max.	mg/l	3.0
23	Cyanide (as CN), Max.	mg/l	0.2
24	Fluorides as F, Max	mg/l	2.0
25	Dissolved phosphates (as P), Max.	mg/l	5.0
26	Sulphides (as S), Max.	mg/l	2.0
27	Phenolic compounds (as C6H5OH), Max.	mg/l	1.0
28	Radioactive Materials α Emitters, µcurie/ml, Max. β Emitters, µcurie/ml, Max.		10-7 10-6
29	Bio-assay test	--	90% survival of fish after 96 hours in 100% effluent
30	Manganese (as Mn)	mg/l	2.0
31	Iron (as Fe)	mg/l	3.0
32	Vanadium (as V)	mg/l	0.2
33	Nitrate Nitrogen	mg/l	10.0

TOLERANCE LIMITS FOR INLAND SURFACE WATER QUALITY

CHARACTERISTIC	DESIGNATED USE CLASS OF INDIAN WATERS				
	A	B	C	D	E
pH value	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.0 to 8.5
Dissolved Oxygen, mg/l, min	6	5	4	4	-
Biochemical Oxygen Demand (5 days at 200C), mg/l	2	3	3	-	-
Total coliform organisms, MPN/100 ml. Max	50*	500*	5000*	-	-
Colour Hazen units	10	300	300	-	-
Chlorides (as Cl), mg/l max	250	-	600	-	600
Sodium Adsorption ratio max	-	-	-	-	26
Boron (as B), mg/l. Max	-	-	-	-	2
Sulphates (as SO4), mg/ l	400	-	400	-	1000
Nitrates (as NO), mg/l max	20	-	50	-	-
Free Ammonia (as NH3), mg/l	-	-	-	1.2	-
Conductivity at 25o C microhm/ cm Max	-	-	-	1000	2250
Arsenic (as As), mg/l. Max	0.05	0.2	0.2	-	-
Iron (as Fe), mg/l	0.3	-	50	-	-
Fluorides (as F), mg/l	1.5	1.5	1.5	-	-
Lead (as Pb), mg/l. Max	0.1	-	0.1	-	-
Copper (as Cu), mg/l	1.5	-	1.5	-	-
Zinc (as Zn) mg/l/ Max	1.5	-	1.5	-	-
Manganese (as Mn), mg/l	0.5	-	-	-	-
Total Dissolved Solids, mg/l	500	-	1500	-	2100
Total Hardness (CaCO3), mg/l	300	-	-	-	-
Magnesium (as Mg), mg/l	100	-	-	-	-
Chlorides (as Cl), mg/l	250	600	-	-	600
Cyanides (as CN), mg/l	0.05	0.05	0.05	-	-

A: Drinking Water Source without conventional treatment but after disinfections;
B: Outdoor bathing organized;
C: drinking water source with conventional treatment followed by disinfections;
D: propagation of wildlife and fisheries;
E: irrigation, industrial cooling, controlled waste disposal.

ANNEXURE III

FORMAT OF ENVIRONMENTAL IMPACT ASSESSENT DOCUMENT

(Source: Environmental Impact Assessment Notification – 2006 of MoEF, Govt. Of India)

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 Terms of Reference)
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 or for the project • Proposed schedule for approval and implementation (A) Technology and process description • Project description. Including drawings showing project layout, components of project etc. Schematic representations of the 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 valued environmental components, 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

S. No.	EIA Structure	Contents
		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 • Social Impact Assessment. R&R Action Plans
8.	Project Benefits	Improvements in the physical infrastructure Improvements in the 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 the administrative aspects of ensuring that 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	The names of the Consultants engaged with their brief resume and nature of Consultancy rendered

ANNEXURE IV

ENVIRONMENTAL APPRAISAL QUESTIONNAIRE (APPENDIX I – FORM I OF EIA NOTIFICATION OF MOEF, 2006)

Basic Information

Name of the Project:
Location / site alternatives under consideration:
Size of the Project: *
Expected cost of the project:
Contact Information:

Screening Category:

Capacity corresponding to sectoral activity (such as production capacity for manufacturing, mining lease area and production capacity for mineral production, area for mineral exploration, length for linear transport infrastructure, generation capacity for power generation etc.,)

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?		
1.6	Demolition works?		
1.7	Temporary sites used for construction works or housing of construction workers?		
1.8	Above ground buildings, structures orearthworks including linear structures, cut andfill or excavations		
1.9	Underground works including mining or tunneling?		
1.10	Reclamation works?		
1.11	Dredging?		

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

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		

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**.** lities, 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 havean 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 effect		

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		

S. No.	Areas	Name/ Identity	Aerial distance (within 15 km.) Proposed project location boundary
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*)		

ANNEXURE V

MODEL TERMS OF REFERENCE (TOR) FOR HYDROPOWER PROJECTS

EIA Studies

Policy, Legal and Administrative Framework

Review of the Country's legislative and administrative frame work within which the Environment Impact Assessment (EIA) is to be undertaken to ensure that the project is in compliance with national environmental and social requirements.

Scoping and Assessment of Alternatives

Scoping should be done before EIA, using suitable standard matrices. All the alternatives explored by project proponent should be studied from the environmental angle. Scoping matrix, likely impacts identified for various aspects of environment (aquatic, terrestrial and socio-economic) during construction and operation phase of the project must be discussed in brief for each alternative and reasons for selecting the best and optimum alternative on social and environmental considerations, and reasons for rejecting other alternatives be mentioned.

Methodology

Methods used for collecting data must be mentioned. In analysis of Air, Water and Noise, methodology adopted, instruments used etc., should be mentioned. The land-use/land-cover pattern of the area should be determined through remote sensing studies, interpretation of satellite imagery, topographic sheets coupled with ground truthing. In analysis of terrestrial as well as aquatic biota, the references used as guidelines should be cited. Standard methods must be used for characterizing the diversity and other significant features of the biota and details of field survey given.

The baseline studies will consist of 3 seasonal studies (Pre-monsoon, monsoon and winter seasons) and will be conducted in the following study area.
Study Area: The study area should include the following areas:

- Catchment Area
- Submergence Area
- Project Area to be acquired for various appurtenant works area within 10 km from main project components (i.e. Dam/Barrage/Diversion structure, Power house etc).
- To examine the cascading effect, a clear map showing the approved/under construction/completed HEPs on the both U/S and D/S to this project. Connect such information to establish the total length of interference of natural river flow, the total length of tunnelling of the river and the committed unrestricted release from the site of diversion into the main river.
- Adverse impact on land stability, catchment soil erosion, reservoir sedimentation and spring flow (if any) due to (a) considerable road construction/ widening activity (b) interfere of reservoir with the in-flowing streams (c) blasting for commissioning the HRT, TRT and some other structures should be studied

- Various maps providing salient features of the project need to be depicted in proper scale map of at least 1:15,000 like

1. The location map of the proposed project.
2. The project layout shall be superimposed on a contour map of ground elevation showing main project features (*viz.* location of dam, head works, main canal, branch canals, quarrying *etc.*) shall be depicted in a scaled map.
3. Drainage map of the catchment up to the project site.
4. Soil map of the study area.
5. Geological and seismotectonic maps of the study area showing main project features.
6. Remote sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of study area using overlay mapping techniques *viz.* Geographic Information Systems (GISs). False colour composite (FCC) generated from satellite data of study area should be presented.

A. BASELINE DATA

1. Geological and Geophysical Aspects

- Geography & physiography of the project area
- Design discharge & its RI (Recurrence interval)
- Regional Geology and structure of the catchment
- Seismicity, tectonics and history of past earthquakes in the area
- Critical review of the geological features around the project area
- Impact of project on geological environment
- Justification for location & execution of the project in relation to structural components (dam/barrage height)

2. Seismo-tectonics:

Study of Design Earthquake Parameters

A site specific study of earth quake parameters will be done. The results of the site specific earth quake design parameters will be sent for approval of the NCSDP (National Committee of Seismic Design Parameters, Central Water Commission, New Delhi for large dams.

3. Hydrology of the basin

- Hydro-meteorology, drainage systems
- Catastrophic events like cloud bursts and flash floods, if any would be documented.
- For estimation of Sedimentation rate direct sampling of river flow is to be done during EIA to get actual silt flow rate (to be expressed in ha-m km-2 year-1). The one year of EIA study will provide an opportunity to do this for ascertaining the actual silt flow rate.
- Water availability for the project and the aquatic fauna
- Design discharge and its recurrence interval

4. Biological Resources

i. Flora

- General vegetation pattern and floral diversity *viz.* trees, shrubs, grasses, herbs, significant microflora*etc.* Vegetation should cover all gropus of plants including lichens and orchids.
- Forests and forest types
- Water body inundating forest area
- Vegetation profile, no. of species in the project area, etc.
- Community Structure through Vegetation mapping
- Species Diversity Index (Shanon-Weaver Index) of the biodiversity in the project area as well as plant fossil & phytoplankton
- Documentation of economically important plants, medicinal as well as timber, fuel wood etc.
- Endemic, endangered and threatened species
- Impact of impoundment and construction activities on the vegetation
- Cropping and Horticulture pattern and practices in the study area.
- Location of any Biosphere Reserve, National Park or Sanctuary in the vicinity of the project , if any
- For categorization of sub-catchments into various erosion classes and for the consequent CAT plan, the entire catchment (Indian portion) is to be considered and not only the directly draining catchment,

ii. Fauna

- Fauna study should be carried-out for all group of animals
- Inventorisation of terrestrial wildlife and present status
- Zoogeographic distribution/affinities, Endemic, threatened and endangered species and animal fossil

iii. Avifauna

- Fauna study should be carried-out for all group of animals
- Status
- Resident/Migratory/Passage migrants
- Zoogeographic distribution/affinities, endemic, threatened and endangered species & animal fossils
- Impact of project on threatened/endangered taxa, if any
- Inventorisation of terrestrial wildlife and present status along with schedule of the species

iv. Aquatic Ecology

- Aqua- fauna like macro-invertebrates, zooplankton, phytoplanktons, benthos etc.
- Conservation Status

Fish and Fisheries

- Fish migrations, if any
- Breeding grounds
- Impact of dam building on fish migration and habitat degradation

- Overall ecological impact upto10 Km d/s from the confluence of the TRT with the river and the impact of untreated and waste water in to the river and the alternatives explored.

v. Conservation areas and status of threatened/endangered taxa

- Biotic Pressures
- Management plan for conservation areas and threatened/endangered taxa

vi. Remote Sensing & GIS studies – various maps Various maps providing salient features of the project need to be depicted in proper scale map of at least 1:15,000 like

- The project layout shall be superimposed on a contour map of ground elevation showing main project features (*viz.* location of dam, head works, main canal, branch canals, quarrying *etc.*) shall be depicted in a scaled map.
- Delineation of critically degraded areas in the directly draining catchment on the basis of Silt Yield Index as per the methodology of AISLUS
- The location map of the proposed project.
- Land use and land cover mapping
- Drainage pattern/map
- Soil map of the study area
- Geo-physical features, slope and relief maps Geological and seismo
- tectonic maps of the study area showing main project features.
- Remote sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of study area using overlay mapping techniques *viz.* Geographic Information Systems (GISs). False colour composite (FCC) generated from satellite data of study area should be presented
- Demarcation of Snow fed and rain fed areas for a realistic estimate of the water availability.

vii. Socio-economic aspects

- Land details*
- Demographic profile
- Ethnographic Profile
- Economic structure
- Development profile
- Agricultural practices
- Cultural and aesthetics sites
- Infrastructure facilities: education, health and hygiene, communication network, etc.
- Impact on socio-cultural and ethnographic aspects due to dam building report.

**Report would include list of all the Project Affected Families with their names, education, land holdings, other properties, occupation, etc*.

viii. Collection of data pertaining to water (physico-chemical and biological parameters), air and noise environment and likely impact during construction and post construction periods.

ix. Air Environment

- Baseline Information on ambient air quality in the project area covering aspects like SPM, RSPM, Sox, NOx
- Noise Environment
- Traffic density in the project area

x. Construction Methodology and Schedule including the tunnel driving operations, machinery and charge density, etc.

B. IMPACT PREDICTION

Air

- Changes in ambient levels and ground level concentrations due to total emissions from point, line and area sources
- Effects on soils, material, vegetation, and human health
- Impact of emissions DG sets used for construction power if any, on air environment.

Noise

- Changes in ambient levels due to noise generated from equipment, blasting operations and movement of vehicles
- Effect on fauna and human health

Water

- Changes in quality
- Sedimentation of reservoir
- Impact on fish fauna
- Impact of sewage disposal

Land

- Changes in land use and drainage pattern
- Changes in land quality including effects of waste disposal
- Riverbank and their stability
- Impact due to submergence

Biological

- Deforestation and shrinkage of animal habitat
- Impact on fauna and flora (including aquatic species if any) due to decreased flow of water
- Impact on rare and endangered species, endemic species, and migratory path/route of animals, if any
- Impact on breeding and nesting grounds, if any
- Impact on animal distribution, migration routes (if any), habitat fragmentation and destruction due to dam building activity

Socio-economic Aspects

- Impact on the local community including demographic changes
- Impact on economic status
- Impact on human health
- Impact on increased traffic

- Impact on Holy Places and Tourism
- Downstream impact on water, land & human environment due to drying up of the river in the stretch between dam site and powerhouse site.
- Positive as well as negative impacts likely to be accrued due to the project are to be listed.

I. ENVIRONMENTAL MANAGENET PLAN (EMP)

(a) Catchment Area Treatment Plan

Delineation of micro-watersheds in the river catchment and mapping of critically degraded areas requiring various biological and engineering treatment measures. Identification of area for treatment based upon Remote Sensing & GIS methodology and Silt Yield Index (SYI) method of AISLUS coupled with ground survey. The prioritization of watershed for treatment based upon SYI. Spatial Information in each micro watershed should be earmarked on maps in the scale of 1:50,000. The Cat plan would be prepared with year-wise Physical and financial details.

(b) Creation of Green Belt Plan around the Periphery of the Reservoir and Compensatory Afforestation Scheme in consultation with the State Forest department.

(c) Biodiversity Conservation and Wild life Management Plan for conservation and preservation of endemic, rare and endangered species of flora and fauna (in consultation with the State Wildlife Department)

(d) Fisheries Development plan for conservation/management of reverine fishes.

(e) Resettlement & Rehabilitation (R&R) Plan along with social/community development. R&R plan would be framed in consultation with the Project Affected Persons (PAPs), Project Authorities and the State Government. R & R Plan would be drafted according to the NPRR 2003 and the policy of State Government.

(f) Muck Disposal Plan (Suitable sites for dumping of excavated material would be identified in consultation with the State Pollution Control Board and Forest Department)

(g) Energy Conservation Measures

(h) Dam Break Analysis & Disaster Management Plan.

(i) Restoration and landscaping of working Areas: reclamation of borrow pits (quarry sites) and construction areas.

(j) Public Health Delivery System including the provisions for drinking water facility for the local community.

(k) Management during the Road Construction

(l) Sanitation & Solid Waste Management Plan for domestic waste from colonies and labour camps, etc.

(m) Water and Air Quality & Noise Environment Management during construction and post-construction periods.

(n) Forest Protection Plan

(o) Reservoir RIM Treatment Plan

(p) Environmental Monitoring Programme (With physical & financial details covering all the aspects form EMP).

(q) For such a large and high budget project, neglecting drinking water component may not be justified. Therefore, if supplying safe drinking water to the population surrounding the project area is not to be considered, a clear justification for this may be given

(r) Option assessment study to show that are the option available for fulfilling the needs of the people that the project hopes to fulfil. This should also show if and how the proposed project is the least cost option and also include reducing the transmission and distribution losses to the minimum.

(s) A summary of Cost Estimate for all the plans (Cost for implementing all the Environmental Management Plans including the cost for implementing Environmental Monitoring Programme, aforesaid compensation, mitigation and management measures, etc.)

In respect of North-East, the following should be added

- Tribal area development plan as the area is predominantly tribal.
- Mitigations measures to check shifting cultivation (Zhum Cultivation) in the catchment area with provision for alternative and better agricultural practices
- In addition to Socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area.