EXECUTIVE SUMMARY

1.0 BACKGROUND

Kuther hydel project has been contemplated as a run-of-river scheme on river Ravi. It envisages utilization of river water through a maximum/minimum gross head of 321.15 / 302 m respectively for generation of 240 MW of electricity in an underground power house located on left bank of river Ravi near village Kharamukh. The project will be able to generate 905 MU and 1092.24 MU of energy at power house bus bars in 90% dependable year and 50% mean year respectively. The power generated shall be fed to northern grid through 23 km long, one number double circuit 220 KV line from Kuther Power House to Chamera-III Power House. About 1200 persons including professionals, technicals, skilled and unskilled laborers will be required during the peak construction stage.

1.1 LOCATION AND APPROACH

The project is located in Tehsil Bharmour of district Chamba of Himachal Pradesh. The diversion barrage on River Ravi shall be located 4 km d/s of village Holi at longitude $76^0$31'58" E and latitude $32^0$20'52" N, and is accessible through existing Chamba-Holi road . The nearest rail head is Pathankot, which is about 160 kms from the project site.

2.0 PROJECT FEATURES

A 125 m long barrage comprising of 5 barrage spillway bays 11 m wide with radial gate of size 11 m x 12.5 m is proposed on the river Ravi to pass 100 year design flood of 6681 cumecs. The barrage crust elevation has been kept at El. 1685 m.a.s.l. while pond-level and upstream HFL is kept at El. 1706.75 m.a.s.l. and the barrage foundation level (lowest) shall be kept at 1678.09 m a.s.l. The FRL and MDDL have been fixed at El. 1706.75 m a.s.l. and 1700 m a.s.l. respectively.The intake shall be located just upstream of barrage at right angle to the flow section. Two number of modified D-shaped 3.5 m x 5.0 m size link tunnels have been proposed to carry the discharge from desilting basin to the intake of head race tunnel. The discharge of 92.64 cumecs shall be conveyed through a 6.2 m finished diameter circular pressure tunnel, which is 14.613 km long and provided under the hill ridge on the left bank of Ravi River.

An under-ground power house of size 85.5 m. x 18.5 m. x 42.0 m. shall be provided on the left bank of Ravi River near village Kharamukh to install and operate three units with cumulative generation capacity of 240 MW. An underground switchgear cum transformer cavern has been proposed adjacent to power house cavern. A circular tail race tunnel of 6.0 m diameter and 296.4 m long with bed slopes 1:71.6 will discharge the water back to River Ravi near village Kharamukh.

2.1 Power Benefits

The energy benefits from the project have been assessed as about 905.0 MU and 1092.24 MU per annum in 90% and 50% dependable years respectively. Out of this 1.2% of the units generated shall be accounted for auxiliary consumption and 0.5% shall be taken as loss in the transrmition upto bus bars. Thus, the net energy available at bus bar will be 889.67 MUs. The project envisages peaking operation of 3 hrs. in two spans of 1.5 hr. each in a period of 24 hrs.

2.2 Project Cost

The project is estimated to cost Rs. 191,520 lac at the rate of June 2009 price level. This includes Rs. 945,74 lac on Civil works, Rs. 343,91 lac on electro-mechanical works and Rs. 1934 lac on LADC. Interest during construction for a period of seven years at the rate of 11.5% per annum amounts to Rs. 373.18 lac. The cost per MW installed works out to Rs. 7.98 Cr. Levellised tariff for 90% dependable year energy for 35 years operation at 10.49% discount rate comes out to Rs. 4.38 per unit.

3.0 ENVIRONMENT IMPACT ASSESSMENT

Based on the EIA Notification dated September 14, 2006 of the Ministry of Environment and Forests, GOI approved on May 30, 2008 the term of references to conduct an Environment Impact Assessment studies and to formulate Environmental Management Plans for "Kuther Hydroelectric Project" (240 MW), M/S JSW assigned the job to Indian Council of Forestry Research and Education (ICFRE), Dehradun to conduct EIA study and formulate EMPs. Comprehensive study has been carried out to cover all the aspects as set out in the TOR offered by the MoEF vide letter dated 30.5.2008.

3.1 METHODOLOGY

Standard procedures were used to assess: (i) physical environment such as land use changes, air, water, noise, wind; (ii) biological environment such as, flora, fauna of both terrestrial & aquatic; and, (iii) social environment for the affected villages and project affected families.

4.0 EXISTING STATUS OF ENVIRONMENT

The EIA study includes assessment of various base line parameters of environment *viz;* physical, biological and socioeconomic aspects. Integration of these parameters gives an overall assessment of positive and negative impacts due to construction of the proposed hydroelectric project. The main findings of the study are as follows:

4.1 PHYSICAL ENVIRONMENT

The catchment is having variable physiography, climate, geology, slope, soil types and land use/land cover. While evaluating the land environment various parameters were analyzed in detail and the environmental impacts were predicted. In order to

study the land environment of the study area the baseline data pertaining to climate, basin characteristics, physiography, slope, geology, seismicity, soil, sedimentation and landuse/landcover etc were assessed in detail.

4.1.1 Local Geology of Project Area

The proposed Kuther Hydroelectric Project is envisaged in Ravi River Basin in the Chamba District in the western part of Himachal Pradesh located between Pir Panjal and Dhaula Dhar mountain ranges. According to Srikantia and Bhargava (1998), the Chamba Basin is located in Tethys Himalayan Tectogen in which a thick sequence of Proterozoic and Upper Paleozoic–Mesozoic rocks is exposed. These formations are co-related with similar rock types of Bhaderwah in Jammu & Kashmir in the northwest and the Proterozoic rocks are considered extension of similar rocks exposed in Lahaul in southeast.

4.1.2 Land use/Land Cover

Systematic mapping of land use and vegetation cover in the study area is one of the most important components necessary for an Environmental Impact Assessment study. The catchment area is a hilly undulating terrain and is characterized by steep hills and deep valleys. The land use pattern of the study area is summarized in **Table 1.1**.

Table 1.1: Land Use Details of the Study Area

Land use category	Area in (ha)	Area in (%)
Water bodies	1349.73	3.50
Degraded forest	4790.71	12.40
Agricultural land	4409.61	11.42
Dense vegetation	12248.90	31.72
Light vegetation	8745.99	22.65
Shrubs / bushes / grasslands	4441.05	11.50
Snow covered areas	2631.18	6.81
Total	**38617.17**	**100.00**

4.1.3 Total Land Requirement for Construction of the Project

Overall land requirement of the project is 83.085 ha, out of which 72.747 ha is forest land and the balance 10.338 ha is private land. The project shall submerge 11.345 ha of land comprising forest land and private land. The break up of land required including submergence area, land requirement in respect of different project components, colonies and offices, road, muck disposal area and borrow/quarry area is given in **Table 1.2**.

Table 1.2 Land Requirements of Submergence and Project Component

Sl. No.	Component	Area of Land, (ha)		Total, (ha)
		Forest	Private	
A	**Surface components**			
1.	Submergence area	11.217	0.128	11.345
2.	Barrage Structure	0.967	-	0.967
3.	Intake structure, Feeder Tunnels	0.178	0.068	0.246
4.	Quarries	6.750	0.092	6.842
5.	Dumping area	17.097	0.323	17.42
6.	Area for adit portals	1.679	-	1.679
7.	Area for approach roads	3.809	0.14	3.949
8.	Surge shaft	0.092	0.352	0.444
9.	Colony area (temporary/permanent /labour camps)	1.868	3.376	5.244
10.	Pot head yard	0.236	-	0.236
11.	Crushing plant, Batching plants, magziene, stores, workshop and miscellaneous	13.062	0.704	13.766
	Total	**56.955**	**5.183**	**62.138**
	Area for underground components	15.792	5.155	20.947
	Total	**72.747**	**10.338**	**83.085**

4.2 AIR AND NOISE ENVIRONMENT

In order to ascertain the base line data for air and noise quality an extensive study of air and noise parameters around the project area was conducted covering three seasons during May 2008, August, 2008 and November 2008. The basic parameters evaluated are as follows:

4.2.1 Ambient Air Quality

The ambient air quality was assessed from four sampling sites. The CO concentration in the air is well below the permissible limit as there are no industries in the area and the vehicular traffic is bare minimum. The other gases in the atmosphere are also well within safe limits. The highest RPM level of 60 µg/ m3 was observed at Kharamukh and lowest RPM level of 24.0 µg/m3 was observed at Dalli. The highest SPM level of 138 µg/m3 was observed at Holi Village and lowest SPM level of 90 µg/m3 was observed at Dalli. Based on the assessment the ambient air quality in the study area, it can be concluded that in all the sampling stations the overall air quality and especially the SOx, NOx values are well within the permissible limit.

4.2.2 Ambient Noise Quality

The ambient noise quality was monitored at eight locations. Having no industries around the project area and not much traffic in the vicinity, the noise level, in the study area is much below the threshold limits at all the locations and is well below the permissible limit.

4.3 WATER ENVIRONMENT

Water quality studies were conducted for three seasons (summer, autumn and winter) at seven sampling stations including three ground water samples. The water quality parameters assessed were observe to be well within the permissible limit of Drinking Water Standards (IS: 10500), except the bacteriological parameters. The discharge in the river is more during monsoon and the water quality is also better as compared to post monsoon season.

4.4 STATUS OF BIOLOGICAL ENVIRONMENT

4.4.1 Introduction

The land required for the project is 83.085 ha of which 11.345 ha would be submerged. To assess the terrestrial and aquatic biodiversity, the entire study area was sub-divided into the four zones viz., Barrage Site, Upstream of the barrage, Downs - -tream of barrage up to power house site and Power house site.

4.4.2 Flora of the project Area

The vegetation of study area of the Kuther HEP was comprised for 33 tree spp., 60 shrubs and 247 herbaceous/ ground vegetation. The commonly occurring species includes: *Alnus nitida, Quercus ilex, Cedrus deodara, Celtis autralis, Berberis lyceum, Prinsepia utilis, Valeriana jatamansi, Pinus wallichiana, Plectranthus rugosus, Rubus lasiocarpus, Urtica dioica, Daphne oleoides, and Debreagasia hypoleuca* etc.

4.4.2.1 Forest Types

According to the classification given by Champion and Seth, the forests of the study area fall under the following types:

Type 12/C1a: Ban Oak Forests (Quercus leucotrichophora)
Type 12/C1b: Moru Oak Forests (Quercus dilatata)
Type 12/C1c: Moist Deodar Forests
Type 12/C1d: Western Mixed Coniferous Forests (Kail, Spruce, Fir)
Type 12/C1e: Moist Temperate Deciduous Forests:
Type 12/1s1: Alder Forests
Type 12/2s1: Low Level Blue Pine (Kail) Forest

4.4.2.2 Phytosociological Analysis

Phytosociological analysis was carried out using nested quadrate technique. The vegetation data collected from identified sample in the study area was analyzed for density, frequency, abundance and summed up to represent Importance Value Index (IVI).

The common tree species include *Alnus nitida, Quercus ilex* and *Cedrus deodara, Juglans regia, Morus serrata, Celtis australis, Populus ciliata* and *Rhododendron arboreum. Alnus nitida* is found growing along the streams along the river while *Q. ilex* and *C. deodara* were recorded on the drier slopes.

4.4.2.3 Microflora

Numerous patches of ashy blue and yellow coloured crustose lichens were observed over the big boulders at the dam site. Species of *Ganoderma, a macrofungi* was also recorded on the rotten logs of *Alnus nitida*. A good growth of mosses, liverworts, and hornworts were observed in the higher humid places on shady slopes, rocks and boulders along the river Ravi in the study area.

4.4.2.4 Ethno-botany of Species

All the plant species found in the study area also exist in the nearby sites and other parts of the state. *Picrorhiza kurrooa* growing at very high altitudes (above 3000 m msl) is listed in the Red Data Book of Indian Plants (IUCN). A list of ethno-botanically important plant species includes 42 herbs, 28 shrubs and 22 tree species was compiled. Details of the species are given in the EIA report.

4.4.3 Fauna

4.4.3.1 Terrestrial Fauna

The Faunal study for the proposed Kuther Hydro-electric Project was carried out in both the submergence and influence zone of the project. As many as 66 species from 18 families of birds were recorded during the survey. A total of 31 species belonging to 4 families of butterflies were also recorded from the impact zone of the project.

Among 15 species of mammals, 5 species were recorded through direct sighting, 2 species were listed as per indirect evidence and remaining 8 species were recorded based on the evidence provided by the local villagers. Three species namely Himalayan Tahr, Asiatic Black Bear and Himalayan Brown Bear fall under the vulnerable category and one species Asiatic Ibex belongs to the Endangered Category as per the IUCN Red Data list of species 2008. The other species are having wide range of distribution.

Some species of mammals are *Hemitragus jemlachicus, Capra ibex, Ursus thibetanus* and *Ursus arctos* and are reported to utilize the influence area (within 5 km^2 radius of the dam site) and thus require conservation measures.

4.4.3.2 Aquatic Fauna

The water samples for assessment of aquactic fauna were taken in the study area (over a reach length of 23 km) along the River Ravi and its streams at seven sampling sites. The samples were assessed for plankton, periphytons, phyto- and zoo benthos, and fishes using standard methods and keys for their identification. Among invertebrates, recorded naids, larvae, and imago of various insects contributed to about 90 % of the total aquatic fauna.

The HP state Fisheries Department has already established a cold water trout hatchery just 4 kms before the Holi town which is about 4 kms upstream of the proposed project site. The river/streams basin harbours exotic rainbow and brown trouts (*S. trutta fario* and *S. gairdnerii gairdnerii)* and trials have been established for introduction of Arctic char *(Salvelinus alpines).* During field survey, no endemic fish were recorded from the study area at different locations in the river Ravi upstream and downstream of project site. Though, the presence of endemic snow trout *Schizothorax richardsonii* (Gray) in river Ravi and its streams has been reported by the state fisheries department, there was not a single species recorded from fish catch or visual observation during the survey and the above mentioned species were introduced by fisheries department in the river and also stocked in raceways built at Trout hatchery. Thus, the present investigation reveals that this region does not contribute significantly to fishery. No fish species was observed in the glacial fed channel except the introduced one.

4.5 SOCIAL AND CULTURAL BACKGROUND OF THE AREA

The social milieu of the region comprises mostly of the Hindu population. The study area falls under tribal notified area of the state and is largely inhabited by the Gaddi community. The construction of the surface component of project requires private land of 5.183 ha (63 bigha, 05, biswa, 04 biswansi) owned by the villagers in holi sub tahshil of Chamba district.

Table 1.3 Village-wise details of PAF on the basis of land holdings

Project Affected Villages	Family losing House	Families losing orchard	Fully affected (losing >50% land	Partially Affected (loosing<50% land	Total Family losing agri. Land
Sutkar	0	3	0	5	5
Kuther	3	3	1	5	6
Bhatada	0	0	0	2	2
Lamu	0	0	0	3	3
Chanhota	0	0	0	6	6
Swai	0	0	0	2	2
Garola	0	0	0	2	2
Ulansa	0	0	0	4	4
Total	**3**	**6**	**1**	**29**	**30**

1.0 ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

5.1 IMPACTS ON LAND ENVIRONMENT

5.1.1 Impact of acquisition of land for project components

The proposed Kuther H.E. project involves acquisition of 62.138 has of land and will have impact on land environment in terms of change of land use and land pollution due to various project related activities an account of changed land use.

5.1.2 Quarrying Operations

The total quantity of construction material required for concreting and masonry in the proposed dam is about 6.84 lac m^3. It is necessary to implement appropriate slope stabilization measures to prevent the possibility of soil erosion and landslides at the quarry sites. In the proposed project, it is proposed to utilize material from river bed etc. as for as possible.

5.1.3 Operation of Construction Equipment

During the construction phase, equipment such as crushers, batching plant, drillers, earth movers, rock bolters, etc. are required. Proper silting of these facilities is important so as to have minimum impact due to their location and operation. Efforts shall be made to select the site for locating the construction equipment in such a way that the adverse impacts on environment are minimal including that on residents of nearby villages.

5.1.4 Soil Erosion/Increased Siltation

The runoff from the construction sites will have a natural tendency to flow towards river or its tributaries. There is a possibility of increased sediment levels in river water resulting in reduction in light penetration and hence reduced photosynthetic activity to some extent. The River has sufficient flow throughout the year; therefore, impacts on this account are not expected to be significant.

5.1.5 Muck Disposal

About 11,10,627 m3 quantity of muck is expected to be generated as a result of construction of the proposed project and other appurtenant works. The project proposes to utilize remaining part of the muck to be generated as construction material in various project structures, while some part of the muck is proposed to be dumped at pre-identified locations in line with the topographic conditions. The details of the same have been covered in the relevant Environmental Management Plan.

5.16 Construction of Roads

The major impacts likely to accrue as a result of construction of the roads are:

- Loss of forest and vegetation by cutting of trees
- Geological disturbance due to blasting, excavation, etc.,
- Soil erosion as the slope cutting operation disturbs the natural slope and leads to land slips and landslides
- Interruption of drainage and change in drainage pattern
- Disturbance of water resources with blasting and discriminate disposal of fuel and lubricants from road construction machinery
- Siltation of water channels/ reservoirs from excavated debris
- Effect on flora and fauna
- Air pollution due to dust from debris, and road construction machinery, etc

5.2 IMPACTS ON WATER RESOURCES

There are about six villages which fall between barrage and power house on the left bank of the Ravi River near Kharamukh village. These villages are dependent upon river for water for irrigation purpose. Though the villagers are not dependent on Ravi River for drinking water, they use this water for irrigation. They do not get their drinking water supply from the river but are dependent upon the streams that join the main river.

5.2.1 Impacts on Water Quality

5.2.1.1 Sewage from Construction of worker Camps

The project construction is likely to last for a period of 3 years. The increase in the population due to project related activities is expected to be of the order of 250-500. The domestic water requirement at the population will be met from the river.

5.2.1.2 Effluent from Crushers

During construction phase, crushers are proposed to be commissioned at the barrage site. Water is required to wash the boulders and to lower the temperature of the crushing edge. The effluent from the crushers would contain high suspended solids. The natural slope in the area is such that, the effluent from the crushers will ultimately find its way in river through natural drains. However, no major adverse impacts are anticipated due to small quantity of effluent and large volume water available for dilution in river. However, turbidity levels in small tributaries, especially, in lean season, will increase. To minimize the impact, it is proposed to treat the effluent before disposal to ameliorate, even if only marginal, impacts that is likely to accrue on this account.

5.2.1.3 Disposal of Muck

The major impact on the water quality arises when the muck is disposed along the river bank. The project authorities have identified suitable muck disposal sites which are located near the river channel.

5.2.1.4 Effluent from Project Colony

During the operation phase, due to the absence of large scale construction activity, the cause and source of water pollution will be less. Only a small number of maintenance and operation staff will be stationed in the area in a well-planned colony with piped water supply and proper sewerage treatment plant.

5.3 IMPACTS ON TERRESTRIAL FLORA

The direct impact of the construction activity for any water resource project in a mountainous terrain, similar to that of proposed project, is generally limited in the vicinity of the construction sites only. As mentioned earlier, a population of 1200 persons likely to congregate in the area during peak project construction phase and the project proponent will supply alternate fuel to the construction work force. Thus, the pressure on the forest for fuel will be taken care of.

5.4 IMPACTS ON TERRESTRIAL FAUNA

5.4.1 Disturbance to Wildlife

During construction phase a large number of machinery and construction workers will have to be mobilized. This activity will have some disturbance to the wildlife population. The operation of various construction equipments is likely to generate significant noise, especially during blasting. The noise may scare the fauna and force them to migrate to other areas. Therefore, project authorities would be advised to devise the activity schedule keeping in mind the animal behavior i.e. breeding season, etc. The equipment used should have silencers and cause minimum ground vibrations during the construction period. Likewise, siting of construction equipment, godowns, stores, construction worker camps, etc. may generally disturb whatever fauna is left in the area. Therefore, Hemitragus jemlachicus, Capra ibex, Ursus thibetanus and Ursus arctos observed in the vicinity of the project site need to be taken care of and the same is to incorporated in the biodiversity conservation plan.

5.4.2 Impacts on Migratory Routes

The faunal species observed in the project area are not migratory in nature. The proposed project area is not the migratory route of wild animals.

5.5 IMPACTS ON AQUATIC ECOLOGY

Impacts due to excavation of construction material from river bed During construction phase, a large quantity of construction material like stones, pebbles, gravels and sand would be needed. Significant amount of material is available in the river bed just downstream of barrage. It is proposed to extract construction material from the river bed. This extraction of construction material may affect the river water quality due to increase in the turbidity levels. The macro-benthic life which remains attached to the stones, boulders etc. gets dislodged and is carried away downstream by

turbulent flow. The benthic fauna will get destroyed, but in due course of time the area may gets colonized with fresh benthic fauna. The study also noticed the presence of minimal aquatic fauna and no indigenous and endemic fish was recorded during the study period. If adequate precautions as suggested earlier are undertaken during operations, then adverse impacts on aquatic ecology shall be mitigated to a significant extent.

5.5.1 Impacts due to discharge of sewage from Construction Worker Camp/Colony

The proposed hydro-power project would envisage construction of temporary and permanent residential colonies to accommodate construction worker and staff engaged in the project. This would result in discharge of sewage which is usually discharged into the nearby water body. Therefore, adequate sewage treatment shall be undertaken considering the mountain terrain condition arising from construction worker camp/colony. However, perennial nature of river, it maintains sufficient flow throughout the year which is sufficient to dilute the treated sewage from residential colonies.

5.5.2 Impacts due to barrage on the river

The construction of barrage on the river will result in submergence of 11.345 ha of area, which will result in changing of fast flowing river to a quiescent lacustrine environment. The creation of a pond will bring about a number of alterations in physical, abiotic and biotic parameters both in upstream and downstream directions of the proposed dam site. The micro and macro benthic biota is likely to be severely affected as a result of the proposed project.

The positive impact of the project will be formation of a water body which can be used for fish stocks on commercial basis to meet the protein requirement of the region. The project authorities are advised to maintain sufficient amount of discharge during the lean period to maintain and sustain aquatic ecosystem functions in this stretch. For mitigating the downstream impacts it is mandatory to release at least 15% of the lean season flow into the river.

5.5.3 Impacts on migratory fish species

The stretch of Ravi River supports cold water fisheries. However, during the present survey no indigenous fish was recorded. The proposed project will have no major impact on the migratory fish or indigenous fish. But the state fisheries departments in Holi has already been working on the trout fish for introduction in this stretch.

5.6 IMPACTS ON NOISE ENVIRONMENT

Operation of various construction equipments will generate noise and likewise, noise due to quarrying, blasting, vehicular movement will also have some adverse impact on the ambient noise levels in the area. The ambient noise quality standards in respect of noise are 65, 55, and 50 dB (A) in day time and 55, 45, and 40 dB during night

time for commercial, residential and silence zone respectively within 1 km from the project area. The noise is also generated due to blasting during tunneling operations. However, it is not likely to have any effect on habitations.

5.7 IMPACTS ON AIR ENVIRONMENT

The operation of various construction equipments requires combustion of fuel. Normally, diesel is used in such equipments. The major pollutant which gets emitted as a result of combustion of diesel is SO2. The Suspended Particulate Matter emissions are minimal due to low ash content in diesel. There would be short-term increase in SO2. Even assuming that all the equipments are operating at same point of time. No major impact is anticipated on this account on ambient air quality. During crushing operations, fugitive emissions comprising mainly the suspended particulate matter will be generated. During layout design, care should be taken to ensure that the construction worker camps, colonies, etc. are located on the leeward side and outside the impact zone (say about 10 km on the upwind direction) of the crushers. During construction phase, there will be increased vehicular movement. Lot of construction material like sand, fine aggregate are stored at various sites during the project construction phase. Normally, due to blowing of winds, especially when the environment is dry, some of the stored material can get entrained in the atmosphere. However, such impacts are visible only in and around the storage sites and is not likely to alter the environment significantly.

5.8 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

A project of this magnitude is likely to entail both positive as well as negative impacts on the socio-economic and cultural fabric of area. If the quantum of human population migrating from other areas is greater than the local human population in the area, it would result in demographic changes and other repercussions that follow with such changes. Since the migrant workforce is generally from different regions with diverse ethnic and cultural backgrounds and value systems, they are bound to affect the local socio-cultural and value systems. In addition, these migrants might be the probable carriers of various diseases not known so far in the region resulting in health risk for the local population.

5.8.1 Positive Impacts on Socio-Economic Environment

One of the main reasons for promoting hydroelectric schemes is their environmen friendly character. This form of energy, unlike the energy from other conventional sources such as thermal power,fossil fuels etc. entails does not discharges of wastes or emission of toxic gases. It is virtually free from pollution and thus can be looked as “technology of the future” for the rural and remote areas. The following positive impacts are anticipated on the socio-economic environment of the local people of villages of project area during the project construction and operation phases:

- A number of marginal activities and jobs would be available to the locals in the project improves the job opportunities during construction phase.

- Education will receive adequate attention of the community. The advantage of education to secure jobs will quickly percolate through all sections of the population and will induce people to get their children educated.
- The availability of electricity to the rural areas will reduce the dependence of the locals on alternative energy sources perticularly forest.
- With increased availability of electricity, small-scale and cottage industries are likely to come up in the area.
- The proposed project site is well connected by road. Efforts can be made to develop eco-tourism, in the area, which could earn additional revenue.

Increased Incidence of Water-Related Diseases

The construction of project will replace the riverine ecosystem by a lacustrine ecosystem. The vectors of various diseases breed in shallow water areas not very far from the barrage margins. The magnitude of breeding sites for mosquitoes and other vectors in the impounded water is in direct proportion to the length of the shoreline. The construction of the reservoir would increase the shoreline as compared to the pre project shoreline of river under submergence. Thus, the construction of the proposed barrage would enhance the potential breeding sites for various disease vectors. There are chances that incidence of malaria may increase as a result of the construction and operation of the proposed project. In addition to the construction of the reservoir, the following factors too would lead to the increased incidence of malaria in and around the Project area:

- Aggregation of construction worker
- Excavation, and
- Inadequate facilities provided in construction worker camps.

Adequate measures have been recommended as a part of Environmental Management Plan to mitigate these impacts.

6.0 CATCHMENT AREA TREATMENT PLAN

The Catchment Area Treatment (CAT) Plan highlights the management techniques to control erosion in the catchment area of a water resource project. The life span of a reservoir is greatly reduced due to erosion in the catchment area. Adequate preventive measures are thus needed for the treatment of catchment for its stabilization against future erosion. A Catchment Area Treatment Plan has been formulated for the total river catchment at proposed barrage site. `Silt Yield Index' (SYI), and the sub watersheds with very high and high erosion categories are identified and suggested for treatment. The cost for the same has been estimated to be Rs.1842 lac.

7.0 COMPENSATORY AFFORESTATION PLAN

The land required for the construction of Kuther Hydroelectric Project activities are approximately 83.085 ha which include 72.747 has of forest land. The diversion of

total forest land for project involved is 72.747 ha.

As per the guidelines compensatory afforestaion is to be taken up over an area twice in extent of the land diverted. So compensatory afforestation is to be taken up in 146 ha of denuded or degraded forest areas. It is also proposed to have avenue plantation along the proposed roads with adequate fencing to maintain the ecological balance of the areas. A budget allocation Rs. 186 Lac has been made for the purpose.

8.0 GREEN BELT DEVELOPMENT

A green belt around the barrage, settlement area, office premises, road sides and around the crushing plants will be created to avoid erosion of soil and prevention of land slips from the direct draining catchment into the reservoir at an estimated cost of Rs. 21 lac.

9.0 BIODIVERSITY CONSERVATION PLAN

A Biodiversity Conservation and Management Plan has been prepared with the objective of sustainable use of natural resources which involves scientific management of natural wealth vis-à-vis developmental activities which are likely to affect these resources. During the construction period various activities like road construction, blasting, excavation for tunnels, quarrying, dumping of excavated material and human population pressure on land and biological resources are likely to exert tremendous pressure on the biological resources of the region. The management plan will ensure mitigation of such impacts with identified mitigation measures with an estimated cost of Rs 150 lac.

10.0 FISHERIES MANAGEMENT PLAN

To sustain biodiversity and fisheries in rivers, sustainable management of both habitats and systems is required. The fishes are considered to be highly prone to the changes in the flow pattern in downstream and upstream of the barrage during the operation of the project and degradation of river water during construction. The altered habitat may result in the destruction of breeding grounds of the fish downstream of the barrage. However, creation of a reservoir would provide ample opportunities for fisheries development in the region. Various measures including improvement of infrastructure facility for the existing state fisheries R&D at Holi village has been suggested for promotion of trout fisheries with an estimated cost of Rs.160 Lac.

11.0 MUCK MANAGEMENT PLAN

The total quantity/volume of material (muck) to be dug out or excavated during the construction of various project components is estimated to be 11,10,627 cubic meters. This excavated material of muck will be required to be rehabilitated. Most of the excavated material is proposed to be dumped at suitable locations identified specifically for this purpose and the proposed locations are spread over land area of 21.246 ha. The muck disposal areas will be developed in a series of terraces of

retention walls. For retaining the dumped/unused material for subsequent stabilization along the hill slopes and along the stretch of the road sausage-cum-retaining walls shall be developed. These will be built prior to the dumping of muck at these sites. The project authorities would ensure that the dumping yards blend with the natural landscape by developing the sites with gentle slopes, bunds, terraced and water ponds, with patches of greenery in and around them. These sites can also be developed later as recreational parks and tourist's spots with sufficient greenery by planting ornamental plants. Engineering and biological measures have been proposed for the development of spoil areas with a budget allocation of Rs 797 Lac.

12.0 RESTORATION PLAN FOR QUARRY SITES

During construction, 6.84 lac m3 materials are required and different river shoals in the upstream and downstream course of river Ravi were investigated for utilizing some of the usable excavated material for the purpose. In the process of excavation of material, environmental degradation of the landscape in and around the quarry sites, and along the haul roads is inevitable as the quarrying operation is a forced activity. The cost estimate for restoration of borrow areas has been kept for Rs. 93.00 lac.

13.0 LANDSCAPING AND RESTORATION PLAN

Different project related activities will require forest and private land. The acquired land will also be used for dumping of muck and other garbage from the colony area. There will be indirect disturbance to the area due to increase in the human population and traffic movement. It will be essential for the project authority to restore the area back to its original state for which a budget allocation of Rs. 24.0 Lac has been made.

14.0 HEALTH MANAGEMENT PLAN

Project construction and operation will bring about several changes in the socioeconomic environment of the area including increased threats to the health of the community. Project construction phase will lead to influx of outside population – temporary and permanent-thereby putting stress on existing infrastructure and will increase potential of various infectious diseases, which are not present in the area. Further, creation of barrage will increase the potential of vector borne diseases. Such threats to public health have been identified and suitable management measures suggested along with budget of Rs 57.00 Lac.

15.0 PROVISION FOR SUBSIDIZED FUEL

The fuel shall be required by the labor for cooking purpose, warming the rooms during cold months, and also for heating water. To avoid pressure for fuel wood in the adjoining forest and consequential increased production of carbon emission, it is proposed to use LPG for cooking and electricity for heating and kerosene stoves at site or for community kitchen. Under this scheme a work plan has been prepared for implementing the subsidized fuel scheme for the work force of the project with the cost of Rs. 79.00 Lac.

16.0 SOLID WASTE MANAGEMENT PLAN

The construction of the proposed Kuther Hydroelectric Project will involve different categories of manpower like labour, technical, other officials and service providers. living in temporary and permanent colonies/settlements. Large amount of solid waste and wastewater will be generated from these areas. An efficient waste management system will be required to be put in place to keep the environment of the region clean and healthy. These colonies and temporary settlements will also require adequate water supply for drinking and cleaning. The project authorities will ensure sewage treatment from the colonies of labors and workers, water supply, cleaning of the colony area and solid waste disposal. Dwellings will be provided with septic tanks and soak pits along with water supply for drinking and other daily needs for each and proper waste disposal by adopting various disposable methods with the budget allocation of Rs 288 Lac.

17.0 REHABILITATION & RESETTLEMENT PLAN

A detailed socio-economic survey of the families whose land is likely to be acquired for the project was conducted. A family-wise door-to-door survey was conducted based upon the list of project affected families. 30 families are likely to be affected due to agricultural land acquisition and 3 families shall be losing their house. The proposed project involves acquisition of 62.138 ha land. It includes 56.955 ha of forest land and 5.183 ha of private land. A total of 8 villages are likely to be affected due to acquisition of land for various components of proposed kuther H.E project. All the villages fall under the jurisdiction of district Chamba of Himachal Pradesh. The project area falls under tribal notified area. Thus suitable resettlement plan for the project affected families and rehabilitation plan in the form of local area development for conservation of the local people's culture have been proposed with an allocation of 1.5% of the project cost towards the funds.

To implement R&R plan, the state government may consider to appoint an officer of the rank of Commissioner/ Secretary to the government for R&R in respect of such projects to which this policy (NRRP-2007) applies. The officer shall be responsible for supervising the formulation of R&R plans/schemes and in case proper implementation of such plans/schemes and redressal of grievances of affected people. As a part of corporate social responsibility the project developer would aim at the improvement in the living standards of inhabitants in the project area by not only by being a catalyst for development but also will develop infrastructure in the area. The infrastructure development will be in addition to the rightful compensation package to the project affected families.

18.0 DISASTER MANAGEMENT PLAN

Dam break may be summarised as the partial or catastrophic failure of a dam leading to uncontrolled release of water. Although, the probability of dam failure is very low, the same has been addressed through computer simulation modeling. The problem of simulating the failure of Kuther H.E. Project is considered by computing the outflow hydrograph from the breached dam and routing this hydrograph along the downstream

channel using dynamic routing technique to obtain the maximum water level marks reached during the passage of flood wave. The model computes maximum flood elevation at each original or interpolated cross-section. A budget allocation of Rs 40.00 Lac has been made towards disaster management plan.

19.0 ENVIRONMENT MONITORING PLAN

Air Environment

Construction and operation of the Kuther HEP will definitely change the air quality of the area. Construction activities such as exploration, tunnels and approach roads, operation of batch mixing plants, crushers and other construction equipments, operation of DG sets for backup power, quarrying and transportation of men and material, etc. will contribute to pollute air in the area. The nature and extent of impact on air environment will vary from time to time and through different stages of development of the project. The project authorities will work closely with representatives from the community living in the vicinity of project area to identify areas of concern and to mitigate dust-related impacts effectively.

Noise Environment

Sound will be generated at the time of construction of powerhouse tunnel boring machine operations, pumps, drilling machines, blasting, dumpers etc. The construction phase will generate noise at various locations in the project area and is likely to affect residents and construction workers. Increase in vehicular traffic in the area will also contribute to high sound levels in the area. Impacts due to high noise levels can be greatly reduced by adopting mitigation measures such as location of equipment, adequate maintenance, traffic management, activity planning.

Water Environment

During the construction of tunnels, shaft and power house installations, surface water (river/ stream water) may get polluted due to generation of large quantities of suspended particulate matter at the time of transportation of muck and wastewater (sewage) coming from temporary arrangements like offices, labor camps, sheds, etc. Mitigation measures such as waste segregation, avoiding accumulation of oil flows, treatment of toxic wastes, constant monitoring will be implemented to minimize such impacts.

20.0 SUMMARY

Based on the findings of the Environmental Impact Assessment study, various Environmental Management Plans viz. Catchment Area Treatment, Compensatory Afforestaion Plan, Biodiversity Conservation & Management, Public Health Delivery System, Fisheries Development, Muck disposal plan, Rehabilitation and Resettlement Plan; Landscaping and Restoration Plan of Construction Area, Creation of Green Belt, etc. have been proposed. In order to monitor the impact and efficacy of these plans,

monitoring of a number of parameters have been proposed during and after the completion of the management plan cost of Rs. 102.40 lac.

21.0 SUMMARY OF COSTS

Allocation of an amount of **Rs. 4886.32 lac** has been recomonded for implementation of different environment management plans.
A summary of the total cost estimates for the execution of different plans is given below:

Table 1.4: Cost for Implementing Environment Management Plans

S. No	Plan	Amount (Rs lac)
1	Catchment Area Treatment Plan	**1842.00**
2	Compensatory Afforestation (excl. NPV)	**186.00**
3	Greenbelt Development	**21.00**
4	Bio-diversity Conservation Plan	**150.00**
5	Fisheries Management Plan	**160.00**
6	Muck Management Plan	**797.00**
7	Restoration Plan for Quarry Sites	**93.00**
8	Landscape and Restoration Plan	**24.00**
9	Health Management Plan	**57.00**
10	Provision for Subsidized Fuel	**79.00**
11	Solid Waste Management	**288.00**
12	Resettlement and Rehabilitation plan	**1046.92**
13	Disaster Management Plan	**40.00**
14	Environment Monitoring Plan	**102.40**
Total		**4886.32**