EXECUTIVE SUMMARY

0.1 INTRODUCTION

*Electricity is an essential requirement for all facets of our life. It has been recognized as a basic human need and quite important for socio-economic development of the country. Hydroelectricity is a clean and renewable source of energy. The total potential in Himachal Pradesh is 12235.24 MW at 60% load factor, with an installed capacity of 20392.07 MW. The proposed Tidong Hydropower project has a capacity of 100 MW and is located on the Tidong Khad, a tributary of river Satlej in Kinnaur district of Himachal Pradesh. It is a **run of the river** scheme proposed to harness the Hydel potential of Tidong Khad in its lower reach between Lumber and Rispa villages. The project is situated 270 km from Shimla on National Highway 22 upto a place near Moorang and thereafter 13 km on state road upto village Thangi. From Thangi upto diversion site, about 8 km stretch road is under construction. Diversion weir would come at Lumber village and powerhouse at Rispa village.*

The main objective of the study is to carry out the Rapid Environmental Impact Assessment (EIA) for the proposed Tidong Hydro Electric Power Project to meet the environmental clearance criteria of Ministry of Environment and Forests, Government of India.

0.2 PROJECT DESCRIPTION

A summary of main feature of the project is given below :

1. LOCATION			
	Longitude	:	*78° 22' 10"E to 78° 47' 50"E*
	Latitude	:	*31° 20' 30" N to 31° 33' 30" N*
2. SPILLWAY			
	Type	:	*Non Gated*
	Maximum Water level	:	*2888.00 m*
	Average river bed level at barrage axis	:	*2880.00m*
	Crest level of Spillway bays	:	*2881.75 m*
	Energy Dissipation System	:	*Stilling Basin*
3. RESERVOIR			
	Capacity	:	*4 Hours peaking (23700m^3)*
	FRL	:	*2873.75 m*
	MDDL	:	*2860.75m*
	Reservoir bed level	:	*2860.00m*
	Type of desilting arrangement	:	*Dragging by Siphon action*
4. HEAD RACE TUNNEL			
	Type and Size	:	*Concrete Lined, D – Shaped, 3.5m Finished Dia.*
	Length	:	*8461 m*
	Design discharge	:	*19.2 cumec.*
	Slope	:	*1 in 160*
4. POWER HOUSE			
	Type	:	*Surface*
	Installed Capacity	:	*100 MW (2 x 50 MW)*
	Size	:	*63.00 m x 25.0 m*
	Maximum gross head	:	*609.42 m*
	Max Net head	:	*603.67 m*
5. TAIL RACE CHANNEL			
	Type	:	*Surface*
	Size	:	*4 m wide open channel, 50 m long*
	Velocity	:	*1.90m/s*
6. ESTIMATED COST			
	Pre Operative and Civil Works	:	*Rs. 2303.5 million*
	Electrical /Mechanical Works	:	*Rs. 1303.6 million*
	Transmission works	:	*Rs. 420.2 million*
7.	***CONSTRUCTION PERIOD***	:	*5.0 years*

0.3 ENVIRONMENTAL BASELINE DATA

The data has been compiled for: Land Environment, Water Environment; Air Environment; Noise Environment; Ecological Environment and Socio-economic Environment. Primary data related to the environmental attributes like air, noise level, water quality and soil was collected from field studies. A structured questionnaire was used for collection of primary information on socio-economic aspects. Ecological information were collected from field studies as well as secondary sources. The other information presented in this chapter has been collected from various sources.

Land Environment

Parameters involved in land environment are physiography, geology, minerals, soils, land use pattern and seismicity

Land Use Pattern : *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 barrage site has been derived using latest cloud free satellite imageries. The data has been geo-referenced using SOI 1:50,000 scale toposheets with the help of standard data preparation techniques in ERDAS IMAGINE software. Interpretation of the geo-referenced data has been done using standard enhancement techniques and ground truthing.The landuse of 10 km radius project area studied through satellite imagery indicates that about 45% of it is covered with various types of vegetation i.e. dense vegetation (15%), medium vegetation (8%) and sparse vegetation (22%), which refers to the crown cover density of >40 %, 10-40 % and <10 % respectively. The other two important land covers are barren; about 23% and snow covered; about 17%.* ***Physiography :*** *The project area is situated in Tidong valley in the Himalayan mountains. The Tidong River joins the Sutlej about 300m downstream of the proposed powerhouse. The catchment area of the project , however, falls in the Himalayan and the Jaskas ranges. The Zasker range (7026 meters) forms the international boundary between India and Tibet. The project is situated at a height of 2872 meters (barrage) to 2287 meters (powerhouse) above MSL .* ***Geology :*** *The project area lies in the Mehbar and Maldi gneisses comprised of kyanite and psamatic gneisses with bands of schist and quartzite. These are intruded by basic and acidic rocks. All the rocks are well foliated. The general trends are N-S with moderate dips towards East. The rock formation within the project area going upstream from the tailrace consist of the Wangtoo, Rampur and Jutogh gneisses and granites.* ***Soils and Minerals :*** *The Soil of the project area is skeletal mountain meadow and sub-mountain. It is thin on most hillsides of the district. Extreme south-eastern part is covered with snow. The profiles of the soils are well developed in dense forest and at higher altitude. Rocks found in the district are mainly granite, slates, schists, gneisses, phyllite, quartzite and limestone. Soil test results indicate sandy loam soil with pH neutral/slightly alkaline and conductivity less than 2. It is rich in Nitrogen, Phosphorus and Potassium content, indicating the good fertility of soil.* ***Seismicity :*** *The project area lies in seismic Zone - IV according to the Seismic Zoning Map of India.*

Water Environment

The domestic, irrigation and other daily needs of water in the project area are met with surface water source, available in plenty in the form of perrineial springs and

streams. Ground water development is very limited due to its limited needs. Surface water test results show that results of most of the parameters are within desirable limits of drinking water except for total hardness and Iron content. Five samples out of the eleven exceeded the desirable limit of total hardness, however, only two results exceeded the class 'A' water limits. Iron content in 8 results exceeded the desirable limits, but only one result is found more than the tolerance limit of class 'A' water. Traces of BOD value appears in the water which may be due to lack of sanitation facility in the project area.

Air Environment

Meteorology : *The tract of the district is of temperate zone climate with winter from November to April and summer from May to October . The winter season is a little extended by virtue of elevation of the area. The summer season in itself includes the rainy season from July to September.* ***Rain Fall:*** *The average annual rainfall in the project area is to the tune of 400 mm and snowfall of about 370 cm.* ***Temperature and Humidity****: The temperature varies between -2.9 deg C to 24.5 deg C and mean monthly relative humidity between 23 to 85% in a year.* ***Air Quality*** *: Air Quality test results indicate that the air pollution level in the project area is within the Ambient Air Quality Standard.* ***Wind Speed and Wind Direction*** *: Windrose for winter, summer, rainy season and annual shows the prevalent wind direction as north-east at 8:30 hours and south-east at 17:30 hours.*

Noise Environment

While comparing the test results with the Standard Ambient Noise Level, it is observed that prevalent noise levels in the project area are a little higher than the prescribed limits for residential area but less than that prescribed for Industrial area. The main source of noise is due to the river water flow.

Ecological Environment

The Western Himalayas represent a storehouse of a large array of floristic diversity. The area is largely inaccessible and hence, the vegetation is far less degraded than the plains. The mountain ecology, however, is extremely fragile and vulnerable to biophysical changes. The distribution of vegetation follows an altitudinal zoning similar to that in the outer Himalayas but on account of the marked variation in the annual precipitation along the entire length of Satlej Valley, the tract can be divided into three main climatic zones namely the wet, dry and arid zones. The project area falls under the dry zone. Field study was carried out for terrestrial and aquatic ecology at three location namely; S1 (near barrage site), S2 (in between of S1 and S3) and S3 (near power house site). ***Terrestrial Ecology:*** *The objective of the study was to prepare an inventory of flora, listing of rare, endangered, economically important and medicinal plant species and to determine frequency, abundance and density of different vegetational components. Quadrate method was used for sampling. Plant diversity of the project area encompasses 20 species of tree, 30 species of shrubs and 30 species of herbs including 6 species of climbers and 8 species of grass. The species diversity indices at sampling site S_1 and S3 indicate a rich biodiversity while at S2 it shows poor biodiversity.* ***Terrestrial Fauna:*** *There is no wildlife conservation area with in 25 km distance from the project site. Wild animals like Snow leopard, bear etc. live at high altitude and are rarely seen around the project area. Lizards are very common in the area. Pug mark of a Snow leopard and a Himalayan pit viper were observed during the study.* ***Aquatic Ecology:***

Aquatic ecological analysis was made following the methods outlined in Wetzel and Likens (1991) and APHA (1998). Periphyton, phytoplankton, macrobenthos and zooplankton were studied for frequency, density, abundance and diversity indices. The P/R ratio in the range from 1.056 to 1.156 indicates autotrophic nature of the aquatic ecosystem. The biological analysis of aquatic organisms revealed that the periphyton, phytoplankton and macrophytes represented as primary producers. However, zooplankton and benthos represented as the secondary producers. No fish species was encountered at sampling site S_1 and S_2. However, the species of Snow trout (Schizothorax richardsonii) and Rainbow trout (Salmo trutta fario) were present at the sampling site S_3.

0.4 SOCIO-ECONOMIC ASSESSMENT

The proposed project will lead to construction of the diversion barrage, headrace tunnel, powerhouse etc. Construction of the project facilities would require 46.66 ha of land, out of which 41.59 ha is the government/forest land and the remaining 5.07 ha is 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, which will be migrating in the project area during construction, would also cause certain demographic and social changes, since the project is situated in remote area

Only four households in Lumber village shall be affected due to proposed partial acquisition of their agricultural land for the project. The project, however, does not require acquisition of any structure /house. A survey was undertaken to study and understand the socio economic conditions of these project-affected households and to examine the impact of the proposed project thereupon.

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***Socio-Economic Profile of Project Affected People (PAP)**:*

***Sex and Age :** The population affected due to upcoming of the project is 40 with 45% male and 55% female population. About 40% are in the age group of 16-25 year, followed by 30% in 41-60 years. **Educational Attainment: 12.5**% of the PAPs have their education up to primary level, 62.5% of them have their education up to and above middle school level. **Religion and Caste:** All Buddhist families come in ST group. **Occupation:** The project-affected families depend on the agriculture activities. **Family Income:** 50,001-1, 00,000/- and 100,001-2, 00,000/- are the two income group of people. **Marital Status:** 42.5% people are the married population. **Family Pattern and Size**: Family has 8 or more family members and is of joint type. **Enlistment:** Affected people are vote listed having the ration card. **Family Assets and Acquisition:** Land is in the range of 1.25-2.5 and 2.5-5.0 acres with average land holding as 3.28 Acres. Their houses are constructed of wooden considered as semi-pucca houses with area of construction 50-100 sq metres. No electricity supply is in the village. They have more than 100 fruit bearing tress. **Infrastructure Facilities:** There is no sanitation facility, dispensary, post office, road, transport and communication system in the village.*

Social Impact Analysis

***Pressure on Existing Infrastructure/Resources :** Creation of the project infrastructure like roads, electric supply would also be available for the project affected people. I**ncidence 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. ***Cultural Conflicts:*** *People of this area have distinct habits of food and clothing along with deep religious faiths celebrating their festivals with great enthusiasm. Hence, chances of cultural conflicts may take place with that of migratory population.* ***Cost of Living and Inflation:*** *Minor increase in cost of living and inflation would 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. As mentioned earlier in this chapter no family will be displaced due to the project and as such no resettlement is involved. Only partial acquisition of agricultural land from the only four families of Lumber village would be necessitated for the project. The number of affected families is much less than 250, hence the NPRR-2003 is not compulsorily applicable in this case.

The affected families would be compensated for acquisition of their land in accordance with the local norms applicable for such acquisition. It is also obvious that such compensation would never render sufficient to compensate the indirect losses to the local people. It is felt strongly that the local population of the project area deserves certain incentives towards their social upliftment, so that they feel themselves an integral part of the overall development. With this principal objective in view, the project proponent has envisaged a Social Response Program (SRP) for the project as described below. The SRP would be carried out with active involvement of the affected people. It provides for livelihood support, infrastructure development, education assistance, public health facility, gender support, water conservation and harvesting and creation of employment opportunities. A provision of Rs. 102.21 lakh has been kept for the SRP. A separate body comprising of representatives from project management & public representatives shall be formed for monitoring and concerted evaluation of the SRP.

0.5 ENVIRONMENTAL IMPACTS

Potential negative and positive impacts of the proposed project have been assessed in different phases of project cycle namely location, construction and operation.

Impacts Due to Project Location

Loss of Land/Change in Land use : *43.59 ha forest land and 3.07 ha private agricultural land will be diverted for the project purpose, permanently. The project does not require any built-up area. In addition, 12 ha of land will be required for temporary purpose which will be reclaimed after use.* ***Loss of Forest Produce :*** *The project would result in loss of 39.2 ha forest comprising 355 tress per hectare on an average, the wood loss is estimated to about 34790 cum.* ***Encroachment into Nature Reserves and Wildlife :*** *The proposed project (10 km radius area) does not encroach into a wildlife sanctuary or any other type of nature reserve. The field observations and the discussions with the local people do not indicate that the project area functions as a corridor for movement of wildlife. It could, therefore, be concluded that the project would not have any impact on the wildlife habitat or corridor.* ***Loss of Monuments :*** *No historical, religious or cultural monuments will be lost due to the project location or its activities.* ***Loss of Infrastructure/Property :*** *The proposed*

project does not cause loss of any infrastructure facility like school, hospital, road, communication facility, post offices or any kind of other community resources. It would also not cause loss of any private houses/structure. ***Erosion and Siltation Risks :*** *A desilting chamber has been provided at the entry of the Head Race Tunnel to arrest the silt of size greater than 0.20 mm, which ultimately is discharged back into the river.* ***Disruption of Hydrological Balance :*** *The flow of water in about 8 km long stretch of the river, downstream of the barrage site, would be affected due to the construction of barrage. It is observed during site inspection that water is not drawn from the affected portion of the river (between barrage site and tailrace tunnel) for irrigation or any kind of industrial use. The people residing in the nearby locality rarely use it for washing, bathing etc., since other convenient sources of water in the form of springs/smaller streams having better quality (with lesser sediment load) are available to the people and animals. The first perennial stream on right bank is 200m downstream of barrage site having discharge of about 36 cum/hour, another perennial streams named Duba Khad, Shicky Khad and Gara Khad along with small streams meets the Tidong river. The most affected stretch of the river thus, will be only 200m downstream of barrage. Reduction of flow in this particular stretch of the river is not going to cause any disruption of water supply for any purpose because water is not drawn from this stretch of river for any kind of use.* ***Risk due to Earthquake:*** *The project area falls in zone IV of the Indian Standard Seismic Map and sensitive from seismic point of view. For safety of the structures, necessary factors and appropriate co-efficient have to be incorporated in designing the structures under worst combination of forces.* ***Environmental Risks due to Future Developments:*** *The projects on its completion would create conditions favourable for setting up of new industries in the surrounding areas, which could accelerate the process of deforestation and have other negative impacts on the environment.*

Impacts Due to Project Construction

Environmental impacts related to construction works are mostly temporary in nature, however, needs to be addressed adequately. The likely impacts related to the construction works are: ***Soil Erosion at Construction Sites :*** *Any groundbreaking activity for construction works, whether permanent or temporary, would require removal of vegetation cover from ground. Runoff from unprotected excavated areas, muck disposal sites, quarry sites, etc., would result in increased soil erosion. Excavations on slopes would also decrease its stability. Given with the topography of the area, unprotected excavations on sloping grounds will make landslide prone sites, especially during the rainy season. Excessive soil erosion and mass movement of soil is likely to disrupt the natural drainage, which can lead to impounding of runoff in dangerous preposition.* ***Muck Generation:*** *Approximately 641,000 cum muck is estimated to be generated from the project activities, out of which about 45% shall be used for backfill and other construction works. The remaining quantity of muck shall be disposed at pre identified sites. The disposal sites, if not designed and managed properly may cause mass movement of soil blocking the natural drainage and causing other sequential problems.* ***Transportation of Muck and Construction Material/Machinery :*** *0.44 million cum of muck generated during the construction of various components of projects will be transported to muck disposal site. The construction of the project requires about 0.63 lakh cum of fine aggregate, 1.27 lakh cum of coarse aggregate, which need be transported from crusher/quarry to the batching plan. About 0.49 lakh tones of cement and 3577 tones of steel plus 15 lakh liters of POL, construction machinery and E&M equipment need be transported from the nearest railway station at Kalka to project site. Transportation of this material would add SPM and other vehicular pollutants to the local air shed.* ***Deforestation :*** *Improved access to the presently virgin area during and after construction of the*

project would put pressure on the forest adjoining to the project site and may lead to degradation of nearby forests, if not managed properly. ***Human Health:*** *Health risk during the project construction includes disease hazards due to lack of sanitation (water supply and human waste disposal), vector borne disease and hazards due to local carriers. Therefore, the health management system must include proper facilities sanitation, water supply, solid waste management and health care.* ***Water Pollution:*** *The BOD load contributed by the domestic sewage will be about 34 kg/ day. The sewage from workers camp and other establishments need be treated before its final disposal.* ***Cultural Hazards:*** *During construction phase of the barrage and other works, problems could arise due to difference in customs of outside workers and local residents. These can be avoided by providing adequate facilities in workers camp and by employing the local labor.* ***Fisheries:*** *The effect on fish population is negligible as no fish habitats are found near the barrage site and immediate downstream.* ***Air Pollution:*** *Diesel powered trucks used for the haulage of construction material and running of construction machinery at the construction sites are the sources of air pollution. Electric power supply from Himachal Pradesh Electricity Board is proposed to put the electrically operated construction machinery/equipments. Hence, only source of pollution will be movement of trucks and use of Gen Set at power cut. The increase in concentration of air pollutants during construction would be of temporary nature and would remain well within the prescribed limits. It is, therefore, considered that the project will not cause any air pollution of significance.* ***Noise Pollution :*** *Construction activities are expected to produce noise levels at source in the range of 80-140 dB (A) and the personnel operating the machines and the workers stationed close to the machines are prone to exposure of high levels of noise. Careful planning of machinery operation and scheduling of operations can however reduce the noise levels. Absence of sensitive receptors around the project results into no significant impact.*

Impacts Due to Project Operation

The impacts due to project operation shall be long term and can be both positive and negative in nature. The negative impacts are : ***Reservoir Evaporation Losses*** *: Due to six months winter and six months summer season and temperature variation between -2.9°C to 25°C, a little evaporation would take place having insignificant impact on environment.* ***Deforestation*** *: Increased human activity in the area will increase the biotic pressure on the forest. The requirements of fuel wood for heating and cooking will be replaced by cheap electricity generated by hydropower projects, ultimately reducing deforestation. Provision of dedicated grazing lands will also help in reducing pressure on forests.* ***Effect on Wildlife*** *: Project area does not harbour any wildlife at or near the site of powerhouse or barrage.The operation of project will not have any impact on the wildlife functioning in the area.* ***Change in Water Quality and Risk of Eutrophication*** *: The change in water quality due to leached soil nutrient and runoff sediment may lead to eutrophication of surface waters. The eutrophication is mainly due to the presence of nutrients such as nitrate and phosphate. Analysis of water samples shows phosphate concentration > 0.1mg/l in six out of the eleven and < 0.1mg/l in the remaining five with an average of 0.11 mg/l. These concentrations added with the very small size of the reservoir does not pose any potential risk of eutrophication.* ***Increased Incidence of Water Related Diseases*** *: As water will be flowing, the chances of vector life (mosquito) to thrive are less hence implementation of project would not lead to malarial fever.* ***Impact on Fish and Aquatic life*** *: The construction of barrage will create a barrier in the natural flow of water and possibility of fish spawning may be seen.* ***Public Health*** *: Domestic requirement of water supply will be met by taking water from upstream side of river or*

springs as found suitable. The spring water is ,however, noted more suitable for drinking and can be supplied after chlorination.

Positive Impacts

Clean and Renewable Source of Energy : *On completion, the project would provide 100 MW of electricity which is a non polluting and renewable source of energy.* ***Employment Opportunities :*** *About 1500 people are likely to work during peak period of activity (equivalent to 1500 people x 240 working days/year x 5 years of construction = 18.00 lakhs mandays). In operation phase, about 70 people will be stationed for operation and maintenance of the project (equivalent to 70 people x 240 working days per year = 16,800 mandays/ year). Thus the project would provide substantial direct employment and in addition to these, more people would be indirectly employed for allied activities.* ***Catchment Area Treatment :*** *One of the major beneficial impacts of hydropower projects is the treatment of degraded catchment area of the project to control the soil erosion. This results in regeneration of natural forests and other ecosystems significantly benefiting to the environment.* ***Recreation and Tourism Potential :*** *The proposed barrage will be located on river Tidong near village Lumber, a tributary of Satlej. Kinnaur is called "Dev Bhumi" and is located in the tottering heights of Himalayas, having passes that remain inaccessible almost for six months was a forbidden land till now and only open to a chosen few. Now the secret beauty of this place is open to all who like to witness what had been hidden for centuries together. Due to above features of district and natural beauty of the project area, it can be considered as a tourist attraction by developing adequate infrastructure in and around the project area.* ***Additional Habitat for Aquatic Life / Wetland Species :****The creation of reservoir (capacity 23700 cum with 1.98 ha surface area) provides a habitat to wetland species, especially water birds. The increased water surface will create additional habitat for aquatic life in or near the reservoir. Receding waters will create dry mudflats and shall provide suitable feeding sites for migratory birds in autumn and spring. This will also provide breeding habitat for resident species and can be a significant environmental benefit.* ***Fisheries and Aquaculture Potential :*** *Efforts to stock commercially valuable fish in the reservoir will lead to the increase in fisheries (catch and income) in the reservoir. Creation of reservoir will develop potential for fish and fisheries farming. No fish is observed at the barrage site in Tidong being the steep slope of river bed and cold climate but it can be developed in the reservoir.* ***Benefits to Economy :*** *Development of infrastructure and availability of reliable power supply as a result of the project realisation would contribute to the stimulation of economic activities like small scale industry in the area. The project will benefit the economy at both local and national level.* ***Less Fuel Consumption :****The project capacity is 100MW and it would generate 301.10 GWh power annually on 90% dependability. In no project scenario, in order to generate this power by thermal power plant, about 0.32 million tones of coal would be utilized. With the implementation of this project equal amount of coal is saved. Specific fuel consumption has been taken as 1.06Kg/ Kwh. This will directly benefit to the tune of Rs. 640 million per year.* ***Reduction in Air Pollution :*** *Hydropower produces no air pollution/greenhouse gases as compared to Thermal/coal power stations. It is very efficient, reliable, and –once installed- inexpensive. Hydropower systems can provide both base load and peaking power.* ***Reduction in Greenhouse Gas (Carbon Dioxide) Emission :*** *About 0.30 million ton of CO_2 will be emitted from 100MW coal fired thermal power plant. This will reduce 0.30 million tones of green house gas contribution to the global environment every year. The cumulative reduction in Green House gas (CO_2) in the taking 70 years lifetime of the project thus works out to 21.0 million tones.*

Increased Infrastructure *: Present infrastructure is either likely to be upgraded or new infrastructure is set up with the implementation of the new project. Basic infrastructures required to be developed are roads, health facilities, educational facilities etc. The project affected people shall be benefited due to development of better infrastructure in the project area.*

CHECKLIST OF IMPACTS DUE TO THE 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			*		
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	*				*

0.6 ENVIRONMENTAL MANAGEMENT PLANS

An EMP for the project has been prepared and presented, which defines actions to be undertaken during the pre-construction, construction, and operation stage of the project. The important actions during the ***pre-construction stage*** *are; site selection*

to minimize the submergence (already minimized to 1.98 ha) and in turn to minimize the loss of terrestrial ecology and displacement of people; adequate design provisions for safety of project structures in general against seismological hazards. ***Construction time*** *mitigation measures include; control of soil erosion/mass movement at excavation sites and muck disposal area; control of air, noise and water pollution as a result of various construction activities; good housekeeping practice at workers camp and close monitoring of any impact on water resources. The effectiveness of these environmental considerations will, however, depend on appropriate inclusion of these in the work contracts.* ***Operation period*** *mitigation would involve good house keeping practice, wastewater disposal and maintenance/upbringing of green area/plantation. The operation unit will also be required to confirm, receipt of the construction period mitigation report and prepare a follow on timetable of actions.*

Mitigation Measures:

Pre-construction mitigation *measures will include; Compensation for Loss of Land: Compensation for private land acquired for the project would be paid to the affected people as per government norms. Over and above the cash compensation, social welfare of the project affected people have been planned and addressed under Social Response Program (SRP) of the project.* ***Compensatory Afforestation :*** *Compensatory afforestation over an area of 87.18 ha in the nearby degraded forest area is proposed. Rs 23.81 lakhs for the same is kept in the estimate.* ***Sedimentation Control:*** *The project design, envisages removal of suspended particles of size greater than 0.20 mm prior through a conventional type surface desilting arrangement to take care of any possible damage to the turbine by suspended particles. A comprehensive Catchment Area Treatment (CAT) plan will reduce the sedimentation load in the water reaching the reservoir/desilting chamber.* ***Sacrificial Flow:*** *A sacrificial flow of 0.25 cumec (about 10% of lean period flow) is considered sufficient and is provided in the design of barrage to sustain the aquatic life and any other down stream use of the river water.*

The construction period mitigation *would include* ***Soil Erosion Control****: A general guideline to control soil erosion shall be to stop all the earthwork activities during rainy season so that surfaces having loose earth are not exposed to rains. The cutting and filling area, on completion of the work shall be dressed well, compacted and covered with plantation.* ***Muck Disposal:*** *All the muck disposal sites shall be covered with vegetation after leveling and dressing the top surface. The muck shall be filled in these areas in layers and compacted mechanically. Dumping sites on sloping ground shall be protected adequately against any possible slide/slope failure through engineering measures i.e. retaining wall. A provision of* ***Rs*** *13.18 lakh towards development of muck disposal sites as green patches has been made.* ***Measures for Road Construction:*** *Guidelines which need to be followed during road construction are minimum required cleaning area, saving maximum number of trees, controlled blasting, retaining wall to stabilise the slope and simultaneous cut and fill operation.* ***Side Slope Stabilization of Excavation:*** *Engineering measures like application of boulder crates at critical locations would be applied to stabilize the slope of excavation if needed. On completion of the excavations the excavated surface shall be dressed neatly and covered with plantation, wherever possible.* ***Measures to Control Indiscriminate Felling of Trees :*** *An inventory of trees required to be cut shall be prepared showing the details of each tree to obtain necessary prior approval. Encroachment on nearby forest reserves and subsequent forest degradation can be avoided by arranging adequate supply of alternative fuels. A provision of Rs. 36.00 lakh has been kept for alternate fuel.* ***Air Pollution Control*** *:*

Though the estimation of air quality during construction shows insignificant impact on ambient air quality, nevertheless certain mitigation measures i.e. timely removal of debris, sprinkling of water, installation of pollution control device at stone crushers, installation of concrete batching plant in the vicinity etc. shall be adopted to reduce the air pollution. ***Noise Control:*** *During the construction phase, there would be a temporary increase in ambient noise levels due to construction machinery operation and movement of construction vehicles. Exposure to continuous and intermittent noise levels louder than 115 dB(A) should not be permitted by adopting certain mitigation measures as provision of special acoustic enclosures should be provided for individual noise generating construction equipment, provision of earplugs to workers etc.* ***Water Supply and Wastewater Treatment Facility for Workers Camps :*** *Labour employment during peak construction period is estimated as 1500, out of which 1000 are expected to stay at workers camp with family, hence provision for water supply and sanitation for 2000 people is provided in the estimate which is Rs 50.8 Lakh.* ***Solid Waste Management for Labour Camps :*** *Solid waste management for 2000 people is provided in the estimate for safe collection, transportation and disposal of solid waste for which about Rs. 62.10 Lakh is kept in the estimate.* ***Health Delivery System :*** *According to the criteria of Ministry of Health and World Health Organisation, two Health Centre (HC) with one doctor and minimum of five health personnel, (nurses, compounders etc.) for each HC would be required costing Rs 90.0 lakh.* ***Safety Precautions in Tunnel Construction*** *: The project authorities must recognize the causes of safety hazards in tunnel construction and establish programs, rules, regulations, guidelines and whatever else might be necessary to reduce accidents.* ***Cultural Upliftment and Education Assistance :*** *The project will serve as a platform for cultural exchanges bringing diverse cultural events which will lead to cultural upliftment of the area. To maintain the cultural heritage/events and promote awareness a provision of Rs. 5.00 Lakh has been provided in the estimate.* ***Training and Extension :*** *The training and extension programmes should also be extended for the local population for their active participation in the project implementation. Apart from training, such programmes should include guidelines for safety, measures of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc. The cost involved for such a programme is Rs 7.70 Lakhs.*

Operation Period Mitigation : Deforestation (Mitigation): *The requirements of fuel wood for heating and cooking can be replaced by cheap electricity generated by the hydropower project, ultimately reducing deforestation. Provision of dedicated grazing lands will also help in reducing pressure on forests.* ***Water Supply and Sanitation in Colony :*** *For 70 officials working at the time of operation of the project will be provided accommodation near to the project site. For the water supply and sanitation facilities, norms of Central Public Health and Environmental Engineering Organisation (CPHEEO) would be followed.* ***Refuse Disposal for Colony :*** *The power generation process does not generate any solid waste however; about 105 kg/day of solid waste would be generated from residential colony and office accommodation. The solid waste first needs to be collected in properly designed collection containers equipped with side handles to facilitate handling. All the collected solid waste will be transported at site for their safe disposal.****DISASTER MANAGEMENT*** *Disaster is anticipated due to failure of the barrage either by man made or natural causes. In case of a disaster, it is proposed to draw guidelines for reporting procedures, communication system and emergency action committee as follows:* ***Reporting Procedures:*** *The level at which a situation will be termed a disaster shall be specified. This shall include the stage at which the surveillance requirements should be increased both in frequency and detail. The engineer-in-charge should notify the officer for exit points for the people, safety areas in*

underground structures, and nearest medical facilities. ***Communication System****: An efficient communication system is absolutely essential for the success of any disaster management plan. This has to be worked out in consultation with local authorities. More often, the entire communication system gets disrupted when a disaster occurs. The damage areas need to be clearly identified and provided with regular and foolproof communication system.* ***Emergency Action Committee:*** *To ensure co-ordinated action, an Emergency Action Committee (EAC) should be constituted. The civic administrator may be the Chairman of this committee. All personnel involved in the Emergency Action Plan should be thoroughly familiar with all the elements of the plan and their responsibilities. They should be trained through drills for the Emergency Action Plan. The staff at the site should be trained for problem detection, evaluation and emergency remedial measures. Individual responsibility to handle the segments in emergency plan must be allotted. Success of an emergency plan depends on public participation, their response to warning notifications and timely action. The public has to be educated on the hazards and key role in disaster mitigation by helping in the planned evacuation and rescue operations.* ***Emergency Measures:*** *shall include Emergency Lighting and Fire Protection****. Epilogue:*** *Impacts, as discussed on natural resources, terrestrial and aquatic ecology of the area could be mitigated with available know-how in technology. The key issue is that the project would cause social upliftment of affected people and improvement in ecological environment in addition to the economic gains. Based on environmental base line data, prediction of positive and negative impacts and assessment, it could be concluded that the project will bring benefit at regional level. After incorporation of environmental management plans, the environmental sustainability will be further improved. In a nutshell, it could be concluded that the project is environmentally sustainable and eco-friendly.*

0.7 CATCHMENT AREA TREATMENT PLAN

Catchment Scenario *: The total catchment area at proposed barrage site is 570.55 sq km, out of which about 95% is above permanent snowline (EL 4200m), which is either stony or snowbound area with no vegetation. The remaining 5% area where any kind of vegetation can grow is substantially denuded and deforested due to indiscriminate felling, repeated lopping of trees for fodder, uncontrolled excessive grazing and annual burning of forest. Reduction of vegetative cover in the recent times has worsened the ecosystem of Tidong valley, which is otherwise fragile due to its geomorphologic features.*

Catchment Area Treatment and its Need: *Sedimentation of the reservoir is a function of soil erosion rate of the river catchment area. It reduces the water storage capacity of reservoir and availability of water for its designated use. It could, therefore, be concluded that useful life of a hydroelectric project is directly related to the soil erosion rates of the catchment area. The past experience of hydropower projects shows that sedimentation of reservoir has determined the useful life span of such projects. Remedial measure like dredging and disposal of sediment has not proved practically useful since it is cost exorbitant. Erosion of topsoil from the catchment also reduces its fertility and the vegetation growth as well. The catchment of river Tidong has very steep ground slopes where rainfall/snowfall is the prime factor responsible for erosion, which is severe to the extent that mass movement of soil (land slide) is a very common phenomenon. Tidong HEP is a run of the river scheme; hence storage of water is not anticipated. A small balancing reservoir has been provided leading to desilting chamber to prevent the wear and tear of the turbine. Catchment area treatment results into less sediment load of water to be removed by desilting chamber and less amount of silt discharge down stream of*

barrage back into the river. It, therefore, becomes imperative to take adequate preventive measures towards soil erosions at the planning stage itself. Providing vegetation cover will have two fold effect in erosion control, the first is that it improves the soil matrix through reinforcing and second it reduces the intensity of run-off. Breaking of slopes through engineering measures like, check dams, contour bunds and retaining walls discontinue the slopes and prevent mass movement of soil ***Objectives:*** *Integrated watershed management aimed at minimizing the sedimentation of reservoir and ecosystem conservation of the catchment area is the prime objective of the catchment area treatment..* ***Approach and Methodology:*** *Two hydroelectric schemes are proposed on Tidong River. The catchment area of Tidong I being downstream shall overlap the catchment of Tidong II. To avoid overlapping of the catchment area treatment, the CAT plan of scheme has to be area specific by dividing the total catchment of the river in a rational manner. In this effort, it is proposed that the catchment area falling between Tidong I and Tidong II barrage site only be considered for treatment under the subject work leaving the remaining catchment for treatment under Tidong-II scheme.* ***Soil Erosion Estimation through GIS:*** *GIS proved a very useful tool for soil erosion estimation using thematic maps: Landuse/ Landcover map, Slope map and Soil map. Data has been generated from Indian Remote Sensing (IRS) Satellite ID/P6, LISS III sensor procured from National Remote Sensing Agency. The data from LISS III sensor is of 23.5 m resolution. The areas falling under various slope categories indicate that 78.32% of the area has a slope of more than 50%, which reflects towards the ruggedness of the area.* ***USLE Modeling****: The catchment area has been divided into small grids of 20mX20m. The vector layer so generated of 20m-grid size was updated by Landuse/Landcover details, soil information and slope values in Mapinfo Professional software using different maps as generated above. Soil loss has then been calculated in tons/acre/annum for each grid using Universal Soil Loss Equation (USLE) through information derived for updated grid with the help of a customized computer software program. A thematic map has been prepared using these calculated soil erosion values for delineating areas prone to soil erosion in the study catchment.* ***Sediment Yield Index (SYI):*** *SYI has been calculated based on the methodology developed by All India Soil & Land Use Survey (AIS & LUS). Each erosion unit was assigned a weightage that indicate the relative erosion intensity. A map of prioritization of different sub-watersheds has been prepared highlighting priority categories.* ***Catchment Area Treatment Measures included*** *plantation over an area of 100 hectare in the degraded forest area. The area earmarked for plantation i.e. sub watersheds no. WW_1 to WW_3, have been earmarked for treatment and are directly draining into the reservoir. Actual patches for plantation shall be earmarked physically by the CAT implementing agency at the time of execution, depending on the accessibility as well as treatability of the area.* ***Cost Estimate and Phasing of Works:*** *Cost of the CAT works has been estimated to Rs. 4.86 crore.*

0.8 ENVIRONMENTAL MONITORING PLAN

The environmental monitoring will be required during construction and operational phases for: Land Compensation and Social Welfare, Water Quality and Public Health, Catchment Area Treatment Measures; and Air Quality and Noise Level. ***Establishment of Environmental Division:*** *Nuziveedu Seeds Limited (NSL) shall establish an Environment Division, which shall have an Environmental Engineer/Officer, a Technical Assistant (environment background) and two other assistants (miscellaneous works). The task of the division would be to supervise and co-ordinate studies, monitoring and implementation of environmental mitigation measures, and it shall report directly to the General Manager of the Project. An Environmental Advisor shall review progress of the division every year. The*

Environmental Advisor would be an experienced Ecologist or Environmentalist familiar with environmental planning of water resources projects. Cost of such a Division has been estimated as Rs.75.35 lakh. ***Environmental Costs:*** *All costs involved in Environmental Mitigating measures and Management to be put on the account Tidong-I Hydroelectric project works out to Rs. 942.20 lakh as summarised in table below..*

Environmental Costs

S. NO.	***ITEM***	***AMOUNT (LAKH RUPEES)***
1.	*Compensatory Afforestation*	*23.81*
2.	*Establishment of Nursary for endangered/medicinally important plant species*	*5.00*
3.	*Catchment Area Treatment Works*	*485.50*
4.	*Establishment of Environmental Division*	*75.35*
5.	*Development of muck disposal sites as green patches*	*13.18*
6.	*Subsidy towards provision of alternative fuel in worker's camp*	*36.00*
7.	*Water supply and wastewater treatment facility in worker's camp*	*50.80*
8.	*Domestic solid waste management facility*	*62.10*
9.	*Health delivery system*	*90.00*
10.	*Cultural upliftment assistance*	*5.00*
11.	*Environmental training program*	*7.70*
12.	*Sedimentation and CAT works monitoring*	*10.00*
13.	*Fishery Management*	*5.00*
14.	*Wildlife Enhancement*	*5.00*
15.	*Social Response Program*	*102.21*
	TOTAL	***976.65***