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## EXECUTIVE SUMMARY

### 1. INTRODUCTION

The Kinner Kailash Power Corporation Limited (KKPCL) promoted by Himachal Pradesh State Electricity Board (HPSEB) has been renamed as Himachal Pradesh Power Corporation Limited (HPPCL). The HPPCL is the joint venture between the state government Himachal Pradesh and HPSEB. The HPPCL proposes to develop the Shongtong –Karchham Hydro Electric Project on river Satluj in district Kinnaur of Himachal Pradesh. The project is envisaged as a run-of the river (RoR) Scheme on river Satluj in district Kinnaur, Himanchal Pradesh. The barrage site is located near village Powari and the power house is proposed to be located near village Ralli on left bank of river Satluj near confluence of river Bapsa with river Satluj. The installed capacity of Shongtong-Karcham hydro-electric project shall be 402 MW. The barrage site is located near village Powari and the power house is proposed to be located near village Ralli on NH-22 about 200km from Shimla. The project location map enclosed as Figure-1.

### 2. PROJECT DETAILS

The Shongtong-Karcham Hydro Electric Project has been envisaged with the purpose of exploiting the potential in the Satluj River between villages Powari and Ralli. The project envisages the construction of:

- Diversion barrage, intake structure with 4 intake bays with gates and four intake tunnels passing through four sedimentation chambers.
- Head Race Tunnel 8.02 km long culminating in open surface surge shaft.
- Three circular steel lined underground pressure shafts to convey water to 3 Francis turbines to generate (3 x 134 MW) 402 MW of power in a underground power house.
- Tail Race Tunnel of 10.0 m dia and 90 m length to discharge flow into river Satluj near village Ralli.

The layout plan is enclosed as shown in Figure-2.

### 3. ENVIRONMENTAL BASELINE STATUS

The study area covered as a part of the EIA study is as below:

- Land to be acquired for various project appurtenances including reservoir submergence
- 10 km on either side from the periphery of reservoir submergence
- Downstream of the barrage site 10 km on either side of various project appurtenances
- Catchment area intercepted at barrage site

The baseline status is described briefly in the following sections.

### **3.1 PHYSIO-CHEMICAL ASPECTS**

#### **3.1.1 Meteorology**

The climate of the project area is characterised by cool and dry climate. Meteorologically, the year can be divided into three distinct seasons. Winter season sets in from the month of October and continues upto February, followed by summer season from March to June. The area receives rainfall under the influence of south-west monsoons over a period of three months from July to September. Temperature rises rapidly after March and the month of July is the hottest month of the year with mean daily maximum temperature going up to 23.0°C. With the withdrawal of monsoons, by the end of October, there is a sharp decrease in temperature. The months of January and February are the coolest months of the year, with mean daily minimum temperature as low as -8.2°C. The total annual rainfall is about 766.5 mm per annum. The maximum rainfall is received in the months from January to March. About 55% of the rainfall is received during winter season. The average 'humidity' observed in the project area is about 50% Apart from the monsoon months. Humidity is generally low from 35 to 54.2%. In monsoon months, humidity is more than 80%.

#### **3.1.2 Geology**

The project area and its surroundings expose one of the oldest stack of rocks in the core Himalayas. This metamorphic sequence is characterised by polyphase regional metamorphism varying from green schists facies to amphibolite facies. These rocks in this part of Himalayas have been categorized in to Vakirata Group comprising of felspathic gneiss, quartzite, high grade schists and magmatites, which are exposed in an accurate pattern. These rest over the rocks belonging to the Jutogh, Salkhala and Rampur Groups along Vakirata Thrust.

These rocks are intruded by Rakcham and Nako granites. The Vakirata Group of rocks extends towards NE along Satluj and Spiti valleys up to Shipki La and Sumdo. The Vakirata Group has further been divided in to three formations, viz- Kharo, Morang and Shiasu, of which the rocks belonging to Kharo Formations are exposed in the area around the proposed project.

#### **3.1.3 Seismology**

The project area falls in under seismic zone-IV, as per IS: 1894: 2002.

#### **3.1.4 Land Use Pattern**

The land use pattern of the study area has been studied through digital satellite imagery data. The land-use pattern of the study area as per the satellite data is given in Table-1.

**TABLE-1**  
**Landuse pattern of the study area based on satellite data**

Type of land	Area in ha
Dense vegetation	13577 (25.93)
Open Vegetation	10133 (19.35)
Alpine Pasture	5793 (11.06)
Barren land	13712 (26.19)
Snow cover	7454 (14.24)
Agriculture	846 (1.62)
Settlements	235 (0.45)
Water bodies	605 (1.16)
<b>Total</b>	<b>52355 (100.0)</b>

**Note :** Figure in brackets indicate percentage.

The major landuse category of land in the study area is forest land as it accounts for 45.26% of the study area. Area under agriculture is only 1.62% of the total study area. Pasture account for about 11.06% of the study area. Settlements and snow cover account for about 0.45% and 14.24%, respectively of the total study area.

### 3.1.5 Soils

The pH of soil at various sites lies within neutral range. The levels of NPK indicate moderate to high soil productivity. The sodium levels do not indicate any potential for soil salinization or adverse impacts on soil productivity.

### 3.1.6 Water Resources

As per the Project Report 2002 the design flood has been estimated using various methods for flood frequency analysis is given in Table-2.

**TABLE-2**  
**Design Flood estimated for the Shongtong hydroelectric Project**

Return period year	Maximum flood average	Inst. Flood 1.15 time of maximum flood
5	1785.81	2053.68
10	2163.47	2488.00
20	2525.83	2904.71
50	2995.37	3444.67
100	3346.38	3848.34
200	3472.27	3993.11
500	3849.94	4427.43
1000	4479.39	5151.30

**Source:** Project Report 2002.

### **3.1.7 Water Quality**

Ambient air quality monitoring has been carried out with a frequency of two samples per week at three locations for three seasons. The BOD values are well within the permissible limits, which indicate the absence of organic pollution loading. This is mainly due to the low population density and absence of industries in the area. The low COD values also indicate the absence of chemical pollution loading in the area. The marginal quantity of pollution load, which enters river Satluj, gets diluted. In fact, even for the minimum flow, there is more than adequate water available for dilution. Level of heavy metal in the water of the project area is below the permissible limit used for drinking purposes. Total Coliform count is very low in the study area. It can be concluded that water quality in the area is quite good.

### **3.1.8 Ambient Air Quality**

Ambient air quality monitoring has been carried out with a frequency of two samples per week at three locations for three seasons namely winter, summer and post-monsoon. The parameters monitored were Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO<sub>2</sub>) and Oxides of Nitrogen (NO<sub>x</sub>). The values of these parameters were well below the permissible limits specified for residential, rural and other areas. The absence of industries, low vehicular traffic and low population density can be attributed for good ambient air quality in the project area.

### **3.1.9 Noise Environment**

The day time equivalent noise level in winter and summer seasons at various sampling stations ranged from 34 to 36 dB(A), 31 to 36 dB(A). Likewise, day time equivalent noise level in post-monsoon season ranged from 31 to 35 dB(A) at various sampling stations which were well within the permissible limit specified for rural area

## **3.2 ECOLOGICAL ASPECTS**

### **3.2.1 Flora**

The project site is surrounded by tall hills and remains under snow during winters. Hill slopes suffer from severe erosion from glacial flow. The vegetation along the slopes however remains sparse mainly owing to the severely cold temperature and largely rocky terrain. Major part of the catchment area is under permanent snow leading to sparse to no vegetation, whereas along the right bank of the river, there are steep slopes with sparse vegetation and few apple orchards. The forests of the project area falls under Dry climatic zone. Himalayan Dry Temperate Forest of Group13 observed in the study area, which has been classified into following different vegetation types as per the Champion and Seth classification:

**Group-13 Himalayan Dry Temperate Forest**

- C-1 Dry broad leaved and coniferous Forests.  
 C-2(a) Neozoa Pine Forest (*Pinus gerardiana*)  
 C-2(b) Dry Deodar Forest (*Cedrus deodara*)  
 C-4 West Himalayan High level dry Blue Pine Forest (*Pinus wallichiana*)

**Field Studies:** As a part of the CEIA study, a detailed Ecological survey was conducted for three seasons namely winter, summer and monsoon seasons. A total number of 115 plant species were recorded during the floristic survey in the study area. Species diversity of the study area is given in Table 3.

**TABLE -3**  
**Plant diversity of the project area**

Groups	No. of Species
Angiosperm & Gymnosperms	
Trees	27
Shrubs	18
Herbs	39
Grasses	8
Pteridophytes	8
Bryophytes	6
Lichens	3
Fungi	6
<b>Total</b>	<b>115</b>

A perusal of the data on the ecological analysis revealed that the most dominant tree species in the study area are *Pinus gerardiana*, *Cedrus deodara*, *Alnus nitida*, *Quercus ilex*. The shrubs were dominantly represented by the species of *Salix tetrasperma* followed by *Vibrunum mullaha* and *Sorbaria tomentosa*. The dominant herbs were the species of *Solanum nigrum*, *Nepeta leucophylla* and *Rumex dentatus*.

**3.2.2 Fauna**

The main wildlife species found in the area are snow leopard, Himalayan black bear, musk deer, ghoral, serrow, bharal, himalayan thar, and langoor and other smaller mammals. Among birds, five species of pheasants namely Western Trapogan, Cheer Pheasant, Monal, Koklash and white crested Kalij are also found in the valley. In addition to these, a number of reptiles, amphibian and smaller birds are also found.

### 3.2.3 Aquatic Ecology And Fisheries

#### (A) Aquatic Ecology

The aquatic analyses of Satluj River were conducted for winter, summer and monsoon season at various sampling sites in the months of February 2008, May 2008 and July 2008 respectively.

**Periphyton and Phytoplankton:** Periphyton was represented by 21 members of the family of Bacillariophyceae, Chlorophyceae and Myxophyceae. However, only 14 members of phytoplankton were represented by the family of Bacillariophyceae, Chlorophyceae and Myxophyceae. The data on frequency, density, abundance and diversity indices of periphyton dwelling in the Satluj River have been presented in Table 5.15-5.23. The total density of periphyton ranged from 1,696 ind. m<sup>-2</sup> to 2,168 ind. m<sup>-2</sup>, which was dominated by the members of Bacillariophyceae. Diversity index (Shannon-Wiener) of periphyton ranged from 3.362 to 3.597, which shows the good quality of aquatic environment of Satluj River I the project area of Shongtong-Karcham hydroelectric project.

**Zooplankton:** Zooplanktons were represented by the taxa of cladocera (01) and rotifera (03). Density of zooplankton was present in the range of 80 –114ind. l<sup>-1</sup>. The diversity index ranged between 1.798– 1.969 at all the sites. It indicates the poor diversity of zooplankton in the Satluj River.

#### (B) Fisheries

The commercial fisheries are non-existent in the project area. Fishing by individuals is only practiced during the lean season in the Satluj River close to the confluence of Baspa with Satluj. Low water temperature compels the individual fisherman to operate his nets for a very short period of time. The inaccessible terrain is also one of the reasons that the fishermen are not able to operate their fishnets very effectively. The small sized cast net having diameter of 1.0 to 1.5 m is a common gear for fishing. The Department of Fisheries, Govt. of Himachal Pradesh releases the fingerlings of Rainbow trout (*Salmon gairdneri*) and Brown trout (*Salmo trutta fario*) in Satluj river and its tributaries (Baspa) in the project area. Occasional sport fishing by the local anglers is also present near the site of confluence of Baspa and Satluj. There is no specific spawning and breeding grounds above the confluence of Baspa and Satluj, because these fish species are not able to go upstream near the barrage site and above in the submergence area

### 3.3 SOCIO-ECONOMIC ASPECTS

A comprehensive socio-economic primary survey was carried-out in those villages where land is proposed to be acquired for the proposed Shontong-Karcham hydroelectric project. For identification of PAFs, i.e., families likely to lose their lands and/or homesteads, extensive use of Record of Rights (ROR), viz., revenue records

was made. Information to assess the socio-economic profile and property enumeration of project affected families (PAFs) was collected with the help of a detailed quantitative 100% primary survey in the affected villages. As per ROR, about 158 persons/ land titleholders were identified, who are expected to lose land (agricultural/non-agricultural/homestead) in varying proportion. However, during survey the survey team had covered 146 project affected families.

### **Demographic Profile of Affected Population**

During survey it was observed that a large majority of the project affected families were Hindus, constituting about 89% of the total surveyed families. About 2% of the affected families practiced Buddhism. However, about 9% of the affected families did not disclose their religious affiliation. About 82% of the total surveyed families belong to the Scheduled Tribe category. The Scheduled Caste category comprises of about 8.4% of the surveyed families, while only 1 family belonged to the General Caste Category. Meanwhile for about 9% of the surveyed families, their caste category could not be ascertained.

About 16.73% of the project-affected population is illiterate/not going to school. The remaining population (80.91%) is either literate or is presently continuing with their education. Thus, out of the total project affected population, persons educated upto or pursuing the primary school level is about 26.0% of the total surveyed population. The percentage of population educated or undergoing their education in middle school and high school is of the order of 13.97% and 29.74% respectively. Individuals who manage to complete school level and have taken-up higher education and who are presently undergoing/have completed graduate (includes BA, BCom, BSc) level comprise 7.88% of the total surveyed population respectively. In addition, about 2.76% of the total surveyed population has either completed or presently undergoing their post graduate level. There are no individuals who are pursuing or have completed traditional form of education.

As per our survey, it is observed that out of the total affected population about 27.25% are gainfully engaged in an economic activity. This group consists of persons engaged in cultivation, service sector, business, and traditional vocations, which constitute about 19.78%, 6.5%, 0.83%, and 0.14% respectively of the total surveyed population. About 0.69% of the population although does not work, but they have worked and presently draws pension.

Amongst the livestock, cattle is the most dominant. Cows are mainly reared for their milk. It was observed that a few families owned He-buffalo. Goats and sheep also reared for their meat and wool. A few families reared pigs and poultry birds, for their by-products.

## **4. PREDICTION OF IMPACTS**

### **4.1 IMPACTS ON WATER ENVIRONMENT**

#### **Water quality**

##### **A) Construction phase**

Sewage from labour colony: The peak migrant population is likely to be of the order of 3,200. The quantum of sewage generated due to this population is expected to be of the order of 0.18 mld. Even at minimum flow, sufficient dilution is available. Thus, no significant impact on water quality of river Satluj is envisaged during construction phase.

Effluent from crushers and other sources: The effluent from the crushers and other sources, like adit, tunnel, would contain high suspended solids. It is proposed to treat the effluents in settling tanks. Thus, no significant impact is envisaged.

##### **B) Operation phase**

Effluent from project colony: During operation phase, only a small number of O&M staff will reside in the colony. The sewage generated would be provided biological treatment before discharge.

#### **Sediments**

The proposed project is envisaged as a runoff the river scheme with a barrage. At regular intervals, the gates of the barrage shall be opened to flush the sediments. Thus, in the proposed project, sedimentation problems are not anticipated.

#### **Water Resources and downstream users**

The river stretch downstream of the barrage site upto the confluence point of tail race discharge will have reduced flow upto the confluence of tail race tunnel. In the intervening stretch, the flow shall be implemented by (i) releases of flushing discharges from desilting chamber, (ii) contribution of flow from various streams/nallahs in the confluence of tail race disposal and (iii) gates of barrage will remain open leading to continuous flow in the downstream river stretch during monsoon months. The reduction in flow or drying of the river in the intervening stretch is not likely to have any adverse impact on the downstream users. This is mainly because of the fact that settlements/ villages within this dry stretch are not dependent on the water of river Satluj, as the villagers use water of small streams or nallahs flowing adjacent to their habitation.

## 4.2 IMPACTS ON AIR ENVIRONMENT

Pollution due to fuel combustion: The major construction equipment would be operated through electricity. Therefore, fossil fuel combustion would be minimal. Diesel would be used only in contingency. Thus, no significant impact on ambient air quality is expected as a result of operation of various construction equipment. No significant impact is envisaged.

Emissions from various crushers: During crushing operations, there would be emissions of dust particles. Minimal impact is expected during construction phase. Therefore, commissioning of cyclone is suggested. Further, the labour camps would be located on the leeward side of the crusher with respect to predominant wind directions.

## 4.3 IMPACTS ON NOISE ENVIRONMENT

The operation of construction equipment is likely to have insignificant impact on the ambient noise level. However, blasting can have adverse impact on wildlife, especially along the alignment of the tunnel portion. A necessary mitigation measure has been suggested as a part of EMP.

## 4.4 IMPACTS ON LAND ENVIRONMENT

**Impacts due to quarrying :** In a hilly terrain, quarrying is normally done by cutting a face of the hill. A permanent scar is likely to be left, once quarrying activities are over. With the passage of time, they become a potential source of landslide. Thus it is necessary to implement appropriate slope stabilization and quarry reclaiming measures.

**Impacts due to muck disposal :** A large quantity of muck is expected to be generated as a result of tunneling operations, construction of roads, etc. The same requires to be suitably disposed. Normally, muck is deposited in low lying areas or depressions. Proper disposal and reclamation has been suggested as a part of EMP.

**Impacts due to land acquisition:** The total land to be acquired for the project is 77.3326 ha. A part of this land is required for labour camps, quarry sites, muck disposal storage of construction material, siting of construction equipment, which will be required temporarily and returned once the construction phase is over. Permanent acquisition of land is required for barrage axis, submergence area, project colony, etc.

## 4.5 IMPACTS ON ECOLOGY

### Terrestrial Ecology

**Increased human interferences:** A large population (3,200) is likely to congregate in the area during the project construction phase. This population residing in the area may use fuel wood (if no alternate fuel is provided). Therefore, alternate fuel should be provided to such population. Further, community kitchens should be provided using LPG or diesel as fuel.

**Acquisition of forest land:** The total forest land to be acquired is about 63.5015 ha. Compensatory afforestation is proposed as a part of compensatory afforestation plan in the EMP.

**Disturbance to wildlife:** The operation of various construction equipment and blasting is likely to generate noise. These activities can lead to some disturbance to wildlife population. Further, the project area does not fall in the migratory routes of animals. Mitigation measures to minimize such impacts have been suggested in the EMP.

### Aquatic ecology

#### A) Construction phase

Due to construction of the proposed project, about 3.57 Mm<sup>3</sup> of muck and debris would be generated at various construction sites. Based on the geological nature of the rock and engineering property of the soil, about 1.52 Mm<sup>3</sup> of the muck generated will be utilized as construction material. The remaining 2.05 Mm<sup>3</sup> would be dumped at designated sites. However, a proper muck disposal and management plan has been suggested as a part of the EMP to minimize such impacts.

#### B) Operation phase

The completion of Shongtong Karcham Hydroelectric Project would bring about significant changes in the riverine ecology, as the river transforms from a fast-flowing water system to a quiescent lacustrine environment. Amongst the aquatic animals, it is the fish life which would be most affected. The migratory fish species, e.g. snow trout and brown trout are likely to be adversely affected due to obstruction created by the proposed barrage. With the completion of barrage, flow in the downstream stretch of the river would be reduced considerably more so during the lean period. A fish management Plan has been suggested to be implemented during operation of the project.

## 4.6 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

Impacts due to influx of labour force: During the construction phase a large labour force, including skilled, semi-skilled and un-skilled labour force of the order of about 3200 persons, is expected to immigrate into the project area. During the construction phase, the most important negative impact would be due to the temporary settling of labour force leading to filth, in terms of domestic wastewater, human waste, etc.

Economic impacts of the project: Apart from direct employment, the opportunities for indirect employment will also be generated which would provide great impetus to the economy of the local area. Various types of business like shops, food-stall, tea stalls, etc. Besides a variety of suppliers, traders, transporters will concentrate here and benefit immensely as demand will increase significantly for almost all types of goods and services. The locals will avail these opportunities arising from the project and increase their income levels. With the increase in the income levels, there will be an improvement in the infrastructure facilities in the area.

Another most important deleterious impact during construction phase will be that, pertaining to land acquisition. About 77.3326 ha of land proposed to be acquired for the proposed Shongtong hydro-electric project. Of this about 13.448 ha is private land (un-irrigated land) while about 63.5015 ha is forest land. The details of land acquisition, project appurtenances-wise and land-use wise, are depicted in Table – 4.

**TABLE-4**

**Land required for the proposed Shongtong-Karcham, h.e. Project**

Type	Quantity (ha)
Forest	63.5015
Private	13.8311
<b>Total</b>	<b>77.3326</b>

It is observed that about 13.8311 ha of private land is proposed to be acquired from 9 revenue villages. It is observed that about 158 PAFs are likely to lose land in varying proportions. No family is likely to lose homestead on account of land acquisition for the project.

## 5. ENVIRONMENTAL MANAGEMENT PLAN

### 5.1 COMPENSATORY AFFORESTATION AND BIODIVERSITY CONSERVATION PLAN

The total forest loss including submergence area and other project appurtenance is about 63.5015 ha. It is proposed to afforest double the amount of forestland being acquired for the project. Thus, a total of 128 ha of land needs to be afforested. The

afforestation work is to be done by the Forest Department. In addition, the project proponent will pay Net Present Value (NPV) and cost of trees

It is recommended that 2 check posts be developed in the major construction area i.e. one near intake and one near power house along the boundary of labour camps to coordinate anti-poaching activities in the area.

A total provision of Rs. 72.08 million has been earmarked for biodiversity conservation and anti-poaching measures. The details are given in Table-5.

**TABLE-5**  
**Budget for implementation of compensatory afforestation and Anti-poaching measures**

<b>Item</b>	<b>Cost (Rs. million)</b>
Compensatory Afforestation	16.65
NPV	36.83
Cost of trees	6.47
Anti-poaching measures	12.13
<b>Total</b>	<b>72.08</b>

## 5.2 CATCHMENT AREA TREATMENT PLAN

The catchment area considered for treatment under the proposed Shontong Karcham hydroelectric project is 33573 ha. The catchment area has been divided into 11 sub-watersheds in the present study. In the present study 'Silt Yield Index' (SYI), method has been used. CAT plan has been suggested for very high and high erosion category, as a part of the present EIA study, the expenses of which have to be borne by project proponents. The area under high erosion categories is 14,947 ha, which is about 44.52% of the total catchment area intercepted at the barrage site. There is no area under very high erosion category. The cost required for Catchment Area Treatment is Rs. 87.5 million which have to be borne by project proponent.

As suggested by the HPPCB, the following aspects shall be covered as a part of the CAT plan:

- Project proponent shall ensure providing display boards for all the works done under the CAT Plan.
- Project proponent shall ensure effective monitoring of the works done under CAT Plan.
- Monitoring reports shall be shared with the Environment Department.

## 5.3 FISHERIES MANAGEMENT PLAN

### 5.3.1 Release of minimum flow

It is proposed to release 10.4 cumec from the barrage. The discharge shall be supplemented by contribution from khads on the downstream side.

### 5.3.2 Sustenance of Endemic Fisheries

**Provision of fish ladder:** Snow trout (*Schizothorax richardsonii*) is the endemic species. The barrage on Satluj will be a barrier to the free movement of fish species. Therefore a provision of fish ladder has been made in the barrage.

**Supplementary stocking:** It is proposed to implement supplementary stocking programme in the project area. It is proposed to stock the river for a length of 10 km each on the upstream and the downstream sides. The rate of stocking is proposed as 100 fingerlings of about 30 mm size per km. All the three species i.e. Snow trout, Brown trout and Rainbow trout can be stock. The stocking can be done annually by the Fisheries Department, State Government of Himanchal Pradesh. To achieve this objective, facilities to produce seed of trout would have to be created at suitable sites. The site would be identified in consultation with Fishery Department.

**Further Studies for Ecological Discharge** :A separate study for assessment of downstream Ecological Discharge shall be carried out. The Terms of Reference for the study shall be prepared and got approved from the HPPCB. HPPCL shall earmark an appropriate amount of provision to conduct the study. The cost to be earmarked shall be decided once the Terms of Reference for the study is approved by the HPPCB.

## 5.4 PUBLIC HEALTH DELIVERY SYSTEM

### 5.4.1 Control of Malaria

Various Primary Health Centres in the nearby villages and Hospital at District Head Quarters can coordinate the anti-malarial operations in association with the project authorities and implement the following measures:

- Site selected for habitation of workers should not be in the path of natural drainage.
- Adequate drainage system to dispose storm water drainage from the labour colonies shall be provided.
- Adequate vaccination and immunization facilities should be provided for workers at the construction site.
- The labour camps and resettlement sites should be at least 2 km away from a main water body or quarry areas.

#### **5.4.2 Development of Medical Facilities**

It is recommended that the hospital should be developed during project construction phase itself, so that it can serve the labour population migrating in the area as well as the local population. Three doctors and 26 paramedical staff are required for the dispensary. Further, a building shall be constructed to provide basic preventive, promotive and curative services to the labour colony with facilities for maternal and child health services, control of communicable diseases and medical care for minor ailments. The total expenditure for implementation of various public health measures shall be about Rs.62.30 million.

Hospitals and dispensaries use a variety of drugs including antibiotics, cytotoxics, corrosive chemicals etc. a part of which is generated as a solid waste. With greater emphasis on disposables, the quantum of solid waste generated in a hospital is quite high. The bio-medical waste generated in the dispensary shall be treated and disposed as per the Bio-Medical Waste (Management and Handling) Rules 1998.

#### **5.5 ENVIRONMENTALMANAGEMENT IN LABOUR CAMPS**

The labour camps shall have the following facilities:

- Provision of Heating
- Provision of Water Supply
- Provision of fuel in labour camps
- Sanitation and Sewage Treatment Facilities in the form of community toilets and an oxidation ditch.
- Adequate facilities for collection, conveyance and disposal of solid waste shall be developed
- Construction of a police check post

#### **5.6 MUCK MANAGEMENT PLAN**

As per the existing proposal for the construction of Shongtong Karcham hydroelectric project about 2.57 Mm<sup>3</sup> of muck is to be generated. It is proposed that 1.52 Mm<sup>3</sup> of muck shall be utilized for various project works, The balance quantity of muck shall be disposed off at six (6) muck disposal sites with a total area of about 10.0944 ha. The dumping of muck will be done in the scientific manner by providing appropriate protection walls with deep foundations so that muck will not flow and washed away in the river Masonry work, create work and check dam will also be provided wherever necessary in order to avoid the chances of soil erosion and to ensure flow of silt, free water. Besides these engineering measures, proper plantation will be done at the dumping sites for reclamation of the dumping areas. The total expenditure required for stabilization of muck disposal sites has been estimated to be of the order of Rs. 164.71 million.

## **5.7 RESTORATION AND LANDSCAPING OF CONSTRUCTION SITES**

### **5.7.1 Restoration Plan for Quarry Site and Borrow Area**

The following biological and engineering measures are suggested for the restoration of quarry site:

- Garland drains around quarry site to capture the runoff and divert the same to the nearest natural drain.
- Construction of concrete guards checks the soil erosion of the area.
- The pit formed after excavation be filled with small rocks, sand and farmyard manure.
- Grass slabs will be placed to stabilize and to check the surface runoff of water and loose soil.
- Bench terracing of quarry sites once extraction of construction material is completed.

### **5.7.2 Landscaping and Restoration Plan for other areas**

The working area of barrage site, power house complex colony area have been selected for beautification of the project area after construction is over.

A total provision of Rs. 15.50 million has been earmarked for restoration of quarry and borrow area, reclamation of construction sites, landscaping and beautification.

## **5.8 ENVIRONMENTAL MANAGEMENT IN ROAD CONSTRUCTION**

The project construction would entail significant vehicular movement for transportation of large construction material, heavy construction equipment. Some of the existing roads in the project area, would require widening. The existing National Highway on left bank of river Satluj will be suitable widened/improved to 7/10 m wide specification for a length of about 6 km to serve as an approach roads to the project site for construction. In addition to above, National Highway will be realigned at some reaches where blind curve exists.

Steeply sloping banks are liable to landslides, which can largely be controlled by provision of suitable drainage. As part of environmental management of road, landslides are proposed to be stabilized by engineering methods or bio-engineering measures or a combination of both. An amount of Rs. 7.12 million has been earmarked for implementation of measures to mitigate adverse impacts due to construction of roads.

## **5.9 GREENBELT DEVELOPMENT PLAN**

It is proposed to develop greenbelt around the periphery of various project appurtenances, selected stretches along reservoir periphery This work would be

completed in two years, which includes nursery creation, advance works, actual plantation and maintenance. The work will be carried out by Forest Department. A provision of Rs. 4.0 million has been earmarked for Green Belt Development.

## **5.10 CONTROL OF AIR POLLTION**

Various measures have been recommended to Control Air Pollution. The same shall be monitored on a regular basis by the project proponent. A provision of Rs. 12.72 million has been earmarked for this purpose.

## **5.11 MEASURES FOR NOISE CONTROL**

Workers operating in high noise areas/ activities should be provided with effective personal protective measures such as ear muffs or ear plugs to be worn during periods of exposure. The other measures to control noise could be as follows:

- equipment and machineries should be maintained regularly to keep the noise generation at the design level;
- silencers and mufflers of the individual machineries to be regularly checked by the project proponent;
- implementation of measures to control noise and DG sets
- exposure of workers to high noise areas, should be limited as per maximum exposure periods specified by OSHA.

An amount of Rs. 1.1 million has been earmarked for control of noise.

## **5.12 WATER POLLUTION CONTROL**

### **Control of water pollution during construction phase**

It is recommended to construct settling tanks of adequate size at two or three sites to settle the suspended impurities in the effluents generated from crushers and tunneling sites.. The sludge from the various settling tanks can be collected once in 15 days and disposed at the site designed for disposal of solid wastes from the labour camps. The sludge after drying could also be used as cover material for landfill disposal site. An amount of Rs. 3.0 million needs to be earmarked for construction of various settling tanks.

### **Control of water pollution during operation phase**

It is recommended to provide a suitable Sewage Treatment Plant (STP) to treat the sewage generated from the colony. The cost required for construction of sewage STP in the project colony has already been covered in the budget earmarked for construction of the project colony.

## **Treatment of solid waste from project colony**

A twin chamber incinerator shall be commissioned to treat the solid waste generated in the project colony.

## **6. RESETTLEMENT AND REHABILITATION PLAN**

The Resettlement and Rehabilitation Plan for the Project Affected Families of the proposed Shontong Karcham hydro-electric project has been prepared in line with the provisions and/or guidelines as given in The National Rehabilitation and Resettlement Policy, 2007; which has been prepared by the Ministry of Rural Development (Department of Land Resources) and published in the Gazette of India, Extraordinary, Part 1, Section I, dated 31<sup>st</sup> October 2007. There are essentially about 6 villages/revenue villages from where private land is likely to be acquired for the proposed Shongtong-Karcham hydro-electric project. A total of about 77.3326 ha of land proposed to be acquired. Of this, about 13.8311 ha is private land, while about 63.5015 ha is forest land. It is observed that about 13.8311 ha of private land is proposed to be acquired from 9 villages. It is observed that about 158 project affected families (PAFs) are likely to lose agricultural land in varying proportions.

### **6.1 Resettlement Plan**

As per the information gathered from the revenue records and field investigations, no PAF is losing their homesteads and/or shed structures. Hence, Resettlement Plan is not required.

### **6.2 Rehabilitation Plan**

The details of rehabilitation benefits extended to the PAFs are summarized in the following paragraphs:

- PAFs have not been provided alternative agricultural land or Job, they will be provided with a Rehabilitation Grant equivalent to 750 days minimum agricultural wages or such other higher amount as may be prescribed by the appropriate Government.
- A monthly Subsistence allowance equivalent to twenty-five days minimum agricultural wages per month for a period of one year from the date of acquisition. This financial assistance is being extended to all the PAFs.
- One member from each of the project affected families would be given scholarships and other skill development opportunities.
- The project developer shall give preference to the affected persons or their groups or cooperatives in the allotment of outsourced contracts, shops or other economic opportunities coming up in or around the project site
- One person from each of the affected families would be give training facilities for development of entrepreneurship, technical and professional skills for self-employment.

### 6.3 Budget for Resettlement & Rehabilitation

A total budget of Rs. 39.296 million [Say Rs. 39.3 million] is required for implementation of Rehabilitation Plan. The details are given in Table 6.

**TABLE 6**  
**Budgetary estimate for implementation of R&R Plan**

S. No.	R&R Components	Cost (Rs. million)
<b>1</b>	<b>Rehabilitation Plan</b>	
i	Financial assistance to PAFs rendered landless on account of acquisition of land (Landless grant)	8.350
ii	One time financial assistance (displacement grant) to Displaced shopkeepers	0.120
iii	Additional financial assistance to displaced shopkeeper, in case shops are not allotted	1.200
iv	Transitional/ Subsistence Allowance	2.730
v	Financial assistance for purchasing land	1.650
vi	Financial assistance for Land Development Cost	0.500
vii	Compensation for agricultural production.	1.580
viii	Financial assistance for a special rehabilitation/employment grant	15.800
ix	Merit scholarship	0.316
x	Grant as seed capital for PAFs artisans, small traders and self employed	0.300
Xi	Addition one time financial assistance to ST PAFs for loss of customary right's or usage of forest produce	5.850
	<b>Sub-Total (Rehabilitation Plan) [1]</b>	<b>38.396</b>
<b>2</b>	<b>Monitoring &amp; Evaluation set-up [2]</b>	<b>0.900</b>
	<b>Total [1] + [2]</b>	<b>39.296, say Rs. 39.3 million</b>

**\*\* Alternative land (about 33.0054 bigha) is to be identified and Cost of land has to be decided and finalized by the District Collector in case land for land is adopted.**

## 7. ENVIRONMENTAL MONITORING PROGRAMME

The Environmental Monitoring Programme during construction and operation phase is given in Tables 7 and 8 respectively.

**TABLE-7**  
**Summary of Environmental Monitoring Programme during**  
**Project Construction Phase**

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from septic tanks	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from each septic tank
2.	Water-related diseases	Identification of water related diseases, adequacy of local vector control and curative measure, etc.	Three times a year	Labour camps and colonies
3.	Noise	Equivalent noise level ( $L_{eq}$ )	Once in three months	At major construction sites.
4.	Air quality	SPM, RPM, SO <sub>2</sub> and NO <sub>x</sub>	Once every season	At major construction sites
5.	Meteorological aspects	Wind direction & velocity temperature humidity, rain	Once every season	At one of the ambient air quality sampling sites

**TABLE-8**  
**Summary of Environmental Monitoring Programme during**  
**Project Operation Phase**

S. No.	Items	Parameters	Frequency	Location
1.	Water	pH, Temperature, EC, Turbidity, Total Dissolved Solids, Calcium, Magnesium, Total Hardness, Chlorides, Sulphates, Nitrates, DO. COD, BOD, Iron, Zinc, Manganese	Thrice a year	1 km upstream of barrage site Water spread area 1 and 3 km downstream of Tail Race discharge
2.	Effluent from Sewage Treatment Plant (STP)	pH, BOD, COD, TSS, TDS	Once every week	Before and after treatment from Sewage Treatment Plant (STP)
3.	Erosion &	Soil erosion rates,	Twice a	-

S. No.	Items	Parameters	Frequency	Location
	Siltation	stability of bank embankment, etc.	year	
4.	Ecology	Status of afforestation programmess of green belt development	Once in 2 years	-
5.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local vector control measures, etc.	Three times a year	Villages adjacent to project sites
6.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Once a year	1 km upstream of barrage site Water spread area 1 and 3 km downstream of Tail Race discharge
7.	Landuse	Landuse pattern using satellite data	Once in a year	Catchment area
8.	Soil	pH, EC, texture, organic matter	Once in a year	Catchment area

## 8. COST FOR IMPLEMENTING ENVIRONMENTAL MANAGEMENT PLAN & ENVIRONMENTAL MONITORING PROGRAMME

### 8.1 Cost for implementing Environmental Management Plan

The total amount to be spent for implementation of Environmental Management Plan (EMP) is **Rs. 568.15 million**. The details are given in Table-9.

**TABLE-9**  
**Cost for Implementing Environmental Management Plan**

S. No.	Item	Cost (Rs. million)
1.	Compensatory Afforestation NPV, Cost of Trees and Bio-diversity conservation	72.08
2.	Catchment Area Treatment	87.50
3.	Fisheries Management	17.14
4.	Public health delivery system	62.30
5.	Environmental Management in labour camp	60.31
6.	Muck management	164.71
7.	Restoration and Landscaping of construction sites	15.50
8.	Environmental management in road construction	7.12
9.	Greenbelt development	4.00

S. No.	Item	Cost (Rs. million)
10.	Air pollution control	12.72
11.	Noise Control	1.10
12.	Water Pollution Control	3.00
13.	Resettlement and Rehabilitation Plan	39.30
14.	Environmental Monitoring during construction phase (Refer Table-10)	16.37
15.	Provision for consultancy services for CDM	5.00
	<b>Total</b>	<b>568.15</b>

## 8.2 COST FOR IMPLEMENTING ENVIRONMENTAL MONITORING PROGRAMME

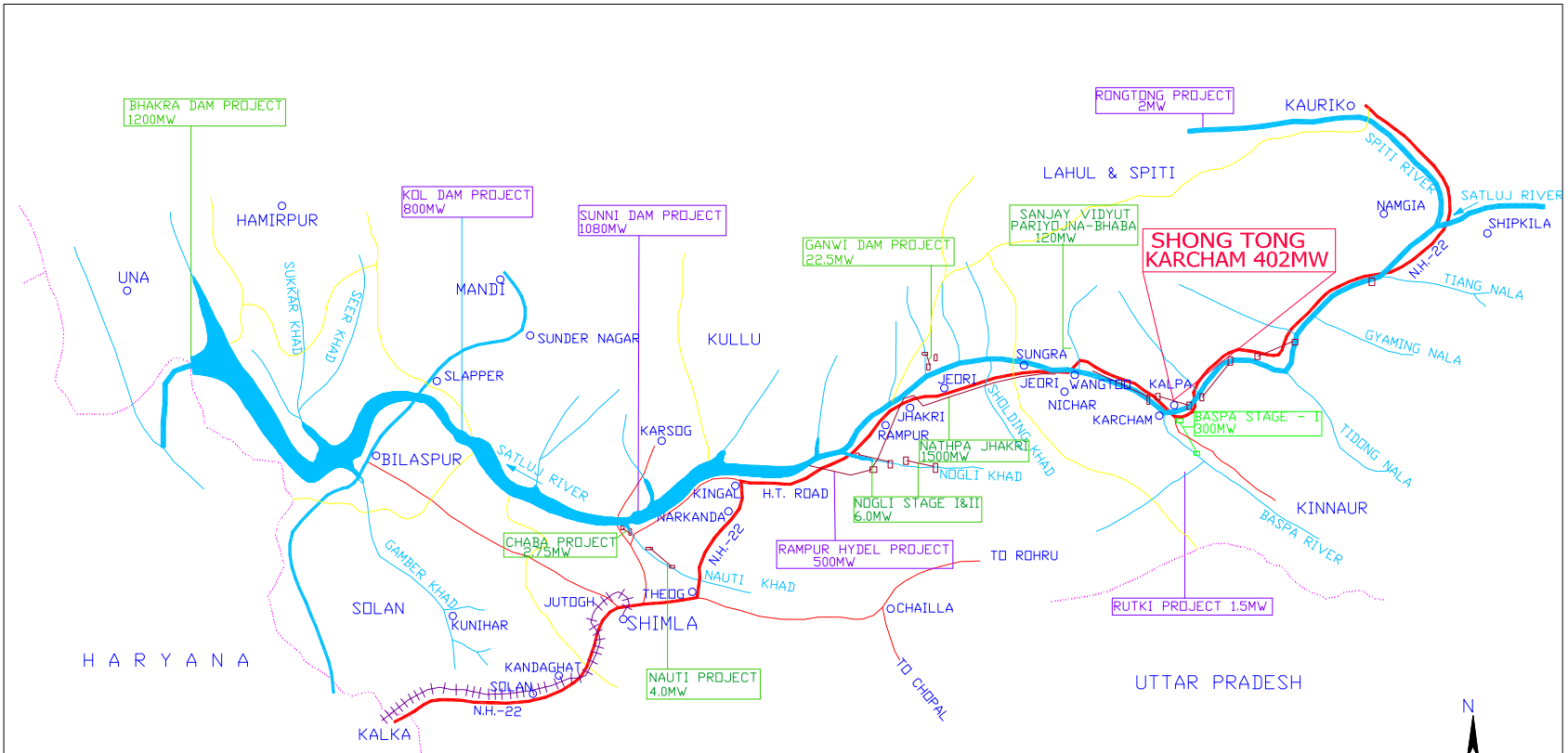
The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs.16.37 million. The construction period for estimation of cost for implementation of Environmental Monitoring programme during construction phase has been taken as 6 years. The details are given in Table-10. The cost required for implementation of the Environmental Monitoring Programme at operation phase is of the order of Rs.1.16 million/year. The details are given in Table-11.

**TABLE-10**  
**Cost for Implementing Environmental Monitoring Programme during construction phase**

S. No.	Item	Cost (Rs. million/year)	Total cost 6 years with 10% escalation (Rs. million)
1	Water quality		13.50
2	Air quality		
3.	Muck disposal		
4.	Ecology		2.10
5.	Incidence of water related Diseases	0.10	0.77
	<b>Total</b>	<b>1.07</b>	<b>16.37</b>

**TABLE-11**  
**Cost for Implementing Environmental Monitoring Programme during operation phase**

S. No	Item	Cost (Rs. million/year)
1	Water quality	0.46
2	Ecology	0.1
3	Incidence of water related diseases	0.3
4	Land use pattern	0.3
	<b>Total</b>	<b>1.16</b>



**LEGEND**

- STATE BOUNDARY -----
- DISTRICT BOUNDARY -----
- ROAD -----
- RAILWAY +++++
- RIVER / NALA -----
- PROJEJT UNDER OPERATION HYDEL PROJECT
- PROJEJT UNDER CONSTRUCTION HYDEL PROJECT



<b>WAPCOS LIMITED</b> <small>(A GOVERNMENT OF INDIA UNDERTAKING)</small> <b>CENTER FOR ENVIRONMENT</b>	
CLIENT :	<b>KINNER KAILASH POWER CORPORATION LIMITED</b>
PROJECT :	<b>SHONGTONG - KARCHAM H.E. PROJECT</b>
TITLE :	<b>LOCATION &amp; VICINITY MAP</b>
SCALE :	FIGURE NO. 1.1
AS SHOWN	

