DAM REHABILITATION AND IMPROVEMENT PROJECT

CONSTRUCTION OF ADDITIONAL SPILLWAY AT HIRAKUD DAM, IN SAMBALPUR DISTRICT, ODISHA

ENVIRONMENTAL IMPACT ASSESSMENT (EXECUTIVE SUMMARY)

Submitted

By

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Government of Odisha

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EXECUTIVE SUMMRY

E.1 INTRODUCTION:

Project specific Environmental Impact Assessment study has been conducted for the proposed additional spillway at Hirakud dam in Sambalpur district of Odisha state proposed as a flood protection measures. The additional spillways have been proposed on the left bank dyke of the existing reservoir. The proposed project will include spill way with 243m long approach channel and RCC spill channel for a length of 2.14 km.

The Central Water Commission have organised to obtain consent of the World Bank for Phase-I and included the Project in the Bank aided ongoing Dam Rehabilitation and Improvement Project (DRIP).

As a pre-requisite of World Bank funding; various project interventions due upon construction of Left bank additional spillway need to be studied to ensure environmental and social compliance. This EIA/EMP is specifically prepared for implementation of additional spillway at the left bank dyke (Phase - I).

The main objective of the Environment Assessment Study is to identify the potential environmental impacts due to the proposed project as well as to formulate the measures for mitigating those environmental impacts at various stages of the project. The study report also covers the specific requirement of World Bank Policy on environment and social safeguards.

E.2 NEED OF THE PROPOSED PROJECT:

While the enormously rich water resources of Hirakud Dam continues to remain the mainstay of Odisha's agricultural prosperity & Hydropower potentiality, it has experienced growing concern since last two decades in working out alternatives for managing exceptional flood events when the reservoir is maintained at its maximum holding capacity.

The Central Water Commission (CWC), the apex technical body of ministry of water resources (MoWR) Govt. of India have conducted protracted study of the Hydrology of River Mahanadi and agreed to the revision of Probable Maximum Flood (PMF) with a peak value at 69632 m^3/sec.

The consequences of this upwards revision of PMF against the existing Release Capacity of 42450 m^3/sec through the entire existing 34 nos. of spillway gates & 64 nos. of under sluice gates of Hirakud Dam, will imperatively raise grave safety concerns in negotiating the excess flood release of 24182 m^3/sec.

In this prospective, the Union Ministry as well as the State Government (GoO) have expressed urgent intentions to workout viable alternative for safe passing of the additional flood so as to restore safety of Hirakud Dam. Thus, the Central Water Commission (CWC) in consultation with experts from dam safety organisation, engineers from the State Water Resources Department (SWRD) and national level consultants have carried out protracted discussions in several sittings to work out a most feasible alternative for a safe release of the excess flood from Hirakud dam during the event of PMF.

The decision emanated from the meetings of the experts was unanimous on the strategy.

- Release of the excess flood at the events of a PMF through construction of additional spillway structures, one at the left bank dyke near Gandhi Hillock and the other on the right dyke with its spill falling into Juanjhaor nalla.
- In the process, the reservoir water level may encroach the free board by 1.om thereby the MWL may rise up to El 193.02m (i.e. FRL 192.02m +1.0m rise).

It was decided to implement the above expert committee recommendations in two phases.

Phase-I: Construction of additional spillway at the left bank dyke on the second saddle of Gandhi hillock, with releasing arrangements through 5 gates each of size 15m X 15m and releasing capacity of 9122cumsec. This phase is herein after referred to as Project.

Phase-II: Construction of additional spillway on the right dyke across Juanjhor nalla with releasing arrangements through 8 nos. gates, each of size 15m X 10m and releasing capacity of 9057 cumsec.

The State Water Resource Department (SWRD), Govt. of Odisha expressed intentions to implement the Project works expeditiously through World Bank funding assistance for Phase-I. The Phase-II will be taken up after completion of Phase-I following all the environmental and social assessment requirements.

E.3 NEED & OBJECTIVE OF EIA STUDY:

The construction activities of the proposed project will remain adjacent to the existing left dyke and within the project owned land for Hirakud dam project.

However, the project interventions will considerably impact the existing environment as well as the social infrastructure in and around the project areas. Submergence of land, construction of new spillway, dykes and spill channel etc. will cause change of land use apart from displacement of population.

It was imperative to conduct Environmental Impact Assessment Study (EIA) and prepare Site Specific Environmental Management Plan (SSEMP) to minimise the project induced impacts.

E.4 SCOPE OF THE STUDY:

The scope of the study included the following issues.

(i) Review of the project features.

(ii) Review of the Acts, Policies and regulatory frame work.

(iii) Baseline Assessment of Environmental and Social Components.

(iv) Analysis of alternatives

(v) Mitigation Measures and Management Plan

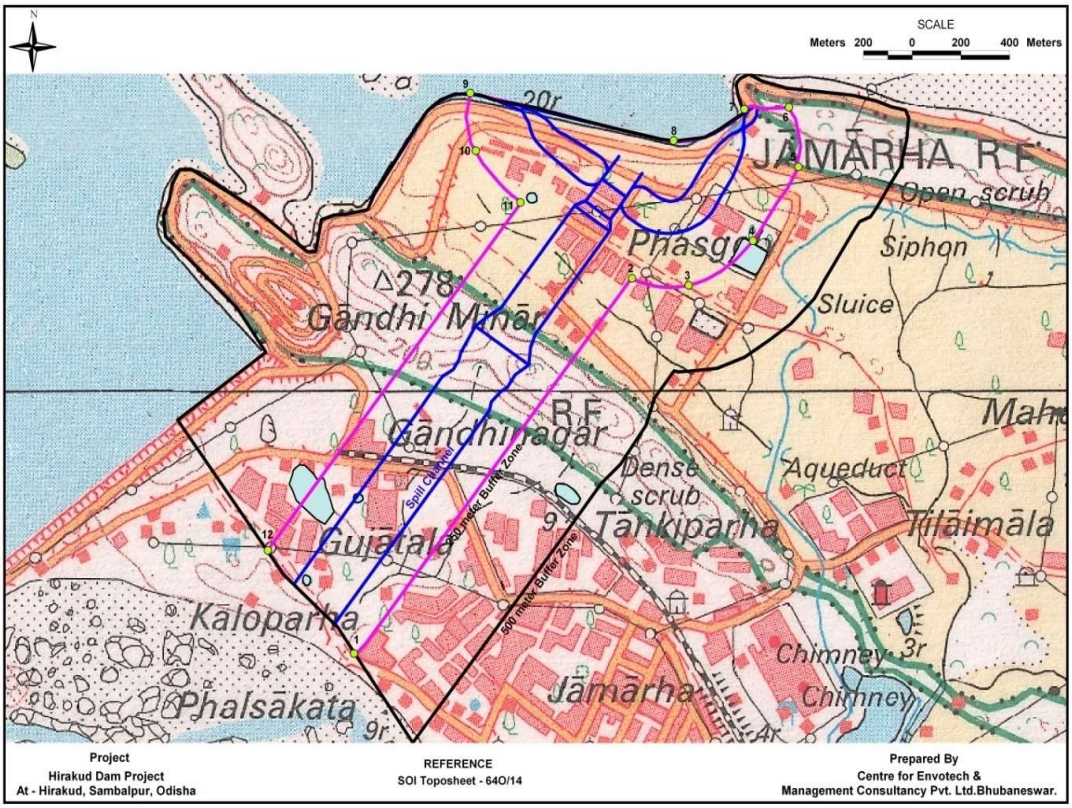
(vi) Monitoring Mechanism & Capacity Building.

(vii) Cost analysis and Budget

E.5 DESCRIPTION OF PROJECT:

The works under this project are featured with:

- Construction of one additional spillway structure located at the left bank dyke between RD 701m (2300ft) and 1646m (5400ft) and 243m downstream of the Hirakud reservoir.
- It is proposed to cut open the left dyke for 945m length and lead the reservoir water to the spillway structure through an approach channel.
- The spread of water will be contained by two small connecting earth dams at either side of the spillway.
- The excess flood water will be released through the proposed additional spillway through its 5 No. gates each of size 15m X 15m which will be discharged to the river Mahanadi by means of a 250m wide X 2.14 km long well designed RCC spill channel.
- A bridge will be constructed across the channel for facilitating access between communities of two opposite sides of spill channel.
- The location of the project, general topography and proposed hydraulic structures are shown in following map**.**



E.5.1 Salient Features of Project:

The summary details of the project features in regard of its finalized location and structural components etc. are depicted below in Table E-1.

Table E-1: SALIENT FEATURES OF PROJECT

Sl. No.	Features for finalised location	
	Item/ Components	**Details**
1.	**Project Location**	
	• Location of Spillway structure	243m downstream of first gap left dyke of Hirakud Dam in Hirapur Notified Area Committee (NAC) in Sambalpur district, Odisha
	• Geo-coordinates of the present location	Latitude: 21^0 32’ 52.15” Longitude: 83^0 53’ 58.03” Latitude: 21^0 32’ 54.38” Longitude: 83^0 53’ 54.8”
	• Township & Railway station	Entire proposed project area is located in Hirakud. Nearest township Burla; Hirakud Railway Station on East Coast Railway is located about 8 km away.
2.	**Spillway**	
	• Discharge capacity • Length of spillway • Length of Abutments (Left/Right)	$9122m^3$/sec (3.22 lakh cusecs) 91.00m (5 nos. Bays each 15m) 52.00m/78.00m

Sl. No.	Features for finalised location	
	Item/ Components	**Details**
	• No. and Size of spillway gates • Crest elevation • Dam top elevation • Width of Spillway Bridge	5 nos. each @ 15m x 15m EL 177.00m EL 195.68m 7.50m
3.	**Connecting Dykes (Left / Right)** • Length of Earthen Dykes • Top elevation of Dykes • Geo-coordinates at the butting points with main Dyke.	**(Left / Right)** 640m/384m EL 195.68m/195.68m 1. Latitude: 21^0 33' 0.54" Longitude:83^0 54' 12.56" 2. Latitude: 21^0 32' 52.15" Longitude:83^0 53' 58.09" 3. Latitude: 21^0 32' 54.38" Longitude:83^0 53' 54.8" 4. Latitude: 21^0 33' 2.6" Longitude: 83^0 53' 44.4"
4.	**Approach channel** • Length of approach channel • Width of approach channel • Bed level of channel (Approx.)	 243.00m 120.00m EL 167.00m
5.	**Spill Channel** • Stilling Basin Invert • Bed level of channel at the beginning • Tail water level (approx.) • Length of Spill Channel/ slope • Width of Spill Channel	**Concrete lined Section** EL 147.00m EL 158.00m EL 173.00m 2.14km/ S=1:3000 120m width x 714m length /200m width (till outfall point) excluding transition length**.**
6.	**Construction of bridge over spill channel**	The bridge will be located at the existing main road.
7.	**Settlement**	Gandhinagar, Gujatal, First gap colony, Laxminagar, Re-rolling colony, Cable Colony, and Prem Nagar of Hirakud NAC.
8.	**Affected Household**	A total of 716 households settled in 7 habitation area are going to be affected
8.	**Tree Felling**	In Reserve Forest Area: 115 nos. In Non Forest Area : 3595 nos. The predominant tree species are Mango, Cassia Siamea, Neem, etc. There is no Rare, Endangered or Threatened species

Sl. No.	Features for finalised location	
	Item/ Components	**Details**
9.	**Forest Diversion**	9.441 ha. of forest land to be diverted In Lamdungri Reserve Forest
10.	**Affected common Property Resources**	Temples and 'Bijesthalis' - 11 "Puja Mandap" - 1 Crematoria structure - 1 Primary schools - 2 High school - 1 Anganwadi centre - 4
10.	**Utility Shifting**	Water supply pipeline network to Burla and Sambalpur. Electric line Major roads - 2 nos.
11.	**Project Cost**	Cost of project is Rs. 590.00 Crores on 2016 price level.

E.6 ACTS, POLICY & INSTITUTIONAL FRAMEWORK:

Acts, policies & institutional frameworks of the Govt. of India, Govt. of Odisha as well as relevant safeguard policies of the World Bank were reviewed for preparation of the Environmental and Social Management Plan and the Resettlement Action Plan.

The relevant Acts, Policies, Legislations and Guidelines applicable to the project pertaining to the Environmental and Social safeguard are stated below in Table E-2.

Table No. E-2: Relevant Acts, Policies, Legislations and Guidelines applicable to the project

Acts, Policies and Notifications	Key requirement	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
Environment Protection Act 1986	To protect and improve overall Environment.	Applicable	Environment Clearance	MoEF&CC, six months (Considering one season data as per approved TOR)	SPMU/IA (Chief Engineer and Basin Manager, Upper Mahanadi basin, Burla)
EIA Notification 14th Sep 2006 And amendment till date	To protect and improve overall Environment. Requires prior environmental clearance for new, modernization and expansion projects listed in schedule 1 of EIA Notification, 2006	Applicable	Environment Clearance required for the construction of the additional spillway	MoEF&CC, six months (Considering one season data as per approved TOR)	SPMU/IA (Chief Engineer and Basin Manager, Upper Mahanadi basin, Burla)
		Applicable	Environment Clearance at the Construction stage for borrowing earth, query for stone & sand as applicable	SEIAA /DEIAA during construction phase 3months	Contractor
Air (Prevention and Control of Pollution) Act, 1981, 1987	An act to prevent and control Air pollution	Applicable	Consent to Establish (CTE) & Consent to Operate (CTO) for Batching plant & stone crushers	SPCB Govt. of Odisha during establishment of Batching plant & stone crushers 3 to 4 months	Contractor
Water Prevention and Control of Pollution) Act, 1974, 1988	An act to prevent and control water Pollution.	Applicable	Consent to Establish &Consent to Operate. for Batching plant & stone crushers	SPCB Govt. of Odisha during establishment of Batching plant & stone crushers 3 to 4 months	Contractor
Noise Pollution (Regulation and Control Rules) 2000 and amendment till date	Ambient Noise Standards for different areas and zones	Applicable	No permits issued under this act. However the Contractor has to comply with the standard limits during construction	SPCB Govt. of Odisha	Contractor

Acts, Policies and Notifications	Key requirement	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
Hazardous & Other Wastes (Management And Trans-boundary Movement) Rules, 2016	Protection to general public against Improper handling storage and disposal of hazardous Waste. The rules prescribe the management requirement of hazardous wastes from its generation to final Disposal.	Applicable	Authorization for storage and handling Hazardous waste	SPCB Odisha	Contractor
MSIHC Rules, 2000	Usage and storage of hazardous material	Applicable	No specific permit is required, however precautions defined under the material safety datasheets should be followed for use of hazardous substances (like paint solvents) listed under the schedules attached to this notification if any proposed to be used. Safety audit and other requirements should have to be complied if storage quantity exceeds the regulated threshold limit	-Do-	Contractor
Construction and Demolition Waste Management Rules, 2016	To manage the construction and demolition waste	Applicable	Approval required from local authorities, if waste generation is >20 tons in a day or 300 tons per project in month	SPCB Odisha	contractor
Plastic waste Management Rules, 2016	To manage the plastic waste generated	Applicable	No authorization to be obtained. Waste Management and Minimization to be done. Fee to be paid to local bodies, if applicable	SPCB, Odisha	Contractor
The Batteries (Management and Handling) Rules 2001	To regulate the disposal and recycling of lead acid batteries	Applicable	No specific registration Required. Compulsion to buy and sale through Registered vendor only	-Do-	-Do-

Acts, Policies and Notifications	Key requirement	Applicability	Type of permit and stage of applicability	Administrative Authority and indicative time frame for grant of permission	Responsibility
The Forest (Conservation) Act, 1980 and amendments The Forest (conservation) Rules 1981 and Amendments till date	To protect forest by restricting conversion of forested areas into non-forested areas and deforestation	Applicable	Forest Clearance / Permission for tree cutting.	Regional Office of MoEF&CC, State Forest Dept. 8 to 10 months	Chief Engineer and Basin Manager Upper Mahanadi basin, Burla
Explosive Act 1884 & Explosive Rules, 2008	Safe transportation, storage and use of explosive material, blasting site and safe distance	Applicable	Permission for storage and usage of explosive	DC, Chief Controller of Explosives, Govt. of India 2 months	-Do-
Central Motor Vehicle Act 1988 and amendment Central Motor Vehicle Rules, 1989 and amendments till date	To minimize the road accidents, penalizing the guilty, provision of compensation to victim and family and check vehicular air and noise Pollution.	Applicable	No permit issued under this Act however the contractor has to ensure proper licence PUC, permits as required	Motor Vehicle Licensing Authority of the Region.- Regional Transport Officer	-Do-
The Gas Cylinder Rules 2004	To regulate the storage of gas / possession of gas cylinder more than the exempted quantity	Applicable	License to store gas cylinder more than the regulated quantity.	Chief Controller of Explosives, Govt. of India	Contractor
Building & Other Construction workers (Regulation of Employment & Condition of Service)	To regulate the employment and condition of service of building and other construction workers and to provide for their safety, health and welfare measures	Applicable	Obtaining labourer licence	Dist. Labour Commissioner	Contractor

In addition to the above Acts and Rules, the Contractor has to comply with the various Labour Rules such as Factories Act, 1948; Employees State Insurance Act, 1948; Workmen's Compensation Act, 1923; Minimum Wages Act, 1948 The Inter-state Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979 , etc.

Safeguard policies of the World Bank were also consulted in regard of the Environmental and social Management Considerations.

Relevant World Bank Safeguard Policies are mentioned below.

Sl.No.	WB Safeguard Policies	Objective & Purpose	Applicability
1.	**OP/BP-4.01** Environmental Assessment	The objective of this policy is to ensure that the Bank financed project is environmentally sound and sustainable.	Triggered
2.	**OP/BP-4.04** Natural Habitat	The policy prioritizes conservation of Natural Habitats for long term project sustainability. The Bank therefore expects the Borrower to suggest appropriate measures for protection maintenance and rehabilitation of Natural Habitats in the study report.	Triggered, while no endangered species are found in the project area, however, there may be potential substantial loss of ecological functions provided by trees that will be cut during the construction process. the EMP has provision for afforestation and mitigation measures.
3.	**OP-4.36** Forestry	The policy gives importance to restoration of forest eco-system, which entails management and conservation methods of forest flora fauna and wildlife. Since a part of the RF is likely to be affected, the Bank expects that these aspects need to be included in the report along with proposal to restore forest health and welfare of the indigenous people who are dependent on forest produce.	Triggered. Since construction of Additional Spillway at Hirakud Dam will involve diversion of 9.441 hectare of forest land. It will involve removal of around 3600 trees and a EMP will include afforestation of double the number of trees.
4.	**OP/BP – 4.37** Safety of dams	The policy enforces adequate measures for ensuring safety of dams during its life cycles.	Triggered as it is additional structure of the existing dam and has been covered under dam break analysis
5.	**OP/BP – 4.12** Involuntary displacement and resettlement	The policy objective is to avoid involuntary displacement and resettlement as far as practicable by exploring viable alternatives. It also emphasizes approach to improve the living standards of the displaced people, encourages community participation in implementation of resettlement activities and provide assistance to the affected people regardless of their legal status on title of the land.	Triggered as project envisage displacement of squatters (716 households); all are non-title holders
6.	**OP 4.10** Indigenous People	The policy aims at restoring the rights and cultural dignity of the indigenous people while	Triggered, Among the affected population

Sl.No.	WB Safeguard Policies	Objective & Purpose	Applicability
		ensuring receipt of proper social and economic benefits.	few numbers of tribal have been recorded. Tribal development plan has been prepared for affected tribal group.
7.	**OP N 4.11** Cultural property	The policy emphasizes preservation of cultural property in the project area, restoration of archaeological monuments and unique environmental features.	Not Triggered, no archaeological site or unique environmental features is located in the project area. However, 11 nos. of temples, 1 crematoria building will be affected.
8.	**OP 4.09**	The policy helps manage the effect of pests on agriculture and health and provides support to strategies which promote the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides.	Triggered. It is envisaged that no pesticide will be procured under the project and only chemical treatment which is a practice during forest management in India will be carried out. However, in the interest to ensure no pesticide is use, the policy is triggered.

E.7 BASELINE ASSESSMENT OF ENVIRONMENTAL COMPONENTS:

Baseline survey was carried out in the study area of the sub-project to establish the existing environmental and social status. This included the study of Physical, Biological and Socio-economic environment in and around the project study area. It also included collection of Secondary data such as Topography, Geology, Meteorology, Seismicity and Flora, Fauna status. In the process of Data collection and compilation, DoWR records were consulted, information obtained from Dam Safety Organisation, Hirakud Dam Authorities, some credible Organisations of the State and Central Government and Literature Consultations.

E.7.1 The Study Area: The study area covers core zone and zone of influence.

The core zone covers the area involved for construction of dykes, spill way and spill channel which is confined to 170m on either side from the centre line of the proposed alignment of the spillway, approach channel and spill channel. The influence zone of the project for monitoring of environmental parameters such as air, water soil, etc is described with River Mahanadi flowing West to East direction forming the southern boundary while the Hirakud dam forms the western and northern boundary and the eastern boundary is demarcated by a line 500m from centre of the spill channel, whereas for the wildlife sanctuary the zone of influence is considered 10km from the centre of the spillway.

The study included analysis of physical, ecological and socio-economic environment to establish the baseline environmental conditions in and around the project area and the likely impacts on these components due to the projects.

E.7.2 Summary of Baseline Data:

Some of the baseline information / data considered for environmental and social impact assessment are summarised below.

LAND ENVIRONMENT:		
1.	Physiography	The topography of the study area exhibits undulating features; the highest elevation is around 278m AMSL over hill ranges and gradually sloping to the minimum at 160m AMSL.
2.	Seismicity	The project area comes under seismic zone III which implies influences as moderate damage risk zone.
3.	Land use	The study area exhibits 19.76% of land as settlement, 60.87% as agricultural land, 12.06% as forest cover, 5.07% as plantation area and 2.22% area exhibits small water bodies.
4.	Soil quality	Soil sampling was done at Gandhi Nagar and Bahadurpada. The soil type is slightly acidic, pH varying from 6.1 to 6.4 with moisture content 13-14%. The conductivity ranges between 114.6 to 169.7micro mho/cm. The N, P, K contents remain at healthy standards.
5.	Land erosion	There is moderate to low land erosion seen around the denudated hill ranges of Gandhi hillock.
6.	Meteorology	Rainfall: Normal Annual Rainfall is 1415.1mm. The maximum rainfall recorded in year 2012 as 1964.7 mm. Temperature: The observed maximum temperature during the study period was 44^0C (2016) and minimum 25^0C. The average maximum temperate is 45^0C in May and average minimum temperate is 10^0C in Dec. & January. Relative humidity: The observed maximum relative humidity was 68% and the minimum is 35%.
7.	Hydrology	The study area features two streams which becomes responsible for draining the area effectively. The major stream is river Mahanadi across which the dam is constructed. The area in the south of the Gandhi Hillock is found to be well drained with S-W slope leading to Mahanadi River. The probable maximum flood of Hirakud dam with peak value is estimated to be 69632 m^3/sec
AIR QUALITY		
8.	Air Quality	Ambient Air Quality was monitored with respect to PM10, PM2.5, SOx, NOx, CO & HC at 4 locations around the core zone to assess the existing status of air quality in the area during the month of May - June, 2016.
		The particulate matter PM10 ranges between 71.22 $\mu g/m^3$ to 94.7 $\mu g/m^3$, PM2.5 ranges between 35.6 $\mu g/m^3$ to 54.9 $\mu g/m^3$, SO_2 concentration ranged from 4.7 $\mu g/m^3$ to 11.1 $\mu g/m^3$, NO_X ranged between <9 $\mu g/m^3$ to 14.1 $\mu g/m^3$. All the parameters are within the maximum permissible limit.
NOISE LEVEL		

LAND ENVIRONMENT:		
9.	Noise Level	Noise level monitoring was done at 4 locations, near the Air Monitoring stations. These monitoring stations are located in residential areas. the day time noise limit varies from 42.1 dB (A) to 51.4 dB (A) and the night time limit ranges between 35.2 dB (A) to 45.3 dB (A).
		The observed noise levels are well within the prescribed ambient noise level standards.
WATER ENVIRONMENT		
10.	Surface Water quality	Surface water samples were taken from 5 locations; of which 3 no. are from Ponds and one from Reservoir on upstream and one at downstream of the Mahanadi river (proposed spillway).
		Chemical analysis of surface water conducted for 22 parameters which are furnished in Table No. C4-19 reveal that the water quality conforms to the tolerance limit under IS:2296 and considered as "Class C" of Use based classification.
11.	Ground Water quality	Two nos. of groundwater samples were analysed i.e., one hand pump near Nilakantha Temple and the other near the office campus.
		Chemical analysis of groundwater was conducted for 28 parameters which is furnished in Table No. C4-18. The result reveal that water quality conforms to IS:10500-2012 at desirable limit.
12.	Groundwater level	The pre-monsoon ground water level in the project area was found to be 3.15m BGL.
13.	Sediment Quality	To determine sources of heavy metals and pesticides in sediment sample was collected from the periphery of the reservoir and was analysed. The test results revealed that the sediments carry negligible amount of heavy metals and pesticides.
14.	Drainage pattern	The major River is Mahanadi across which the dam is constructed. The study area features two local seasonal streams which becomes responsible for draining the area effectively. The area in the south of the Gandhi Hillock is found to be well drained with S-W slope leading to Mahanadi River.

BIOLOGICAL ENVIRONMENT		
1.	Forest cover and Biodiversity	The proposed spill channel pass through Lamdungri Reserved Forest is located on the hill having an area of 490 Ha. This is a scrub and degraded forest with scanty vegetation. The predominant tree species are Mango, Neem, Chakunda, etc The project will require diversion of 9.441ha of forest area from this Reserved Forest located in Sambalpur Forest Division.
		The floral population in the project alignment does not include any endangered or threaten tree species.
		No Schedule-1 species of wild animals found in the area. However, snake, monitor lizard, mongoos, etc are observed.

		About 23 bird species were noticed during the study. List furnished in Table No. C4-28. These are all local species and none of them attract the Schedule-1 category. No migratory birds are reported in the proposed area.
		Common fish species like Kau, Balia, Magura, Todi, etc are observed in local ponds.
2.	Location of eco-sensitive areas	There is no wildlife sanctuary or Biosphere Reserve in the study area. The nearest wildlife sanctuary is Debrigarh Sanctuary, which is located at 13.0km away from the project at its western direction. There bis no migratory route of wild animals located in the project area.
SOCIAL ENVIRONMENT		
1.	Affected families	A total of 716 households settled in 7 habitations of Hirakud are going to be affected which are Gandhinagar, Gujatal, First gap colony, Laxminagar, Re-rolling colony, Cable Colony and Prem Nagar. Demography profile of these PAPs, as assessed during survey, has been summarised in para 4.5.1 of Chapter 4 of the EIA report.
2.	Archaeological monuments	There are no Archaeological monuments or historical importance places found within 10 kms from Hirakud dam.
3.	Cultural features	There exist one or more temples in almost every village. There are about 11 temples and 'bijesthalis', 5 holy grooves and a "puja mandap" located in the study area. One Crematoria is recently built from benevolent fund alongside of river embankment towards the Mahanadi river. This structure is falling within the proposed alignment of spill channel near confluence point of proposed spill channel and river and will require relocation. There are 2 primary schools, 1 high school and 4 numbers of Anganwadi centers located within the study area which will be affected due to the project
4.	Infrastructure	Two major road connections from the nearby habitations to approach the Dam proper will be cut off by the proposed spill channel. A water treatment plant is located at about 150 m towards right hand side of the proposed spill channel in Taranagar which is connected with drinking water supply network for Hirakud/ Burla and Sambalpur Towns. This pipeline network may get affected due to this project implantation.
5.	Livelihood	Agriculture is the main source of livelihood for the affected population. 14 Households depend on Agriculture who use to cultivate vegetables and sale in nearby urban area.

		Though the proposed project displacement area is situated in a very close proximity of the Dam, still no household is going to be affected of fisherman category who use to depend on fishing for their livelihood.

E.8 STAKEHOLDERS AND PUBLIC CONSULTATION:

- During the process of baseline assessment, formal and informal discussions were held with Govt. officials and individuals of the project affected locality, including women and tribal inhabitants.

- **Stake holders for EIA study were identified and indicated in the Table below.**

Stake-Holders		
Central Government Organisation [GoI]	**State Government Organisation [GoO]**	**Local Public**
• Central Water Commission(CWC) [for CPMU/MoWR] • Dam Safety & Rehabilitation of Projects (MoWR) • Designated consultants of CPMU (EGIS)	• Water Resources Department(SWRD) • Dam Safety Organisation • Forest and Wildlife Department • Public Health Department • Revenue Department(District Collector, RRO and Tahsildar) • Local Municipality authorities • Local village committees,	• Inhabitants of project influence area around proposed project • Project affected persons • NGOs & Nagarik committee • Fisheries cooperative society

E.8.1 Issue Discussed:

Some significant issues linked to the project were discussed with stakeholders in several meetings. Issues which have environmental and social concern are mentioned below.

- Intensity of rainfall and recording mechanism of inflow in to Hirakud reservoir.
- Downstream flooding problems during release of excess flood from Hirakud dam.
- Locational as well as structural aspects of the proposed left bank additional spillway.
- Reservoir operation and alarm system
- Environmentally sensitive features in the vicinity
- Local issues arising out of submergence
- Resettlement of displaced people
- Tourism development prospects
- Construction related issues

Sl.	Issues Raised	Stakeholder consulted	Issues Raised/Suggestions	Addressal
1.	Disruption of utility services	Project authority, Public Health Engineering Organisation and water users.	Disruption of utilities and services as the Proposed channel will intersect the supply line Relocation of water supply pipeline and other utilities	The existing pipeline and electric poles will be relocated at project cost. The Dam Authority will deposit the estimated amount to the line department for relocation and will provide all necessary support in facilitating the relocation process.
2.	Damage to the existing road network and closure of the area on the other side of the channel	Project authority, local people and consultant.	Re-linking of approach road to Gandhi Minar disrupted by Spill Channel.	Agreed to construct a bridge across spill channel prior to cutting of the road and construction of channel in the affected location.
3.	Impact on Temples and Crematoria	Project authority, consultant and local inhabitant	Local residents raised the issue of impact on temples and crematoria and requested to shift this structure in the adjacent land before construction of channel to avoid interference with rituals and inconvenience to the user community.	Project authority agreed to shift all the affected temples and crematory to the adjacent area beyond proposed channel in consultation with the local people/user community
4.	Fishery in dam	Fishing community, Representative of Fishery Co-operative society, Chief Engineer, SE, representatives from WB, EGIS and CEMC	The Fishery Cooperative Society representative informed that there are 10 Fishery Cooperative Society involve in fishing from Hirakud Reservoir, but they do not have facility such as pond for fingerling development. They requested for provision of ponds for development of fingerlings in project land along the dam. They Society people gave their consent that they will maintain the pond if they are allotted the same It was also informed by the Fishery Department and the Fishermen Society the no fishing is done on the reservoir towards left dyke, near proposed area.	The Chief Engineer, Hirakud Dam assured that they will explore the possibility to provide additional area for pond development within the Dam area.

Sl.	Issues Raised	Stakeholder consulted	Issues Raised/Suggestions	Addressal
5.	Disruption in Electricity supply	Junior Manager from electricity dept., Chief Engineer, SE, representatives from WB, Egis and CEMC	The department has to draw 11kv line along the bridge or supply electricity from Burla side supply to Gujatala, Gandhinagar etc. If supply from the Burla side then a transformer will be needed. So as alternate arrangement they can provide electric supply to villages from both sides.	
6.	Wildlife movement The excess of earth material and top soil after utilization	DFO, Sambalpur, Chief Engineer, SE, representatives from WB, Egis and CEMC	No wildlife from Debrigarh sanctuary approaches Hirakud Dam. The dug up earth from spill-way should not be dumped on forest land. The excess of earth material and top soil after utilization by project can be dumped at nearby places of degraded forest in consultation with forest department, so that the earth material can be utilized by forest department at a lesser cost for plantation purpose in the degraded forest. Forest dept. expressed their interest to take top soil for thier use in plantation	The Dam Authority agreed to provide surplus top soil if the Forest Department is interested to take the soil for development of the degraded forest area in the Lamdungri Reserve Forest area. The site for dumping of the top soil will be given by the Reserved forest for the quantity they intent to use.
7.	Compensation for the house, structure and property	Affected person of the area	They were interested to know the compensation package and the project authority describe that the package will be disclosed after finalization of the package by the state govt.	All the affected persons are squatters and fall under Non-titleholder Category. The Project Authority informed the people that they have already appointed Consultant for SIA study and preparation of R&R Policy which will require approval of the State Government. The affected persons will be compensated according to the R&R Policy.
8.	Pollution	Affected person of the area, Project authority and consultant	The local people express their concern about the dust generation and deterioration of air quality in the area.	Periodical water sprinkling will be carried out in and around the proposed project alignment to curb the

Sl.	Issues Raised	Stakeholder consulted	Issues Raised/Suggestions	Addressal
			They also inform that sometime they face air pollution problem in the area due to HINDALCO Factory. Dust generation during excavation, demolition and construction of spill channel	dust generation. This aspect has already addressed in the EMP adequately.
9.	Public Safety/ Inconvenience during construction	Affected person of the area, Project authority and consultant	Issues raised by public regarding safety issues during construction activities. the project authority assured that all safety measures will be taken during construction and will be strictly monitored. Disruption of Public moment during construction as the alignment will cross the road. The project authority informed that a bridge will be constructed across the spill channel prior to the excavation activities in the road network to ensure uninterrupted traffic movement.	All safety arrangements such as hard barricading, delineators, Caution signboards, lighting etc, will be provided along the construction zone near habitation area. This has been addressed in the EMP and will be responsibility of the Contractor. The same will be strictly monitored. The public may complain to the Dam Authority if they find any incidence of lapsed through grievance redressal mechanism.

E.8.2 The Second Level Public Consultation:

The second Level Public Consultation meeting on Environmental Impact Assessment, Social Impact Assessment Reports and R&R issues of Proposed Additional Spillway Project of Hirakud Dam, Sambalpur was held on 26th September, 2017 at 10.00 A.M. in-front of Nehru Udyan, Gandhinagar as per the notification no. 550, dated. 11.09.2017 issued by office of the District Collector, Sambalpur. The meeting was chaired by Sri Trilochan Majhi, Additional District Magistrate, Sambalpur and representatives from various organizations such as District Administration, Department of Water Resources, Hirakud Dam Project, State Pollution Control Board, Police Department, Sambalpur Municipal Corporation, Public Works Department, EGIS Expert Consultant, Odisha Construction Corporation Limited, Centre for Envotech and Management Consultancy Pvt. Ltd. were participated along with Public representatives/ Local leaders, Project Affected Persons and media representatives.

The meeting was started by the welcome address of Chief Engineer and Basin Manager and he briefed about the need of the project with its technical aspects. ADM, Sambalpur, described the audience about the purpose of the Public Consultation. This is followed by explanation regarding World Bank's policy, requirement by Dr.Surjit Singh Dipak, Egis. The representatives from CEMC Pvt. Ltd. explained about the Environmental and Social Impact due to the project. The R&R package for project affected persons was explained by special LAO, Sambalpur.

The Project Affected Persons were given a chance to raise their doubts and queries after detailed deliberation by administration. Some of the issues raised by the public are related to technical matter where as rest are of social nature. The issues were clarified by Chief Engineer and officials from district administration.

The proceeding of consultation meeting and list of the members present in the meeting are given in the Annexure -6.2.

E.9 ANTICIPATED IMPACTS ON VARIOUS ENVIRONMENTAL COMPONENTS:

Environmental impacts due to various project components were predicted concerning three important phases of project cycle; namely the pre-construction phase, construction phase and operation phase. Some significant impacts predicted in each of those phases are briefed below.

Components	Location / Activities	Anticipated Impacts	Mitigation Measures
PRE-CONSTRUCTION PHASE			
Land acquisition (Forest land)	Lamdungri RF across the spill channel alignment	• Change of landuse • Landscape degradation • Loss of forest, flora, fauna	• To Carryout plantation on Non forest open land as per approved C.A. Plan
Land acquisition (Govt. land)	Land for other project requirements such as Borrow area, Dumping yard, Approach road and labour colony	• Landscape degradation • Affects natural drainage • Contamination Water of existing surface water and groundwater sources	• Ensure implementation of the approved RAP/payment of compensation • Removal of debris through contract agencies • Avoid effluent discharge as well as solid waste disposal from the work site either to the reservoir water body or to Downstream of river. • Cement Slurry, lubricants, oils contained in the wash water (Curing) should be

Components	Location / Activities	Anticipated Impacts	Mitigation Measures
			primarily led to a sedimentation pond before leading it to the water body.
Resettlement and rehabilitation	Shifting of habitations (Parts) adjacent to left side of Hirakud Dam, affected due to submergence and construction activities.	• Displacement of population • Loss of property-livelihood • Dismantling of private, Govt. and religious structures, public utilities etc. • Socio-economic disturbance of indigenous community, vulnerable people.	• Float Notices to Owner agencies well ahead of dismantling action • Ensure evacuation of occupants and shifting • Involve district administration for maintaining law & order situation • Compensation and payment and other benefits will be made as per RAP
Utility Shifting	Social infrastructure • Temple • Cremation structure • Water works	• Affects religious and cultural rights of people • Disruption in potable water supply, electricity	• Moderate social Impacts (till relocation) • disruption of services like water supply, traffic movement, electricity, • Hirkund water supply line will be realigned before start of construction to ensure continued water supply
CONSTRUCTION PHASE:			
Excavation: Blasting Quarrying Borrowing of earth	For new spillway, spill channel and earth dam structures	• May affect air quality and noise level for a temporary period during construction • Generation of solid waste (Muck) and safe muck disposal • Land erosion- land degradation • Increased traffic intensity • Public health and safety concern.	• Air pollution control measures to be followed • Ensure use of PUC vehicles • Dust generated during operation of heavy excavators should be curbed by water sprinkling • Other plants, machineries & Equipments are to be maintained properly to prevent high noise level • Demarcate the 'No Entry' boundary by flagging so as to avoid any likely accidents • Displays Signboard / Warnings • Strictly adhere to the recommendation blasting time (i.e. before sunrise and after sunset) so as to avoid public inconvenience • Organise awareness programme on blasting effects precaution measures and environmental resource management. • Organise periodic health camps • Ensure supervision of blasting activities by experts.

Components	Location / Activities	Anticipated Impacts	Mitigation Measures
			• Approved Quarry area should be operated only after obtaining appropriate authority. • : blasting wherever required shall be controlled blasting, Blasting timing will be pre notified to the public. Area will be cordoned off before blasting to ensure safety of people and workers. • Borrow areas will be rehabilitated after use. Prior Environmental clearances shall be obtained its before use. •
Use of • Heavy machineries • Heavy pumps • Concrete mixers • Batching Plant	Work site - Plant Site	• Air pollution (dust generation) • Noise pollution (Running period) • Surface water quality • Soil pollution.	• Adopt Air Pollution Control measures like water sprinkling • Limit hours of quarry activities to prevent public inconvenience • Use barriers & signals to reduce public exposure to blasting (if any) • Plants, Machineries & Equipments should be handled properly to minimize dust generations high noise • Green belt development around quarry and crusher site • Deploy PUC vehicles • Ensure providing safety gadgets to workers & Safe working environment • Organise health camps at periodic intervals.
Transport of materials and haulage of machinery	Work site - Use of vehicles and machineries	• Increased traffic intensity • Air pollution (Dust) • Workers and local people exposure	• Dust generated during operation of heavy machineries should be curbed by water sprinkling • Machineries & Equipments are to be maintained properly to prevent high noise level • Avoid plying trucks on village roads / populated areas. • Install speed breakers on road • Trucks may be covered with tarpaulin during the carriage.

Components	Location / Activities	Anticipated Impacts	Mitigation Measures
			• Ensure routine maintenance of transport vehicles
Material handling and storage	Stacking yards Storage godowns	• Landscape degradation • Soil pollution • Pollution of water quality • Obstruction to land drainage	• Dust generated during material handling should be curbed by water sprinkling • Use separate storage stacks / Bins for different construction materials like sand, metal, chips & steels etc. • Provide lined drains between the stacks to collect rainwater which are to be connected to a sedimentation pond before released to natural drains.
Hot mix plants	Batching plant for concrete mix	• Affect air quality and noise level • Soil pollution • Workers and local people exposure	• Locate the Plant at higher elevation & away from movement of labour force, operational staff • Limit the hours of operation to minimize exposure • Prevent spreading of plant washouts on land • Effluents should be collected in still ponds; treated & then recycled for road sprinkling purpose • Prior consent shall be obtained from SPCB
Debris disposal	Dumping yards Stacking areas	• Landscape degradation • Obstruction to land drainage • Water quality pollution	• Dust generated during operation of heavy excavators should be curbed by water sprinkling • Other plants, machineries & Equipments are to be maintained properly to prevent high noise level • Ensure Air Quality monitoring • Dump Solid wastes in specified dumping areas to minimize Contamination of water. • Provide drainage for waste water through collection ponds. • Project all ground water extraction well if located nearly • Avoid plying trucks on village roads / populated areas. • Install speed breakers on road • Trucks may be covered with tarpaulin during the carriage. • Ensure routine maintenance of transport vehicles

Components	Location / Activities	Anticipated Impacts	Mitigation Measures
			• Backfilling of construction areas to be taken up after construction is over • The waste disposal area is to be levelled / graded • Plantation may be taken up • Select separate disposal sites for useful stones • All disposal will be made as per Construction and demolition debris waste management rule 2018
Labour camps Contractor's camps	Demarcated area for housing of the labour force and contractor camp	• Likely loss of green cover • Affects local ecology • Sanitation problems • Worker's health • water pollution	• Select location of camping sites away from the worksite as well as from the existing villages / Townships. • The contractor should maintain the labour camps properly by sheltering outstation labourers & their families; each camp to host around 50 (fifty) families to facilitate safe living. • Minimum requirement of Living by this imported labour force should be provided by the contractor so as to prevent conflicting issues with the neighbouring population/villagers. • The project authority, through the designated contractor, should ensure fulfilling the following requirements. (i) HEALTH FACILITY - Free medical check up - Supply of medicines, - Ambulance for shifting (ii) SANITATION FACILITY /CLEANER ENVIRONMENT - Provide temporary toilets. - Arrange for proper sanitation facilities, (iii) DRINKING WATER SUPPLY - Provide potable drinking water (iv) Supply of Electricity - Provide free electric supply for Minimum domestic use (v) SUPPLY OF FREE FUEL - Ensure supply of free fuel to each labourer family - Prevent collection of fuel wood for cooking (vi) ENFORCING USE OF SAFETY GADGETS

Components	Location / Activities	Anticipated Impacts	Mitigation Measures
			- Motivate the labourers to use protective footwear, Head gear, Ear Plugs and goggles etc while on duty during construction period. - Setup First-Aid Centre at the worksite
OPERATION PHASE:			
Monitoring of pollution	• Water quality • Sediment quality • Groundwater level in the region	---	• Consistent monitoring, review of the constraint areas and resource management renders the implementation process safe and successful.
Maintaining safe operational mechanism	• Gate operation for excess flood release • Warning system	• Likely disaster due to downstream flooding • Loss of lives and property due to improper warning system.	• Improved mechanism to alert the D/S localities against likely flooding will help people to stay prepared. • Dam authorities (SWRD) will take steps for advance warning signals.

- **No direct impact is anticipates on aquatic flora and fauna of the river.**

E.10 ANALYTICAL FINDINGS FROM IMPACT ASSESSMENT:

- Environmental Impacts sectorized in Land Environment, Water Environment, Biological Environment were studied broadly for the implementation phase and Post Implementation Phases of this project.
- In the Implementation phase, most of the negative environmental impacts are site specific and relate to construction phase environmental components. Negative impacts of low severity such as soil erosion and soil pollution; Air Noise and water pollution; Drainage and water logging; Generation of construction spoils and their disposal; Transportation and traffic congestion; location of labour camps and Health problem etc. are viewed as Direct-short term-low impacts which are mostly Reversible in nature and does not severely affect the livelihood of the people.
- On the other hand; Impact on Flora, Loss of habitats and landscape degradation are viewed as short term but irreversible impacts of low severity.
- All the above components responsible for causing moderate social and environmental impacts are categorised as "Category-B" which can be mitigated easily with precautionary measures and standard mitigative methods.
- Environmental and Social components like Acquisition of forest land & Private land for project use, Displacement of population marked with loss of property loss of livelihood and Socio cultural bonding etc have long term, irreversible impacts which are of low serving in the instant case. These two components are categorized as "Category-A" whose impacts required specific management plan (such as Forest Diversion Plan & Resettlement Action Plan) and close monitoring of mitigation measures, proposed there in.
- Landscaping, tourism development and prospects of Fishery Development are positive impacts of the post-implementation phase besides the priority objective i.e. safety of Hirakud Dam.

E.11 MITIGATION MEASURES:

It has been established in the analytical review of components and their included impacts as in the previous paragraph that most of them are short termed, reversible and Low severity impacts, reasonably categorised as B-Category. These can be addressed through appropriate mitigation methods and precautionary procedure.

Such mitigation measures proposed for environmental and social impacts both for the implementation phase as well as for the post-implementation (Operation) phase are described in chapter-5 of this EIA report.

The various mitigation measures for air, water and soil pollution, as well as for other issues such as landscape degradation, increase in plying of vehicles and machineries, health safety are described in detail in chapter 5.

E.12 ANALYSIS OF ALTERNATIVES:

In the event of negotiating the PMF 69,632 cumsec, there would be urgent necessity to release the excess routed flood @ 27,182 cumsec through additional spillways to be constructed over and above the existing spillways and sluices of Hirakud Dam.

Without the project the safety is compromised at the time of flooding. So risk will rise if we don't give additional spill way. We have studied 2 alternatives for additional spill way; one is on top of Gandhi Hill Rock and the other is at the downstream of the hill, near existing left dyke.

- It is revealed from the Exploratory Drilling Operations conducted by GSI, that competent foundation strata are not available at the first identified location on the saddle, on Lamdungri forest.
- Suggested shifting of the spillway location 700 meters further upstream of the original spillway axis where suitability of foundation confirmed.

E.13 ENVIRONMENTAL MANAGEMENT PLAN [EMP]:

The Environmental Management Plan [EMP] has been framed on the basis of baseline data, components of the project activities and relevant mitigation measures. While it emphasizes effectiveness of managing the recommended mitigative measures it was necessary to identify credible organizations/agencies which could be made responsible to implement them properly. Budgetary support has been made intrinsic with the management items. Adopted mitigation measures against some significant environmental issues have been broadly discussed in chapter 7 of this EIA document. The EMP will be part of the Tender Document for contractors.

E.13.1 Environmental Monitoring Plan [EMOP]:

Monitoring being an effective tool for ensuring environmental quality in the project implementation, the EMF delineates Environmental & Social monitoring Plan [EMoP] as essential requirement.

Monitoring activities are proposed for (i) Construction phase and (ii) Operation phase till defect liability periods.

It is proposed to constitute one monitoring evaluation cell which would carry periodical monitoring of implementation of environmental safe guards. The cell will be headed by chief Engineer /Executive Engineer of implementing agency under whom the team leader an Environment Officer of PMC and EHS experts of the contractors will be working as the members of the cell. The contractor will be directly responsible for implementation of EMP at the site where as the PMC and the IA will be supervisory.

A summary table for EMoAP has been prepared showing Environmental indicators; frequency of monitoring; Responsible organisation and individuals which have been furnished in **Table No. C7-5** of Chapter 7 in this EIA report. The table may serve as a ready reckoner for the project management unit to facilitate decision making.

However the Monitoring format may further be improved, upgraded and modified by the Project Management Unit to suit the site specific requirements.

E.13.2 Environment Grievance Redressal Mechanism:

Effective environmental grievance redressal mechanism has been developed to receive the grievances from the concern public or other stake holders at the site during construction and to address the issue raised by different agency. The proposed mechanism on grievance redressal on environmental issues is described in Chapter 7.

E.13.3 Institutional Arrangement, Training & Capacity Building:

An environmentally complied sustainable project needs to have a competent organisation & Institutions support having trained personnel in the background. In this EIA study necessity for Training & Awareness programmes for capacity building has been emphasized. Although the State Water Resources Department (SWRD) is already positioned with efficient, experienced & skilled technical personnel; the state government may consider to impart adequate training for a screened group to be deployed for management of this specifically important Dam safety project of Hirakud Dam. A training module with monitoring Budget has been suggested with most probable time frame, contained in chapter 7 of this EIA document. The State Management Unit may improve or upgrade this as per site specific requirements.

E.13.4 Budgetary Support:

A cost estimate for amelioration of environment has been suggested with most approximate quantification and component wise expenditure. This estimate has also taken into consideration the probable expenditure on monitoring and capacity Building.

A budgetary provision of **Rs. 600.667** lakhs or 60.06 Mn rupees has been made for implementation of environmental safeguards as stipulated in the EMP for different stages of the project.