

ENVIRONMENTAL IMPACT ASSESSMENT STUDY
for
CHINKI BORAS BARRAGE COMBINED MULTIPURPOSE
PROJECT (1,31,925 ha), MADHYA PRADESH



Executive Summary
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Prepared for:
NARMADA VALLEY DEVELOPMENT AUTHORITY

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1. PROJECT DESCRIPTION

Chinki Boras Barrage Combined Multipurpose Project is a multipurpose project with irrigation and power generation components. The proposed project is a multipurpose project with two barrages across river Narmada. Chinki Barrage, along with Chinki powerhouse, is located at Chinki Village, district Narsinghpur. Boras Barrage, along with Boras powerhouse, is located at Boras Village, district Raisen. Command area will be spread in 3 districts viz. Narsinghpur, Raisen and Hoshangabad. Submergence will spread in 3 districts viz. Narsinghpur, Raisen, and Jabalpur.

Chinki Boras Combined Multipurpose project is designed to cater to 1,31,925 ha of command (CCA) spread in 3 districts of Madhya Pradesh viz. Narsinghpur, Raisen and Hoshangabad. The project will provide irrigation water during rabi season to 396 villages. Chinki Barrage will have a gross storage capacity of 209.365 MCM at FTL; its submergence will spread over 1729 ha of government and private land. Boras Barrage will have a gross storage capacity of 107.165 MCM at FTL; its submergence will spread over 1215 ha. There are two powerhouses – one each at Chinki and Boras barrage with 25 MW of installed capacity each. Project will require 62.41 MW of power to lift water through 5 pumphouses. In addition, Solar Panels of suitable size and capacity shall be used for the Scada, communication and lighting at various locations based on the requirement. There will be five pumphouses, with pumphouse 4 divided into two parts for lower and higher Boras command separately. All the pumphouses are designed to house 4 working and 1 standby pump. **Table 1** gives the salient features and **Figure 1** gives the layout map of Chinki Boras Combined Multipurpose Project.

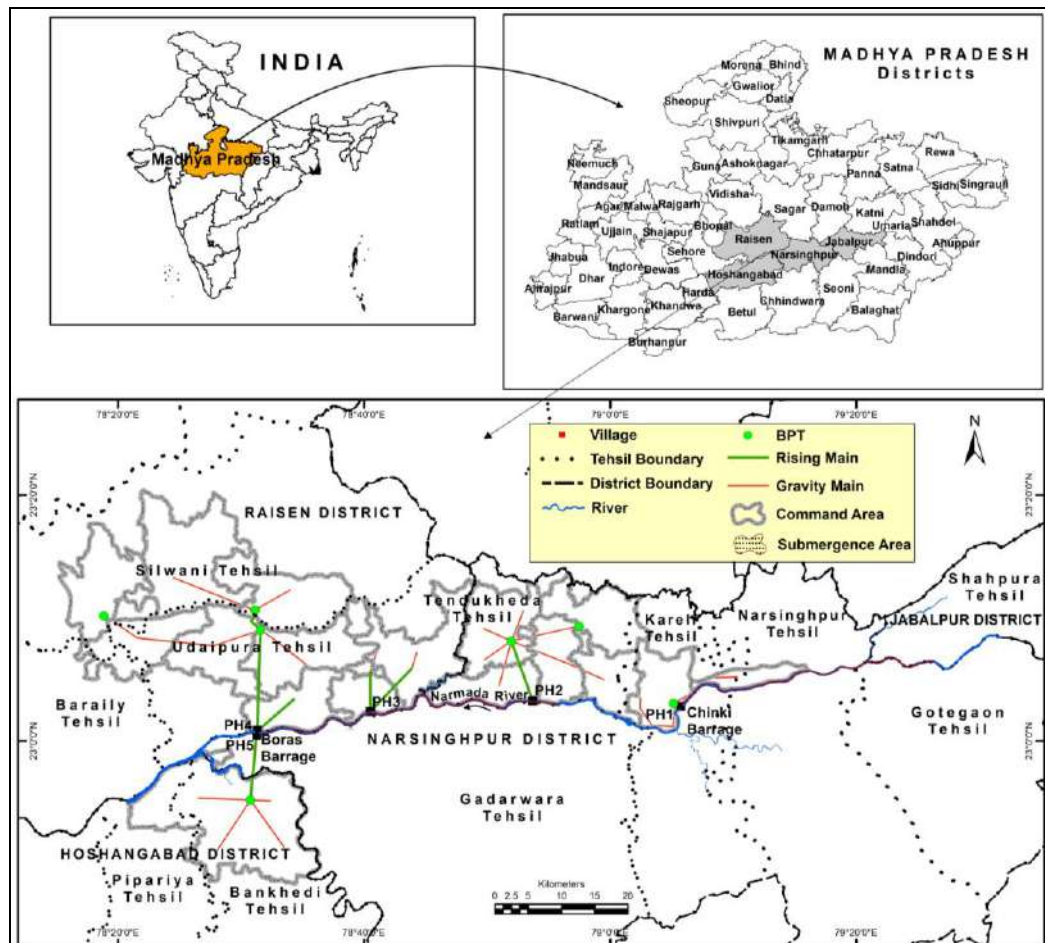


Figure 1: Location Map of Chinki Boras Barrage Combined Multipurpose Project

Table 1: Salient features of Chinki Boras Barrage Combined Multipurpose Project

Chinki Barrage		
Location		
1	State	Madhya Pradesh
2	District	Narsinghpur
3	Tehsil/ Block	Kareli
4	Latitude	23° 02' 00" N
5	Longitude	79° 05' 24" E
6	River	Narmada River
7	Location	19 km from Kareli on NH-26, and 15 km from Narsinghpur.
Hydrology		
8	Catchment area upto dam site	23,358 Sq. km.
9	Design Flood discharge (PMF)	36,614 Cumecs
Reservoir Data		
10	Gross storage at FRL	209.365 MCM
11	Live Storage	14.31 MCM
12	Dead storage	195.055 MCM
13	Gross Area of submergence at FRL	1729 ha
14	Private Land	518 ha
15	Government Land	1211 ha
16	Forest Land	0 ha
DAM Data		
17	Type of Dam	Concrete Barrage
18	Total Length	404.10 m
19	Length of spillway	324.10 m
20	Height	25.92 m
21	No. of Openings/ Gates	17 Nos
22	Size of Gates	15.30 m (width) x 14 m (height)
23	Crest Level	316.50 m
Control Level		
24	T.B.L	339 m
25	F.R.L	330.50 m
26	M.D.D.L	330 m
Power House		
27	Location	Narsinghpur
28	Power House size (m)	30.00 x 15.00
29	Turbine (MW)	3 x 8.33 MW
30	T.W.L	335 m
BORAS BARRAGE		
Location		
31	State	Madhya Pradesh
32	District	Raisen
33	Tehsil/ Block	Udaipura
34	Latitude	23° 01' 00" N
35	Longitude	78° 33' 00" E
36	River	Narmada River
37	Location	near village Boras
Hydrology		
38	Catchment area upto dam site	30,000 Sq. km.
39	Design Flood discharge (PMF)	39,981 Cumecs

Reservoir Data		
40	Gross storage at FRL	107.165 MCM
41	Live Storage	13.18 MCM
42	Dead storage	93.985 MCM
43	Gross Area of submergence at FRL	1215 ha
44	Private Land	210 ha
45	Government Land	1005 ha
46	Forest Land	0 ha
DAM Data		
47	Type of Dam	Concrete Barrage
48	Total Length	631.50 m
49	Length of spillway	551.10 m
50	Height	17.25 m
51	No. of Openings/ Gates	30 Nos
52	Size of Gates	15.30 m (width) x 9 m (height)
53	Crest Level	301 m
Control Level		
54	T.B.L	317 m
55	F.R.L	310 m
56	M.D.D.L	309 m
Powerhouse		
57	Location	Raisen
58	Power House size (m)	30.00 x 15.00
59	Turbine (MW)	3 x 8.33 MW
60	T.W.L	313.45 m
Area proposed under Irrigation		
61	G.C.A	1,54,425 ha
62	C.C.A	1,31,925 ha
63	Power required	62.41 MW
Financial Aspects		
64	Estimated Cost (USR 2017) updated 2021	5839.32 crore

2. LAND REQUIREMENT

The total land requirement for Chinki Boras Barrage Combined Multipurpose Project is estimated as 2973.65 ha. Out of which, 757.65 ha is private land, and the remaining 2216.00 ha is government land. No forest land shall be diverted for the project. Breakup of the land requirement is given at **Table 2** below.

Table 2: Land requirement for the project

Component	Chinki		Boras		Total (ha)
	Private Land	Govt. Land	Private Land	Govt. Land	
Submergence	518.00	1211.00	210.00	1005.00	2944.00
Pump Houses	5.00	-	5.00	-	10.00
Gravity Main	1.33	-	18.32	-	19.65
Total (ha)	524.33	1211.00	233.32	1005.00	2973.65

3. STUDY AREA

The study area for the collection of data on various baseline environmental parameters has been defined as per the Terms of Reference (TOR) issued by EAC, MoEF&CC, Govt. of India as part of scoping clearance (refer to **Figure 2**). The Study Area for assessment of environmental baseline status was delineated as follows:

- The area within 10 km radius of the main project components like proposed reservoir area and dam site.
- Area within 2.5 km buffer on either side of pipeline (water conductor system) in proposed command area.

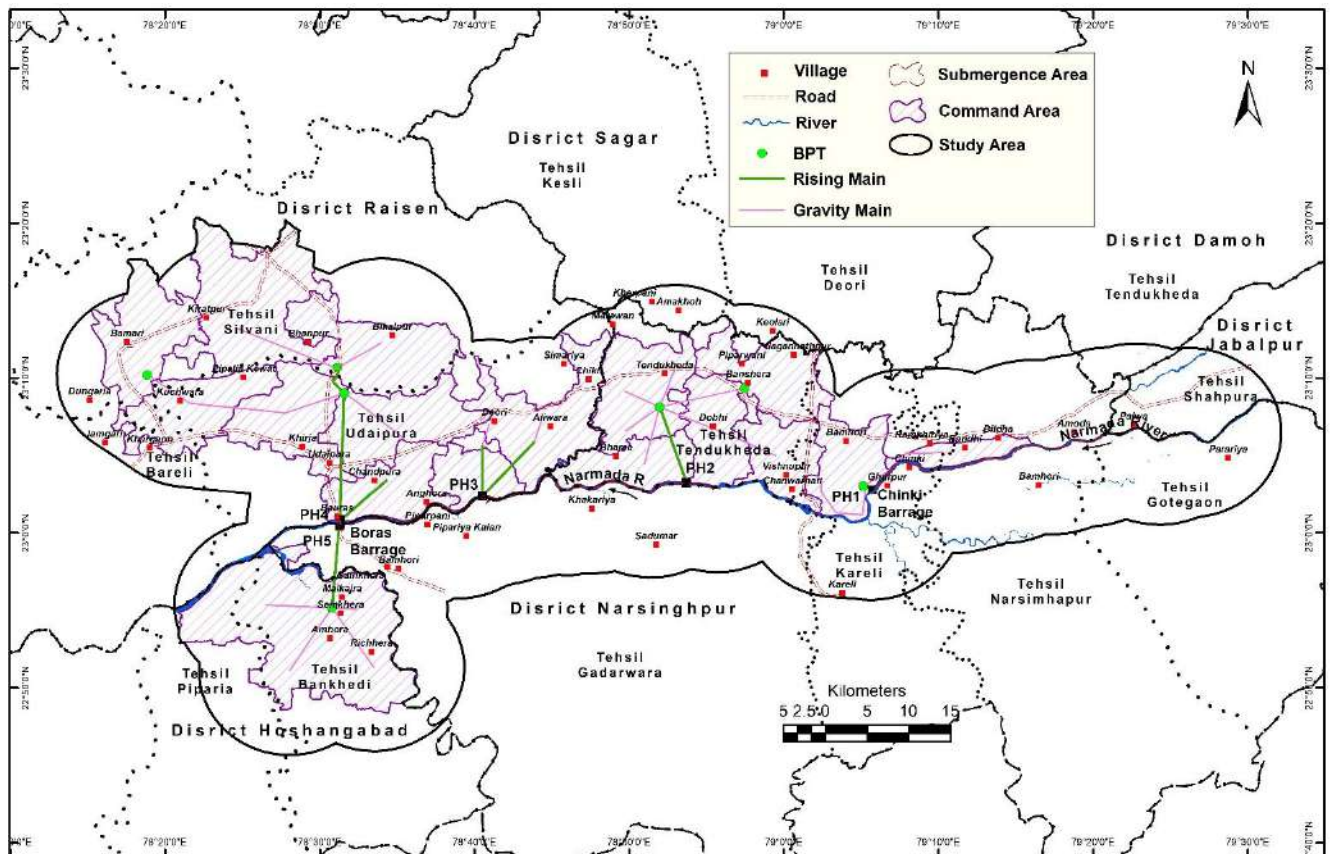


Figure 2: Map showing the study area

4. DESCRIPTION OF THE ENVIRONMENT

Data on the existing environmental parameters in the study area delineated as per the approved Terms of Reference (TOR) for EIA studies by Ministry of Environment, Forests & Climate Change (MoEF&CC), Government of India were collected to understand the present setting of the environment at the project site. The base line status is described briefly in the following sections.

4.1 Physiography

The study area of the proposed project lies between 300 m and 657 m elevation. About 61% of the project study area lies in 301 m to 350 m elevation band, about 29 % of the study area be restricted to 351m to 400m elevation band and rest 10% lies in above 500 m).

4.2 Land Use/ Land Cover

Agricultural land constitutes predominant land use comprises of 79.33% of the study area. Forests comprised of Deciduous Forest and Scrub Forest is 14.72%. 2.03% of study area lies under Scrub land, 2.17% under Waterbodies and 1.32% under Settlement.

4.3 Geomorphology

Physio-graphically, the area can be broadly classified as Narmada Valley alluvial plain. The area exhibits mostly a region of low-level plateau of extrusive origin in the north eastern and eastern part, older flood plain along with younger flood plains (including in-filled riverbeds) in the south eastern part and low-level structural plateau in the central and western part. The other landforms are plain of extrusive origin in the north western part, structural hills and valleys and denudational slope in the mid-eastern and southern most part. Narmada River and its tributaries drain the central and Southern part of the study area and the general gradient is towards west direction. The central alluvial plain, occupy a large area to the north and south of the Narmada River and a narrow strip to the north. The southern hilly terrain constituted the Satpura hill ranges.

4.4 Geology

i. Geology at Chinki Barrage Site

At this barrage site Quartzite and Quartzite breccia are exposed about 450 m downstream of the barrage axis and on the left bank amidst river alluvium. The rocks are reddish brown in colour, coarse grained texture, compact, hard and strike obliquely across the river with N-S trend and upstream (easterly) dip of about 35° for a strike length of about 90 m. The width of these rocks is over 06 m and towards the left bank the strike suddenly veers to E-W and this trend further persists for about 50 m until they are concealed by alluvium. Here they dip 45° due south. Thickness of individual beds varies from 30 cm to 1.5 m. Another set of joints trend spaced at 30 cms interval with 40° downstream (westerly) dip is also noticed. The outcrop represents beds near the core of an anticline with NW-SE axis plunging SE.

Overlying the Quartzite breccia is noticed a meter thick bed of medium- grained friable sandstone and a meter thick conglomerate with N-S strike. As these beds are intricately folded they have squeezed into the axial tension fractures in the crest of an anticlinally folded quartzite breccia. The phyllites, next younger in the series, are greenish, buff and grey in colour, closely jointed and exhibit typical phyllitic texture. Shales which succeed the phyllites are dark or grey and greenish grey in colour, thinly bedded, splintery and have at places slaty foliation. The shale and phyllites are intercalated with concordant lenses of metabasic rocks. The total width of the exposure is about 85 m and strike length about 90 m. On the northern side they are concealed under the river water and at the southern end are covered by alluvium.

ii. Geology at Boras Barrage Site

The length at the top the Barrage is 672.00 m and height is 19.00 m (above river deepest bed level i.e 298.00 m). The river flows from East to West direction at the proposed site. Both the banks form undulating topography and river terraces. There are few seasonal

nallas on U/s & D/s of the axis on both the banks. The barrage area on both banks are covered by 30 to 40 m thick alluvial deposits of silty clay, fine to coarse grained sand, silty sand, gravels and pebbles. The rock is not met even at a depth of 40 m in both the banks.

Geologically the project area is correlated with Boras formation from both Stratigraphic sequences due to its proximity to the project. Complete range of investigations including geological mapping, geophysical survey & subsurface exploration, soil rock mechanic tests have been conducted for providing geological inputs needed for firming up of the layout of the project. Surface & subsurface investigations have been satisfactorily completed so as to arrive at the design parameters forming data base for construction work of different stage of the project.

This site at Boras barrage was selected for its steep abutments and due to easy accessibility. The Barrage site is approachable on right bank from Udaipura by Jeepable kachha road of about 17 km length and from left bank through Saikheda from Jeepable Motorable kachha road. At this site, the river valley has a span of about 400 m. The left bank has width of 200 m sand deposit & the left bank has gradual raising slope up to elevation 317.2 M and then it is flat. The right bank is steep and vertically rises up to EL 317.2 M and after words it is more or less plain and then undulating. Both the banks are composed of consolidated overburden material of yellowish silty clay, pebbles & cobbles, fine to coarse-grained sand. There are few seasonal nallas / gallies available in u/s & d/s of this axis.

4.5 Seismicity

Seismically, the project area falls in the Narmada-Tapti-Son zone, which is seismically mild, and it falls under Seismic Zone III, therefore, appropriate coefficients together with suitable safety factors would be used in the design of the major project components.

4.6 Catastrophic Events

Some of the earthquakes of large magnitude that have occurred in this region are listed below:

- i. The earthquake of May 1846 near Damoh (Magnitude =6.5 on Richter Scale).
- ii. The Son valley earthquake of June 2, 1927 (Mag. = 6.5)
- iii. The Satpura Earthquake of 14th March 1938 (Magnitude= 6.3) and
- iv. The Jabalpur earthquake of May 22, 1997 (Mag. =6.0).

Keeping in view of the above, the project area has to be considered as an area of mild seismic zone related to empirical aspect and regional tectonic setting.

4.7 Hydrology

The proposed Chinki Boras barrage Combined Multipurposed Project to be constructed on Namada River. The Chniki barrage is located near Piparaha village and Boras barrage is located near Chouras village. The catchment area Narmada River upto Chinki barrage site is 23358 sq. km. and at Boras barrage site is about 30000 sq. km.

For water availability and flood study, gauge discharge data of Barman and Sandia G/D site of CWC from 1990 to 2021 was used in the analysis. As these sites are on the same stream very near to the proposed sites and the transportation using the weighted area method was found appropriate for hydrological analysis.

The detail hydrology report of Chinki Boras Barrage Combined Multipurpose Project was submitted to Central India Hydrology Regional Centre (CIHRC), National Institute of Hydrology, Bhopal (M.P.) for vetting.

Central India Hydrology Regional Centre (CIHRC), National Institute of Hydrology, Bhopal (M.P.) vide their letter no. क्र.म.भा.ज.क्षे.के./ स.ज.स./ 8047 dated 25/05/2022, approved the hydrology of proposed Chinki Boras barrage Combined Multipurposed Project.

4.8 Meteorology

In the study area, the average maximum temperature of 43.5°C was recorded in Udaipur town during May. The average minimum temperature of 11.4°C was recorded during January. The relative humidity is generally low throughout the year, except during monsoon months when the average humidity in the study area is close to 88% in August. The summer months are generally the dry months of the year with average humidity as low as 19% in the study area. The area receives maximum rainfall during the southwest monsoon i.e., between June and September when about 90.0% of the annual average rainfall is received and 10.0% of the annual average rainfall occurs between October and November post-monsoon or retreating monsoon season. The wind speed is higher during the monsoon period as compared to the post-monsoon period. The average maximum wind speed of 4.19 m/s is observed during May.

4.9 Soil

Soil in the project area is Loam and Sandy Loam in nature. As per the soil taxonomic classification of the study area, about 23 % of the area is characterised by deep, moderately well drained, calcareous, clayey soils on moderately sloping plain land (slightly dissected) with moderate erosion. While about 14% is characterised by deep, well drained, loamy soils on gently sloping plain land (slightly dissected) with moderate erosion and slightly stony.

The physical and chemical soil quality indicators reflect the good quality of the soil in the study area. The soil fertility based upon Nutrient Index in terms of NPK shows that Nitrogen and Potassium is in 'Low' and 'Medium' range respectively. While Phosphorus fertility rating has been 'Low' during pre-monsoon and monsoon season, while 'Medium' during Winter season.

4.10 Ambient Air Quality

The Ambient Air Quality monitoring was carried out conforming to the National Ambient Air Quality Standards for Industrial, Residential, Rural & Other Areas and Ecologically Sensitive Areas. The concentrations of PM_{2.5}, PM₁₀, SO₂, and NO₂ at all the sites were well within the Residential & Rural area permissible limits prescribed by National Ambient Air Quality Standard 2009 notified by CPCB.

Air quality was also assessed using 24h averages of PM_{2.5}, PM₁₀, SO₂, and NO₂ levels in the AQI calculator of CPCB and calculated Air Quality Index (AQI). 3 sampling locations fall under the 'Satisfactory' category in the different seasons in the study area and also one site during pre-monsoon season fall under satisfactory category, however, all the samples fall under 'Good' category in different seasons in the study area.

4.11 Noise Quality

Noise levels are also well within permissible limits as per CPCB standards. This is mainly due to the absence of major industrial establishments and a medium volume of traffic in the study area.

4.12 Water Quality

The data on water quality has been collected to evaluate surface and ground water quality in study area. The water quality in the study area, in general, is good. This is primarily due to the absence of any industrial establishment and low population density in the project area.

A. Surface Water Quality

Surface water quality of Narmada River samples collected during winter, pre-monsoon, and monsoon seasons was compared with the Water Quality Criteria of Central Pollution Control Board (http://www.cpcb.nic.in/Water_Quality_Criteria.php) fall under Class 'A' with Drinking-Water Source without conventional treatment but after disinfection, this is due to DO concentration is more than 6 mg/l, BOD is less than 2 mg/l, pH range between 6.5 and 8.5 and the Total coliform count is less than 50 MPN/100ml. Samples SW1 Hiran river and SW6 River Near Imaliya Village fall under Class 'B' with outdoor bathing (Organised), this is due to Total Coliform organism less than 500, pH between 6.5 to 8.5 and dissolved oxygen more than 5mg/l.

According to WQI values obtained for different seasons surface water quality, in general, is in the 'Good' category in winter and pre-monsoon seasons but in monsoon season WQI lies in Medium category all the sampling locations in the study area.

B. Ground Water Quality

Analytical results of ground water samples were compared with drinking water standards IS-10500:2012 to assess the status of ground water taken from tube wells and hand pumps as this water is used for drinking purpose in villages. All the samples were found within permissible limits as per drinking water standards prescribed by CPCB.

The DWQI calculated for ground water samples collected from different locations in the study area. All samples fall in 'Excellent' water quality class in all the seasons.

4.13 Floristic Diversity

As per the land-use map, more than 79% of the study area lies under agricultural land. Forest areas consist of about 14.72% of the total study area. According to "A Revised Survey of the Forest Types of India" by Champion and Seth (1968) the forest types are under Tropical Dry Deciduous forest. Forest in the area is comprised of dry deciduous

vegetation comprised of Dry teak Forest, mixed deciduous forest and deciduous scrub forest.

The tree cover in the study area is comprised of Dry deciduous and thorny vegetation. *Anogeissus pendula* and *Tectona grandis* either in pure form or associated with *Diospyros melanoxylon*, *Schleichera oleosa*, *Sterculia urens*, *Lannea coromandelica*, *Butea monosperma*, *Bauhinia racemosa*, *Terminalia tomentosa* and *Terminalia bellirica*, are the distributed along the hill slopes as well as on plain areas.

Scrub forest in the study area was mainly represented by *Acacia catechu*, *Prosopis cineraria*, *Madhuca longifolia*, *Azadirachta indica*, *Aegle marmelos*, *Butea monosperma*, *Phyllanthus emblica*, *Bauhinia racemosa*, *Ziziphus jujuba*, and *Dendrocalamus strictus* are other common tree and bamboo species in the area.

Tree species near habitation and agriculture field was represented by *Azadirachta indica*, *Mangifera indica*, *Madhuca longifolia*, *Dalbergia sissoo*, *Aegle marmelos*, *Syzygium cumini*, *Morus alba*, *Desmodium oogeinense*, *Corymbia citriodora*, *Albizia lebbek*, *Phyllanthus emblica* and *Ziziphus jujuba*.

Shrubs around agriculture fields and settlements were represented by species like *Lantana camara*, *Calotropis gigantea*, *Justicia adhatoda*, *Colebrookea oppositifolia*, *Ajuga integrifolia*, *Argemone mexicana*, *Agave americana*, *Acacia pennata* and *Dendrocalamus strictus*. Commonly found herbaceous species are

Commonly found herbaceous species are *Senna tora*, *Senna obtusifolia*, *Carissa spinarum*, *Calotropis gigantea*, *Argemone mexicana*, *Rungia repens*, and *Asparagus racemosus*. *Asparagus racemosus*, *Embelia robusta*, *Carissa carandas*, *Phoenix acaulis*, *Tribulus terrestris*, *Solanum virginianum*, *Galium aparine*, and *Smilax zeylanica* common in Scrubland and open/ scrub forest. Grasses in the study area were represented by species like *Aristida ascensionis*, *Brachiaria eruciformis*, *Cyperus rotundus*, *Dichanthium aristatum*, *Eragrostis amabilis*, *Heteropogon contortus*, *Saccharum spontaneum*, *Sorghum halepense*, *Erianthus munja*, and *Cenchrus ciliaris*.

During field surveys 109 plant species belongs to 37 families were recorded from the study area. The list includes 39 tree species, 30 Shrub and 40 species of herbs, grass/bamboo.

The detail inventory of Plant species reported from the study area has been prepared based on primary survey and same has been supplemented with available secondary data. An inventory of 169 species of plants belonging to angiosperms was compiled which includes plant species found in forested areas, scrub land, near agricultural fields and settlements, abandoned land, etc. Fabaceae and Poaceae are the dominant families in the area. This list includes 52 species of trees, 46 species of shrubs, 60 species of herbs, and 16 species of grasses. Most of the vegetation is found mainly in the forest area.

None of the plant species found in the study area falls under endemic or Threatened category of RED Data Book of Indian Plants.

As per IUCN Red List of Threatened Species Version 2022-1, only *Aegle marmelos* is the species listed under Near Threatened (NT) category. Rest of species evaluated by IUCN are under the 'Least Concern' category (LC).

4.14 Faunal Diversity

Mammals: In the study area, species like *Semnopithecus entellus* (Common Langur), *Macaca mulatta* (Rhesus macaque), *Herpestes edwardsii* (Indian Grey Mongoose), and *Funambulus pennantii* (Five-striped Palm Squirrel) were sighted during the field survey. In addition to the presence of *Sus scrofa* (Wild Boar) and *Lepus nigricollis* (Common Hare) was also confirmed by villagers.

In addition, the presence of *Axis axis* (Spotted deer), Sambar Deer (*Rusa unicolor*), *Vulpes bengalensis* (Fox) and *Canis aureus* (Jackal), were also confirmed by villagers.

Avifauna: A total of 43 species of birds belonging to 10 Order and 25 families were recorded during the field survey from the study area. Most commonly found birds are White-throated Kingfisher, Indian Roller, Red-wattled Lapwing, Wagtail, Yellow-eyed Babbler, Indian Robin, Pied Bush chat, Long-tailed Shrike, House Sparrow, Black Drongo, Common Myna, Egret, Cormorant, etc. A large portion of avifauna species is comprised of resident birds in the project study area.

Herpetofauna: During the survey, Stream frog (*Amolops formosus*), Garden lizard (*Calotes versicolor*), Common house gecko (*Hemidactylus frenatus*), and Indian Chamaeleon (*Chamaeleo zeylanicus*) were commonly sighted species in the area.

Butterflies: During the field survey conducted total of 4 species of butterfly belonging to Lepidoptera Order and 3 families were recorded from the study area.

Aquatic fauna: During experimental fishing 16 species of fish and one species of Crab were landed. Out of 16 species of fish 10 species belong to family Cyprinidae and one each of Anguillidae, Bagridae, Cambaridae, Cichlidae, Clariidae, and Pangasiidae families.

Conservation Status

As per IUCN Red list of Threatened Species Version 2021-1, *Rusa unicolor* is under Vulnerable (VU) category, rest of the mammals reported from the study have been listed under Least Concern (LC) category. Among the avifaunal species *Neophron percnopterus* is under Endangered category (EN), rest of the bird species sighted during field survey area under Least Concerned category.

Among the fish fauna recorded during field survey, *Anguilla bengalensis* and *Tor tor* are listed under Near Threatened category of IUCN Redlist of Threatened species, while *Cirrhinus cirrhosis*, *Cyprinus carpio* and *Oreochromis mossambicus* are categories under Vulnerable (VU) category IUCN (Version 2022-1). Rest of the species recorded from the area are under Least concern category.

According to Wildlife (Protection) Act, 1972; five mammalian species reported from the study area are listed as Schedule-II species and four species are listed under Schedule-IV species. All other bird species sighted from the study area are either Schedule IV or are Schedule V species.

4.15 Proximity to Protected Area

The proposed project is located around 23.70 km from the notified boundary of Singhori WLS and around 5.82 km from Nauradehi Wildlife Sanctuary boundary. All the project components are outside the notified ESZs. Certificates have been issued by respective forest departments regarding distance of WLS from project locations.

4.16 Social Environment

The Chinki Boras barrage combined multipurpose Irrigation Project is proposed to be developed on the Narmada River near Chinki village of Kareli Tehsil in Narsinghapur district & near Boras village of Udaipura Tehsil in Raisen district in the state of Madhya Pradesh.

There is total of 487 villages & 2 towns in the study area which includes 396 benefited villages in the proposed command area. There are 114 project affected villages in the submergence area. Out of 396 project affected villages, 21 villages are also listed as Project Affected Villages due to acquisition of private land.

On the basis of primary survey (interaction with Village Sarpanch, FGD, public consultation and discussion with influential person of the study area) and secondary sources, the major outcomes specify the following observations and gap in the study area. Sanitation, Drainage, Medical infrastructure system is very poor. Approx. 80.05% has no Pucca close drainage system in the study area.

Livelihood of most of the people of the study area depends on agriculture and labour work. Tube well and Hand pump are the source of drinking water in the study area. The project area is connected with the roads which are black topped (pucca), gravel (kuchcha) and footpath. There are no any chronic or epidemic disease has been reported in the study area except general cases of cough and fever.

4.17 Historical, Religious and Archaeological Importance Places

No places of archaeological importance were reported from the study area. Among the historical sites a cave associated with Adi Guru Shankracharya's is located near Neemkheda village in Narsinghpur district.

The sacred Narmada River, the lifeline of Central India, is worshipped as *Narmada maiyya* (mother) or *Ma Rewa*. The presence of holy Narmada River offers religious tourism in the area.

5. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 Ambient Air Quality

Construction Phase Impacts: The air environment around the project site is free from any significant pollution source. Therefore, ambient air quality is well within the limit in and around the project area. Increased vehicular movement for transportation of men and material and use of construction equipment will impact air quality at the construction site through emissions from the engines and equipment, fugitive emissions due to material handling, etc.

Additionally, construction activities including operation of crushers, concrete batch plants, construction work, and movement of vehicles along the unpaved road will generate dust & gaseous emissions and impact air quality. The burning of waste will also affect air quality and therefore, need to be controlled. In absence of proper fuel, construction workers at the project site may tend to use wood for fuel burning, therefore, needs to be managed properly.

Operation Phase Impacts: Multipurpose project involving irrigation and hydro power generation do not generate air pollution during the operation phase as there is no source of air pollution. Activities, during operation phase are supply of water in closed pipes and power generation only. Therefore, during the operation phase, no major impacts are envisaged on the air environment.

5.2 Noise Environment

Construction Phase Impacts: Noise in and around the construction site may affect the wildlife in the nearby areas. Sources of noise will be increased vehicular traffic due to project construction on approach roads and at construction sites. Due to construction activity in the area, noise levels will increase during the period of construction, however, they will remain limited to the work area. Other sources of noise and vibration will be the operation of various equipment and use of explosives for blasting purposes for construction activities.

Operation Phase Impacts: No major impacts are envisaged on noise environment during project operation phase.

5.3 Water Environment

Construction Phase Impacts: Water is used in construction activities leading to wastewater generation with high suspended solids. Similarly, effluents due to washing from truck or equipment etc. would have high concentration of oil and grease. The water quality may get impacted when the muck is disposed of along the water bodies and natural drainage system. The unsorted waste going into the channels/ water bodies can contribute to the turbidity of water.

Domestic wastewater will be generated from project and worker's colony to be set up during construction phase, which can find its way to river/ ground water without any

treatment will cause significant impact on water environment therefore needs to be managed properly.

Operation Phase Impacts: During operational phase only a small number of O&M staff will reside in the area in a well-designed colony with sewage treatment plant and other infrastructural facilities, the problems of water pollution due to disposal of sewage are not anticipated. The treated sewage will be reused for gardening and green belt around the colony.

5.4 Land Environment

Construction Phase: The following positive impacts are anticipated on Land environment during construction phase

- **Impact due to Land Requirement and change in land-use:** A major impact of land acquisition is a permanent change of land use, which is unavoidable and cannot be mitigated. Private land acquisition has impacts on the local population by way of loss of their agricultural land and displacement of families. These impacts cannot be mitigated and therefore, compensation need to be provided to ensure that life of project affected families can be restored and their quality of life should improve.
- **Impact Due to Muck Generation:** Muck generation, transportation and disposal can significantly impact the land environment, if not managed properly.
- **Impact due to Waste Generation:** The main sources of waste generation can be categorized as:
 - i. Municipal waste (includes commercial and residential wastes, excluding industrial hazardous wastes and bio-medical wastes)
 - ii. Construction and demolition debris (C&D waste)
 - iii. Bio-medical waste
 - iv. Hazardous waste (generated from construction machinery and equipment)
 - v. e-Waste (computer parts, Printer cartridges, electronic parts, etc.,).

5.5 Flora and Fauna

Construction Phase

Impact on Terrestrial Flora: Increase in human interference could have an impact on terrestrial ecosystem. The workers may cut trees to meet their requirements for fuelwood, construction of houses, furniture etc. Thus, it is necessary to provide alternative fuel, training and awareness; and implement adequate surveillance to mitigate the adverse impacts on terrestrial flora during project construction phase.

Impact on Terrestrial Fauna: During the construction period, large number of machinery and construction workers shall be mobilized, which may create disturbance to wildlife habitat in the vicinity of project area. The operation of various equipment will generate significant noise; noise and vibration will also increase during blasting which will affect the fauna of the area. The noise may scare the fauna and force them to migrate to other areas however, it will be temporary and last during the construction phase. The impact of blasting needs to be mitigated by adopting controlled blasting and a strict surveillance regime and the same is proposed to be used in the project.

Operation Phase

On completion of the construction of the project, the land used for construction activities will be restored. Operation phase impacts on flora and fauna will be positive due to restoration of construction areas, restoration of the muck disposal area, green belt development, implementation of Biodiversity Management and Wildlife Conservation Plan, etc. The increase of greenery and increased moisture due to the creation of the reservoir will have a positive impact on avifauna.

5.6 Fish Fauna

Narmada river in this stretch is abundant in fish species. 16 fish species have recorded during the baseline studies including the migratory species such as Tor tor. Construction of barrages and creation of reservoir will change the habitat of fish species and impact their breeding and spawning cycle. To compensate for the impacts on fish fauna, reservoir fisheries have been proposed as part of Fish Conservation and Management Plan. In addition, it is proposed to construct fish ladder/pass, the design of which shall be provided by CIFRI. In addition, release of environment flow, as recommended above, will ensure that the river stretch between two barrages and downstream of Boras barrage will never run dry due to storage of water.

5.7 Socio-Economic Environment

a) Positive Impacts on Socio-Economic Environment

The following positive impacts are anticipated on the socio-economic environment of the local people of villages in vicinity of project area during the project construction and operation phases:

- i) This being primarily an irrigation project, with an objective to provide irrigation water during rabi season to the project benefitted villages. 396 villages will get benefit from the project and population in these villages will reap all the benefits of better agriculture production and improved economic status.
- ii) Several marginal activities and jobs would be available to the locals during the construction phase.
- iii) Project will bring large-scale investment to the area will also invest in local area development and benefit will be reaped by locals.
- iv) Education, medical, transportation, road network, and other infrastructural facilities will improve.
- v) Petty jobs and R&M works shall be awarded to the locals.

b) Negative Impacts on Socio-Economic Environment

- i) Loss of land and displacement of population
- ii) The influx of outside population will also increase the risk of socio-cultural conflicts and increase of petty crimes, gender based violence, increased incidences of diseases, etc.
- iii) Increased incidence of Diseases.

5.8 Mitigation Measures for Air, Water and Noise Pollution

Proposed project involves construction of dam, reservoir, pump houses, and other associated infrastructure in a period of 6 years. Major construction activities have potential

of pollution generation as discussed above. Impacts arising out of construction activities can be mitigated significantly by taking appropriate mitigation measures, as discussed below.

Control of Air Pollution: For the control of air pollution during construction phase of the project, it is suggested that it should be made mandatory for the contractor/s engaged in the construction works to ensure the implementation of pollution control measures as per CPCB guidelines with regular monitoring of ambient air quality in the project area. Vehicles should have valid PUC and all project roads should be metalled.

Control of Noise Pollution:

- Diesel Generator sets are to be placed in acoustic enclosures to reduce the noise.
- Proper and regular maintenance/lubrication of machines should be done.
- Noise producing machines (such as crushers, aggregate processing plants, etc.) should be provided with sound barriers.
- Quieter machines and vehicles with high quality silencers should be used.
- Ambient noise should be monitored periodically at different locations.

Control of Water Pollution:

- Provision of septic tank/ soak pit of adequate capacity for labour camp.
- Commission of suitable treatment facilities such as STP to treat the sewage generated from the colony & offices.
- Oil interceptors/ catchers will be provided and residue of petroleum products, batteries, e-wastes, etc. will be disposed in accordance with SPCB guidelines.
- Provision of sedimentation cum grease traps to prevent entry of contaminants to the water bodies.

A lump sum budget of **Rs. 50 lakh** has been proposed for the mitigation measures for control of air, noise and water pollution during project construction phase.

6. ENVIRONMENTAL MONITORING PROGRAMME

Environmental Monitoring shall be performed during all stages of the project (namely: construction and operation) to ensure that the impacts are no greater than predicted, and to verify the impact predictions.

Environment monitoring is proposed for a period of 6 years commensurate with the construction period of the project. If the construction period is extended, the monitoring period will also be extended accordingly and additional budget provided. The monitoring program for the proposed project will be undertaken to meet the following objectives:

- To monitor the environmental conditions of nearby area;
- To check on whether mitigation and management measures have been adopted, and are proving effective in practice

A total of **Rs. 167.20 lakh** have been allocated to implement various activities envisaged under Environmental Monitoring Programme.

7. ADDITIONAL STUDIES

7.1 Resettlement & Rehabilitation Plan

The total land requirement for Chinki Boras Barrage Combined Multipurpose Project is estimated as 2973.65 ha. Out of which, 757.65 ha is private land, and the remaining 2216.00 ha is government land. No forest land shall be diverted for the project.

Private land of 114 villages from Raisen, Narsinghpur and Jabalpur will come under submergence. In addition, 29.65 ha of private land will be acquired, scattered in these villages for pumphouses and gravity main. A total of 4419 project affected families have been identified from 114 villages. All the families are losing their land holdings mainly due to land coming under submergence. Out of these PAFs, 192 PAFs will be losing their houses and would require resettlement also. In addition to houses, wells/tubewells, shops, ashram, dharamshala and cremation ground will also come under submergence. Adequate compensation and resettlement package will be prepared as per the Rules and shall be awarded and implemented by district administration.

Resettlement of displaced families will be done as per the procedure laid down in Right to Fair Compensation Act (First and Second Schedule) by the appropriate government including determination of value of land and compensation for loss of house. For resettlement plan, it is proposed to develop resettlement colony in about 2.5 ha of government land. Land is being identified for resettlement of displaced families and shall be finalized shortly.

The financial requirement for implementation of the Rehabilitation and Resettlement plan and Economic Development Package is **Rs. 239.00 Crore**. This is budgetary estimate prepared for the purpose of EIA report. Actually compensation will be as per the award declared by the appropriate government.

7.2 Local Area Development Fund

The aim of Local Area Development Activities is focused sustainable development to improve the quality of life of neighborhood communities through equitable and proactive smart initiatives in spheres of education, health, rural development, environment, and livelihoods resulting in improvement of the overall social and economic conditions of locals as well as improvement of environmental conditions of their surroundings.

Based on the local consultations in project affected villages, the focus areas covering many important components of the sustainable development such as social, economic, livelihoods and environment will be identified and set of development activities shall be proposed under each focus area for the benefit of the local people under the Project. An amount of **Rs. 5.839 crore** has been earmarked for local area development activities.

7.3 Public Consultation

Draft EIA report and its Executive Summary in English and vernacular language (Hindi) will be submitted to Madhya Pradesh State Pollution Control Board (MPSPCB) to initiate the process of Public Hearing (PH).

8. PROJECT BENEFITS

The project will bring water to 396 villages, which are presently water scarce and cannot irrigate their land efficiently due to shortage of water. The project will bring direct environment and social benefits, which in turn will bring prosperity to the area and increase spending power of farmers, bringing economic benefits to the region. Direct benefits include public health infrastructure, awareness and training programs for farmers, etc.

9. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

Pollution generation mainly during construction phase will be in the form of air, water and noise pollution, which will be mitigated by adopting various mitigation measures and implementation of environment management plans.

NVDA is the project proponent/implementing agency for the entire scheme. NVDA has engaged M/s RVRPPL-NEC JV for design and execution of the work including its operation post commissioning Institutional arrangement for planning and implementing various mitigation and management measures along with carrying out environment monitoring.

9.1 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.

In the present study, CAT Plan has been formulated for the free draining catchment of Chinki Boras Barrage Combined Multipurpose Project. Therefore, study area is defined as catchment area of Narmada river from the dam site near Boras village to the dam site of the Bargi Project on Narmada river and diversion sites of Mehgaon Tola, Barnoo, Madai, Pariyat and Bohri Bund Irrigation Projects in the catchment of Hiran river, an important right bank tributary of Narmada river.

The catchment area treatment involves

- Understanding of the erosion characteristics of the terrain and,
- Suggesting remedial measures to reduce the erosion rate.

The estimated cost of implementation of CAT plan including monitoring and evaluation is **Rs. 38.67 crore.**

9.2 Compensatory Afforestation Plan

Since, there is no requirement of any forest land diversion for the project. Hence, requirement of preparation of Compensatory Afforestation Plan is not applicable in the present case.

9.3 Biodiversity Conservation & Wildlife Management Plan

Keeping in view of the anticipated impacts of proposed project on the biodiversity of area, the mitigation measures suggested for biodiversity conservation and wildlife management plan are as follows:

- i. Wildlife Habitat Preservation & Improvement
- ii. Fire Protection Measures
- iii. Construction and Maintenance of Water Holes/Ponds in Wildlife Habitat
- iv. Veterinary Care
- v. Strengthening of Infrastructural Facilities of Forest Department
- vi. Awareness Programme
- vii. Safeguards during construction phase

The estimated cost of implementation of various activities envisaged in the Biodiversity Conservation and Wildlife Management Plan would be **Rs.90.70 lakh**.

9.4 Fisheries Development Plan

To conserve the habitat of fish fauna in the Narmada River, to provide easy passage to migratory species and economic upliftment of the region, following measures suggested for Fisheries development plan.

- i. Fish Pass
- ii. Development of Reservoir Fisheries
- iii. Stock Management
- iv. Stock Density
- v. Conservation methods adopted in reservoir fishery

A budgetary provision of **Rs. 50.00 lakh** has been kept for management of reservoir fisheries and its maintenance the under Environmental management Plan for Fisheries development in proposed reservoir area of Chinki Boras Barrage combined multipurpose project.

9.5 Muck Management Plan

The construction would involve soil and rock excavation from Chinki and Boras barrages, pipelines, approach channels and pump houses. Maximum amount of muck will be generated from pipeline route, i.e. disposal requirement is estimated as 10,11,709 cum from pipeline, out of total disposal requirement of 17,76,886 cum.

For efficient muck management, first attempt is to utilise as much muck as possible in project construction. Substantial quantities of hard and soft rock will be utilised for backfilling in aflux bund. Muck from the pipeline route will be disposed off locally in low lying area. During excavation, care will be taken that top fertile soil is kept aside and will be used for re-filling the top area after laying pipe line. This top soil will be spread on adjoining farming fields with consent of farmers or alternatively will be used for green belt development.

Keeping in view the requirement of secured dumping of excavated muck, location of muck generation and away from drainages and at least 30 M away from the HFL of the river; two

muck dumping sites have been identified – one near Boras site and One near Chinki site having a total land area of 12.468 ha and 26.8452 ha respectively.

The Rehabilitation plan of the muck dumping site includes engineering and biological measures. The project authorities would ensure that the dumping yards blend with the natural landscape to develop the site with patches of greenery in and around it. The estimated cost of the relocation and rehabilitation of excavated material will be **Rs. 215.25 lakh**.

9.6 Landscaping and Restoration of Construction Sites

During construction phase of the project, number of temporary construction sites and working areas will come up. For the restoration of proposed project affected areas to its original landscape as much as possible and retain its aesthetic values. Various engineering and biological measures will be implemented for the restoration of proposed project affected areas. The estimated cost of restoration of construction is **54.50 lakh**.

9.7 Green Belt Development

To improve green cover for floral and faunal improvement in the command, it is proposed that plantation in 350 hectare in several patches in non-forest waste land will be done subject to availability of suitable land. The species to be planted will be chosen in consultation with local villagers and will be site specific. Suggested species for plantations are Teak, Dhawda, Sisham, Bamboo, Siras, Amaltas, Karanj, Neem, Sagon, Aonla, Mahua, Khair, Babool etc. Various biological measures viz. Normal Forestation, Enrichment, Assisted Natural Regeneration and Agroforestry (Energy Plantation) have been proposed in Watershed Development Plan under Environmental Management Plan. As the cost of the measures proposed under watershed Management Plan have already been taken under those heads, no additional cost at present required to be budgeted for Green Belt Development Plan.

9.8 Reservoir Rim Treatment

The Chinki Boras Barrage Combined Multipurpose project is proposed on the Narmada River with two barrages creating two reservoirs with a total extent of 2944 ha (1729 ha for Chinki reservoir and 1215 ha of Boras reservoir). During operation, reservoir level would fluctuate between FRL and MDDL level, and in addition, there will be water movement due to high run-off during monsoon season. It makes the slopes along the reservoir prone to slips and minor slides due to repeated water level fluctuation and charging of slips and soil erosion along the reservoir periphery. Therefore, the susceptible slopes along the reservoir would require treatment to avoid any slope failure.

A combination of engineering as well as biological measures are undertaken for slope stability and control of landslides in the reservoir area. As the cost of the measures proposed under CAT Plan and watershed Management Plan have already been taken under those heads. However, it is expected that during detailed engineering phase, some area may get identified requiring treatment before filling, which are not covered in CAT and Watershed Plan. Therefore, an additional budgetary provisions of Rs. 1.00 crore is proposed under this head.

9.9 Sanitation and Solid Waste Management

Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management for disposal. The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed as per the SPCB guidelines. It is proposed to provide adequate septic tanks with soak pits for treatment and disposal of sewage. Various aspects of solid waste management include:

- Reuse/Recycling
- Storage/Segregation
- Collection and Transportation
- Disposal

The waste generated from the project area will be collected, segregated and disposed off in line with the provisions laid down in Solid Waste Management Rules, 2016. The total budget in order to manage the solid waste generated from this population, has been proposed as **Rs. 300.0 lakh**.

9.10 Public Health Delivery System

Project construction and operation will bring about several changes in the socio-economic environment of the area including increased threats to health of the community.

- i. New Diseases due to Migratory Population
- ii. Chances of increase in water borne diseases as malaria, and dengue are high
- iii. Chances of increase in respiratory troubles due to increase in suspended particles during the construction phase.
- iv. Chances of occurrence of gastroenteritis, cholera and typhoid in the labour camps.

Medical services at secondary level play a vital and complimentary role to the tertiary and primary health care systems and together form a comprehensive district-based health care system. Following activities are proposed:

- Ambulance: 2 no. with all the basic Medicare facilities and small DG set, etc. to cater for villages in the project area.
- Budget for running the ambulances including driver, fuel and maintenance for 6 years.
- First aid posts (02 nos.) including sheds, furniture and basic equipment.
- Budget for running the first aid post including cost of medico, para-medico/Nurses and attendant, consumables, etc. for 6 years.
- Budget for strengthening existing medical facilities.
- Budget for Health Awareness/ Vaccination Camps for 6 years.
- Mitigation measures to avoid spread of COVID19 among workforce

Budgetary estimates for public health delivery system to be implemented have been worked out as **Rs. 226.00 lakh**.

9.11 Energy Conservation Measures

The existing facilities will become insufficient for supply of kitchen fuel for the migrant population during the construction of the project. Therefore, the project authorities would make adequate arrangements such as Community kitchen, Supply of Kitchen fuel, efficient cooking facilities and solar lantern either directly by developer or through contractor to reduce the pressure on natural resources in the project area and minimize impacts on this count. A total budget of **Rs. 252.00 lakh** have been proposed under Energy Conservation Plan.

9.12 Labour Management Plan for their Health and Safety

Construction work has many associated risks and health impacts for the workers who are directly exposed to such health and safety risks. Therefore, there is a need to prepare complete health and safety documents for workers either by project proponent/contractor and proponent shall ensure its implementation. A detailed plan will be prepared covering the above activities before start of construction work. A tentative budget of **Rs.89.00 lakh** for labour management have been proposed under EMP.

9.13 Disaster Management Plan

In order to visualize the worst-case scenario Dam Break Modeling exercise was undertaken and an inundation map was prepared. Based upon the outputs generated from this modeling, a Disaster Management Plan has been formulated. This plan presents warning and notification procedures to be followed in case of failure or potential failure of the barrages. The purpose is to provide timely warning to the population likely to be affected and alert key people who have to take respective actions in case of an emergency.

The estimated total cost of execution of disaster management plan including the equipment would be **Rs. 175.00 lakh**.

9.14 Watershed Development Plan

In compliance of the additional condition of scoping clearance accorded by MoEF&CC, Watershed Development Plan has been prepared. Proposed Watershed Development Plan focusses on soil and water conservation within the study area. Major objectives of the watershed management program are:

- conservation, up-gradation, and sustainable utilization of natural endowments such as land, water, plant, animal, and human resources in a harmonious and integrated manner with low-cost, simple, effective, and replicable methods.
- generation of employment so as to reduce dependence on resources around and arrest exploitation of same.
- reduction of inequalities between irrigated and rain-fed areas and poverty alleviation.
- Reduction of organic, inorganic and soil pollution load.
- Provision for adequate supply of water for domestic, industrial and agricultural needs.
- Flood control through small man-made reservoirs and other water impounding structures.

The following physical components have been included in the present watershed development plan:

- Land/Soil and water conservation measures
- Plantation/horticulture activities
- Agronomical practices
- Livestock management
- Renewables
- Alternative employment avenues to reduce impact on resources
- Capacity building/Institutional mechanism

The estimated cost of implementation of watershed development and management plan for the study area as defined above is **Rs. 1009.47 lakh.**

10. SUMMARY OF COST

The capital and recurring costs involved for implementation of Environmental Management Plan for Chinki Boras Barrage Combined Multipurpose Project is summarized in **Table 3.**

Table 3: Cost for Implementing Environmental Management Plan

S. No.	Component of EMP	Capital Cost	Recurring Cost (Rs. in lakh)						Total Cost
		(Rs. in lakh)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	(Rs. in lakh)
1	Catchment Area Treatment Plan	3867.19	00.00	00.00	00.00	00.00	00.00	00.00	3867.19
2	Compensatory Afforestation Plan*	00.00	00.00	00.00	00.00	00.00	00.00	00.00	0.00
3	Biodiversity Conservation & Wildlife Conservation Plan	90.70	00.00	00.00	00.00	00.00	00.00	00.00	90.70
4	Fisheries Development Plan	50.00	00.00	00.00	00.00	00.00	00.00	00.00	50.00
5	Muck Dumping and Management Plan	0.00	40.00	50.00	50.00	50.00	25.25	00.00	215.25
6	Landscaping, Restoration of Construction Sites	12.00	7.50	7.00	7.00	7.00	7.00	7.00	54.50
7	Green Belt Development Plan**	0.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
8	Reservoir Rim Treatment	100.00	00.00	00.00	00.00	0.00	0.00	00.00	100.00
9	Sanitation and Solid Waste Management Plan	0.00	50.00	50.00	50.00	50.00	50.00	50.00	300.00
10	Public Health Delivery System	100.00	21.00	21.00	21.00	21.00	21.00	21.00	226.00
11	Energy Conservation Measures	60.00	32.00	32.00	32.00	32.00	32.00	32.00	252.00
12	Labour Management Plan	35.00	9.00	9.00	9.00	9.00	9.00	9.00	89.00
13	Disaster Management Plan	130.00	7.50	7.50	7.50	7.50	7.50	7.50	175.00
14	Pollution Mitigation Measures	0.00	50.00	50.00	50.00	50.00	50.00	50.00	300.00
15	Environmental Monitoring Program	1.00	27.70	27.70	27.70	27.70	27.70	27.70	167.20
16	Rehabilitation and Resettlement Plan***	23899.12	00.00	00.00	00.00	00.00	00.00	00.00	23899.12
17	Local Area Development Plan	5839.00	00.00	00.00	00.00	00.00	00.00	00.00	5839.00
18	Watershed Development Plan	1009.47	00.00	00.00	00.00	00.00	00.00	00.00	1009.47
	Total	35193.48	244.70	254.20	254.20	254.20	229.45	204.20	36634.43

*No forest land diversion required; **Cost of green belt included in watershed development plan, ***Cost of private land acquisition will be part of DPR cost.