



TABLE OF CONTENTS

Map 1:	Project Location Map	iii
Map 2:	Drainage Network and Catchment Area Map.....	iv
Map 3:	Landuse Map of the Study Area.....	iv
1.	Project Description	1
1.1.	Project Location and Accessibility	1
1.2.	River System and Catchment Area	1
2.	Description of the Environment	3
2.1.	Physical Environment	3
2.1.1.	Meteorology and Climate	3
2.1.2.	Geology and Seismicity.....	3
2.1.3.	Physiography and Topography	3
2.1.4.	Landuse Pattern.....	4
2.1.5.	Soil Quality.....	4
2.1.6.	Water Resources (Design Flood)	4
2.1.7.	Water Quality	5
2.1.8.	Noise Environment.....	5
2.1.9.	Terrestrial Ecology	5
2.1.10.	Aquatic Ecology	6
2.2.	Socio-economic Environment	7
2.2.1.	Demographic configuration of affected Villages.....	7
3.	Anticipated Environmental Impacts and its Mitigation Measures.....	8
3.1.	Impact on Water Environment.....	8
3.2.	Air Quality	9
3.3.	Noise Environment.....	9
3.4.	Impact on Land and Soil	9
3.5.	Impact on Biological Environment	10
3.5.1.	Terrestrial Ecology	10
3.5.2.	Aquatic Ecology	10
3.6.	Socio-Economic Impact	10
3.7.	Impacts due to Construction Camp	11
4.	EnvironmentAl Management Plan.....	11
4.1.	Compensatory Afforestation and Bio diversity Conservation Plan	11
4.2.	Catchment Area Treatment Plan.....	12
4.3.	Fisheries Management Plan	12
4.4.	Public Health Delivery System	13
4.5.	Environmental Management Plan for Labour Camps	13
4.6.	Muck Management Plan	13
4.7.	Reclamation of Quarry Sites/ Restoration and Landscaping of Working Area	14
4.8.	Solid waste Management Plan for Colonies and Labour Camps	15
4.9.	Measures for Air and Noise Pollution Control.....	15
4.10.	Water Pollution Control	15
4.11.	Reservoir RIM Treatment Plan.....	15
4.12.	Disaster Management Plan.....	16
4.13.	Energy Conservation Measures.....	16
4.14.	Resettlement and Rehabilitation Plan	16



Summary Environmental Impact Assessment of 90MW Gongri Hydro Electric Project at
West Kameng District of Arunachal Pradesh

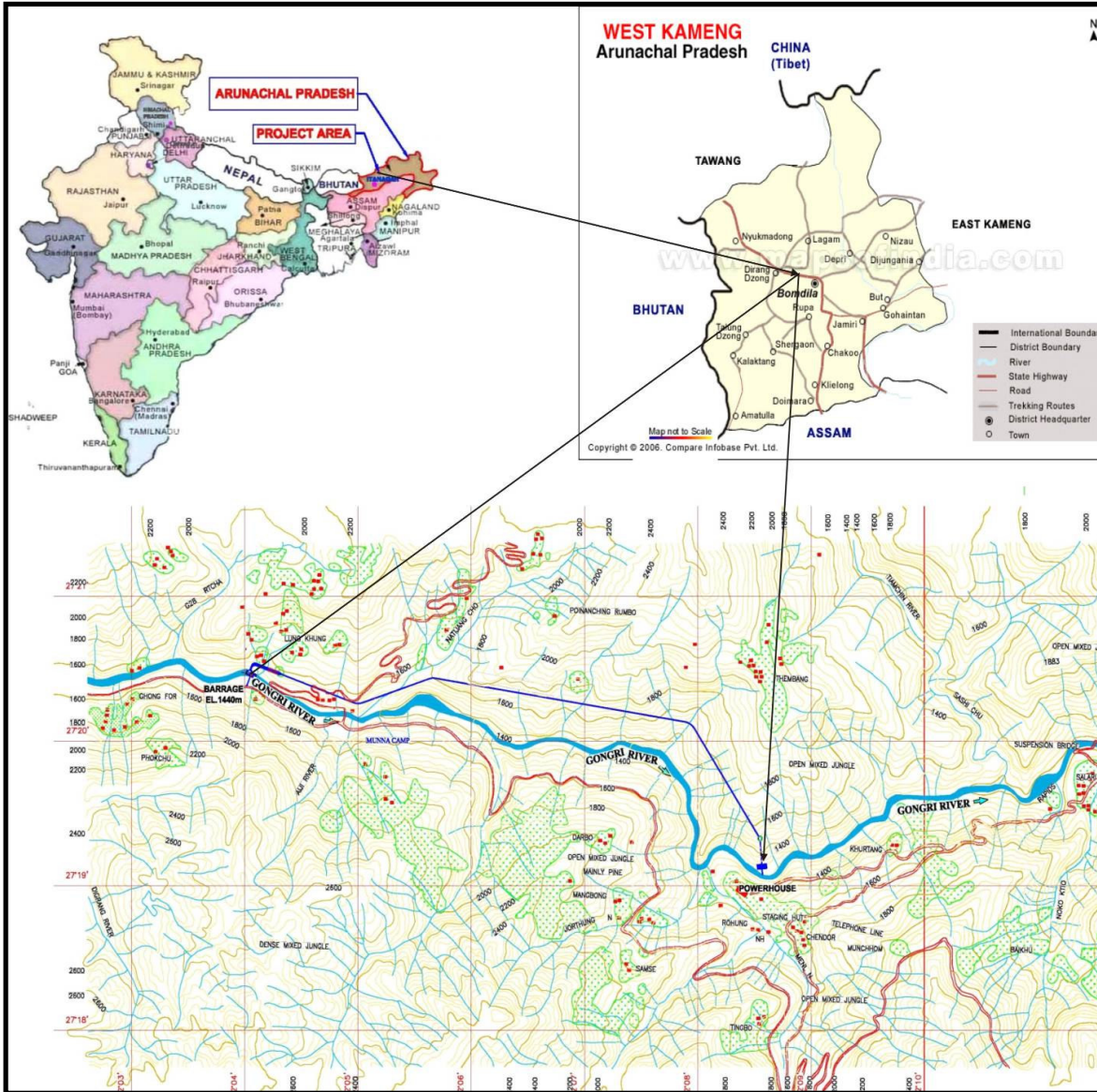
4.15.	Environmental Monitoring Plan	16
4.16.	Environmental Cost Estimates	18
4.17.	Cost for Implementing Environmental Monitoring Programme	18
4.18.	Project Benefits:.....	19
4.19.	Additional Studies	19

List of Tables

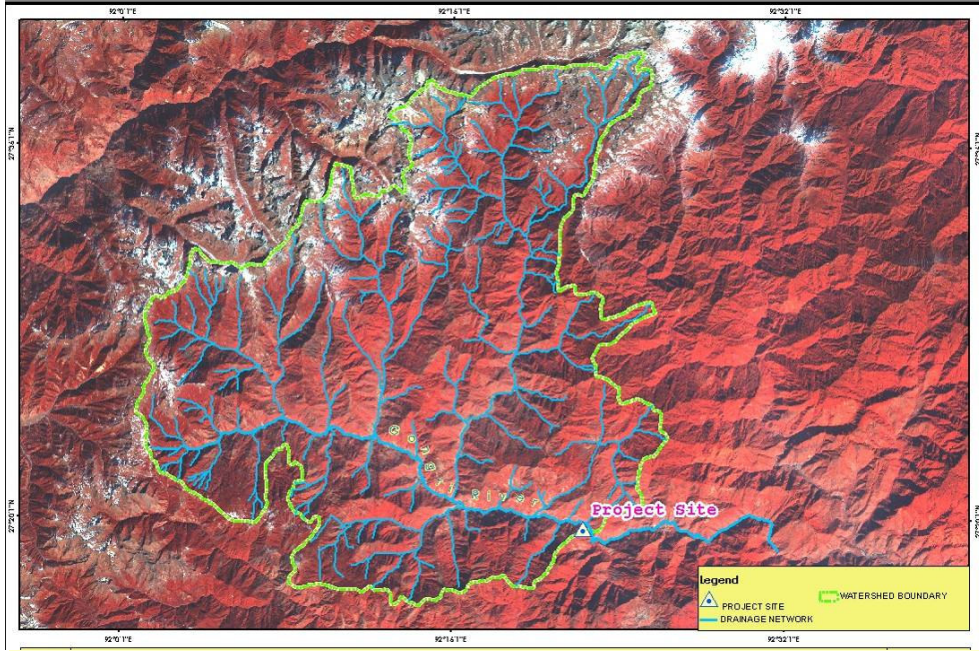
Table 2.1	Landuse pattern of the Study Area based on Satellite Imagery.....	4
Table 2.2	Final Flood Values, Gongri Diversion Site.....	5
Table 2.3	Demographic Details of Project Affected Villages	7
Table 2.4	Literacy Profile of project affected village.....	7
Table 3.1	Summary of Social Impact.....	11
Table 4.1	Budget for implementation of biodiversity conservation measures	12
Table 4.2	Environmental Monitoring Plan for Construction Stage	17
Table 4.3	Monitoring Plan for Operation Phase.....	17
Table 4.4	Cost for Implementing Environmental Management Plan	18
Table 4.5	Cost for Implementing Environmental Monitoring Programme During Construction phase	19
Table 4.6	Cost for Implementing Environmental Monitoring Programme during operation phase.....	19



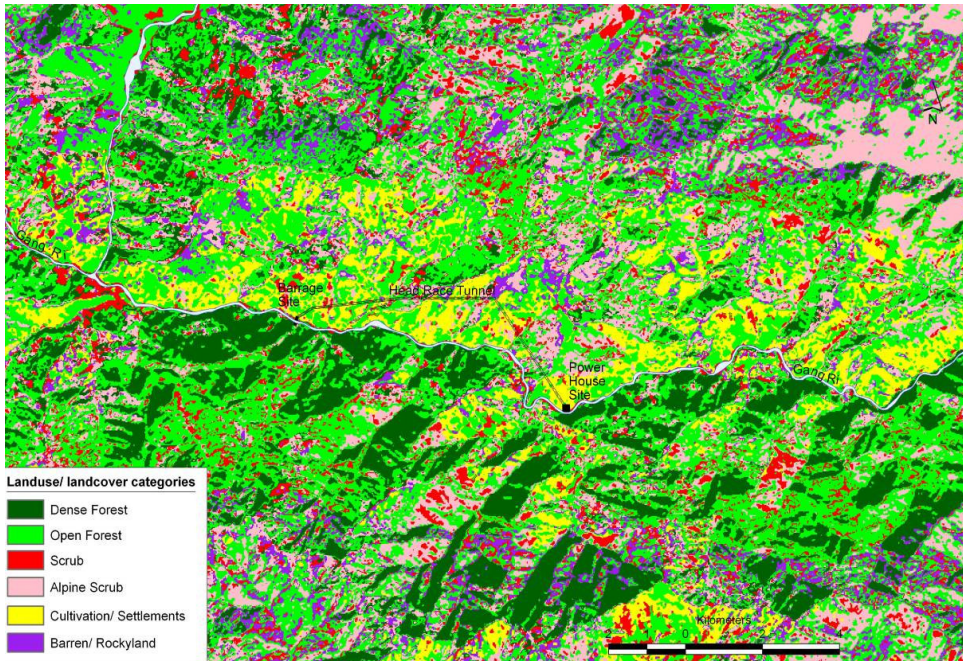
Summary Environmental Impact Assessment of 90MW Gongri Hydro Electric Project at West Kameng District of Arunachal Pradesh



Map 1: Project Location Map



Map 2: Drainage Network and Catchment Area Map



Map 3: Landuse Map of the Study Area



1. PROJECT DESCRIPTION

1. Gongri Hydro Electric Project (90 MW) is proposed for the development in the West Kameng District of Arunachal Pradesh and envisages harnessing the hydropower potential of Gongri River. The project is proposed to be developed on Built, Own, Operate and Transfer (BOOT) basis and was identified by Patel Engineering Limited (PEL). The project will be implemented by Dirang Energy Pvt. Ltd, a Special Purpose Vehicle which is fully owned subsidiary of PEL.

1.1. Project Location and Accessibility

2. The proposed site is about 410 km from Guwahati, the capital of Assam. The project is well connected by National Highway 52 from Guwahati via Tezpur and further by Bomdila-Dirang State Highway and located about 200 km from Tezpur and about 35 km from Bomdila, the State Headquarter of West Kameng District of Arunachal Pradesh. The nearest town is Dirang, about 10 km from the project site. The Bomdila-Dirang state highway joins the project site at a tri-junction point. The tri-junction point is about 14 km upstream of Munna Camp, a small habitation, downstream of Dirang. Project location map with layout as INSAT been placed as Map 1.

1.2. River System and Catchment Area

3. The river Gongri originates in the western part of Kameng basin at an elevation of 4600 masl. The main tributaries of Gongri are Saskang Rong, Pasom Rong etc. The Gongri in its upper reaches generally flows in north-south direction, taking almost straight course. It is a part of Kameng river system, a right bank tributary of Brahmaputra river. The river has very steep bed slope that is almost of order of 104 m/km in its upper reaches up to Saskang Rong diversion site. The overall river bed slope up to diversion site is 1 in 28. The total length of the river up to diversion site is 47 km from its origin. The average slope of the river in the vicinity of Barrage axis is about 1 in 50. The catchment area up to the proposed barrage site is 1039 km².
4. Project Salient Features

Hydrology

Catchment area	1039 km ²
Average Discharge	54.5 m ³ /s
Max Discharge	315.32 m ³ /s
Min discharge	12.43 m ³ /s

Reservoir

Full Reservoir Level (F.R.L.)	1457.5 m a.s.l.
Minimum Draw-down Level (M.D.D.L.)	1447.0 m a.s.l.
Gross Storage at FRL	0.48 Mm ³
Live storage	0.43 Mm ³
Area under submergence	6.66 ha



Barrage-Spillway

Top of Barrage	1458.5 m a.s.l.
Stream Bed Level	1441.0 m a.s.l.
Barrage Height	17.5 m
Gate Type and Size (WxH)	5 Nos. Radial; 6.0m x 7.7m

Intake (On Left Abutment)

Number of Feeder Tunnels	2
Feeder Tunnel Size	3.5x4.25m,
Intake well size	43.5m x 13.2m x 20.5m
Nominal Discharge	65.4 m ³ /s

Desilting Chambers

Desilting Chamber Size (LxHxW)	215m x 13.8m x 9m, 2Nos.
Size of Particle to be Removed	>0.2 mm
Design Discharge for each Chamber	30.0 m ³ /s
Flushing Discharge for each Chamber	5.45 m ³ /s

Headrace Tunnel

Shape of HRT	Modified Horse Shoe Shaped
Finished Size	4.7m
Length	7730m;
Design Discharge	54.5 m ³ /s

Surge Shaft

Type	Underground open to the surface Restricted Orifice Vertical Shaft
Diameter	10.0 m
Total Height	70 m

Pressure Shaft

Number and Diameter	1 No. and 3.5 m
Total Length of Pressure Shaft	488 m
Design Discharge through Pressure	54.50 m ³ /s

Surface Powerhouse

Turbine Type	Francis
El. of Turbine Runner Center Line	1247.5 m a.s.l.
Rated Discharge per Unit	18.17 m ³ /s
Max./Min. Gross Head	203.05/171.60m
Rated Head	183.10 m
Installed Capacity	3x30.0 MW

Tailrace Channel

Length	40m
Channel Shape	30.2 t 9.8m (W)x12.0 to 2.4m(H)Outlet
sill elevation	1253.6m.a.s.l



2. DESCRIPTION OF THE ENVIRONMENT

5. The study area covered as a part of the EIA study is (i) land to be acquired for various project appurtenances including reservoir submergence (ii) 10 km on either side from the periphery of reservoir submergence (iii) Downstream of the barrage site 10 km on either side of various project appurtenances and (iv) Catchment area intercepted at barrage site. The baseline status is described briefly in the following sections.

2.1. Physical Environment

2.1.1. Meteorology and Climate

6. The study area falls under Alpine/Mountain climatic region as per climatic classification of India which is an indicator of low temperature conditions. The climatic conditions in West Kameng vary greatly with change in altitudes. Four seasons are distinctly observed in the study area are (i) **Pre Monsoon** (March-May): Temperature generally ranges between 7-22°C. Humidity varies from 81-87% (ii) **Monsoon** (June-September); the area receives maximum rainfall under the influence of south-west monsoons during this season. The average annual rainfall in the region is 1450 mm. A total of 1190 mm annual rainfall was recorded in the catchment area during September 2007 to August 2008. The temperature generally ranges from 10-24°C and humidity varies from 90-84%, (iii) **Post Monsoon** (October-November) : in this season, there are occasional showers. (iv) **Winter Season** (December to February): The minimum and maximum temperature in this season varies from 1°C and 14°C.

2.1.2. Geology and Seismicity

7. Arunachal Pradesh can be divided into four major geotectonic blocks. They are (i) The Himalaya (ii) The Mishmi Hills (iii) Naga-patkoï ranges of Arakan Youma Mountain and (iv) The Brahmaputra Plain.
8. Out of four geotectonic blocks of Arunachal Pradesh, the project area falls under 'the Himalaya' block. The region is characterized by rocks of Dirang formations and Bomdila Group comprising quartzite phyllites, meta-volcanic and biotite granite gneisses. The gneisses are foliated, augen bearing and mylonitised. The gneisses are fine grained as well as coarse grained in nature. The Main Central Thrust is reported in the vicinity of Dirang town. The dominant rock type of the project area is granite gneiss with quartzite and phyllite. General trend of foliation is N-S to NNW-SSE. The area is bounded in the north by MCT and in south by Lower Gondwana group along Bichom river valley. The granite gneisses are well exposed in the area.
9. The project area falls in under seismic zone-V, as per IS: 1894: 2002 which is a high damage risk zone.

2.1.3. Physiography and Topography

10. The topography of the area is mostly mountainous. A greater part of it falls within the higher mountain zone, consisting of tangled peaks and valleys. The altitude of the project area varies between 1300-1600 m



and the project site (barrage) is at about 1456 meters above msl. The project area is covered with moderately steep hill slope at both the banks. The slope of the hill behind the terrace is moderate with exposed bed rock.

11. The Gongri river valley resembles typical V-shaped valley of Himalayan terrain surrounded by denudational hills. Developments of terraces were observed at few locations along present river course on both sides of the river with an average elevation of about 5-15 m from the river bed. Development of shoal was also observed at places along the river. Gongri river follows a nearly straight course from the diversion site up to about 8 km downstream where it forms a big U shaped loop before it reaches the proposed powerhouse site. In general both the banks of the river are mostly covered with slopewash deposits with occasional bed rock outcrops. Major Geodynamic features observed along the left bank of the river are dormant slide zones with slopewash deposits and potential rock fall zones. Such features occurring near the project components were identified and marked on the map during the field work.

2.1.4. Landuse Pattern

12. The land use pattern of the study area has been studied through digital satellite imagery data. Predominant landuse of the area is Conifer/fer forest (40%) followed by Alpine scrub (18%), Open Mixed forest (16%), Barren rocky land (10%) and cultivation (7%). The land-use pattern of the study area as per the satellite data is given in Table 2.1. The False Colour Composite and Classified Imagery of the catchment area map are given as Maps 2 and 3 respectively.

Table 2.1 Landuse pattern of the Study Area based on Satellite Imagery

S. No	Landuse Category	Area (in %)
1	Open Mixed Forest	16
2	Conifer/fer Forest	40
3	Scrub	9
4	Alpine Scrub	18
5	Cultivation/Settlement	7
6	Barren Rocky Land	10
Total		100

2.1.5. Soil Quality

13. Physico-chemical characteristics of soil samples indicate that the pH of soil at various sites lies within neutral range. Texture of the soil is sandy loam. Organic content and nutrients viz. nitrogen, sodium, potassium and phosphorous are comparatively low as per recommended norms of Indian Council of Agricultural Research (ICAR). The sodium levels do not indicate any potential for soil salinization or adverse impacts on soil productivity.

2.1.6. Water Resources (Design Flood)

14. The design flood by both approaches i.e. frequency as well as hydro meteorological has been estimated. The following final values at Gongri diversion site have been proposed for planning purpose as given in Table-2.2.



Table 2.2 Final Flood Values, Gongri Diversion Site

Return Period (Year)	Flood Peak (cumec)	SPF (cumec)	PMF (cumec)
25	1350		
50	1500		
100	1600	6547	8363
500	1950		
10,000	2550		

2.1.7. Water Quality

15. There are no major sources of organic pollution loading in the basin. The Gongri river basin has low population density with low cropping intensity. The low cropping intensity coupled with low agro-chemical dosing also means that the pollution load due to agro-chemicals is quite low. The absence of industries implies that there is no pollution load from this source as well.
16. Surface water samples at all locations are fit for propagation of wildlife and fisheries during all monitored seasons. Water quality during winter at all locations is suitable for meeting drinking water requirements. Though the coliform levels are nil, it is recommended that water be used for domestic use after disinfection, especially in monsoon seasons.

Air Quality

17. The ambient air quality monitoring results in the project area establishes that all measured parameters conforms the prescribed National Ambient Air Quality Standard for different land use category. The values of various pollutants are well within the permissible limits specified for residential, rural and other uses.

2.1.8. Noise Environment

18. Noise levels conform the prescribed limit both during day and night time for residential area at all locations.

Ecological Resources

2.1.9. Terrestrial Ecology

19. **Flora:** The project site is surrounded by tall hills and remains in the sub snow zone during winters. Hill slopes suffer from severe erosion from when precipitation started during monsoon. The vegetation along the slopes however remains sparse mainly owing to the severely cold temperature and largely rocky terrain. Major part of the catchment area is under low dense vegetation cover, whereas along the right bank of the river, there are steep slopes with sparse vegetation with mostly alpine vegetation.



20. The forests of the project area falls under Eastern Himalayan forest and classified into following different vegetation types as per the Champion and Seth classification:
- 12/C3a – East Himalayan mixed coniferous forests and**
14/C2 – East Himalayan sub-alpine birch/fir forests
21. A total number of 66 plant species were recorded during the floristic survey in the study area. Rosaceae and Pinaceae were the dominant families present in the study area.
22. During the course of survey, one threatened plant species namely *Ulmus lancifolium* was observed. The species is listed in Red Data Book as rare species. This species is endemic to Assam and Sikkim and is observed in other areas of North Eastern India as well. 16 economically important plant species were found in the study area
23. **Fauna:** Common Leopard, Barking deer, Chinese Pangolin, Hairy footed flying squirrel, Himalayan black bear, Himalayan goral Leopard cat, , Himalayan striped squirrel, etc. were reported and observed in the study area based on the primary and secondary sources of data. Avian species found were 135 in number with 10 butterfly species. In addition to these, a number of reptiles, amphibian and smaller birds are also found. No Threatened or endangered species was recorded in the immediate vicinity of the project.

2.1.10. Aquatic Ecology

24. **Phytoplankton:** A total of sixteen phytoplanktons were found in the Gongri HEP area viz. Myxophyceae-3, Chlorophyceae-5, and Bacillariophyceae-8. The total density of phytoplanktons ranged from 1,254 ind. m⁻² to 1,923 ind. m⁻², which was dominated by the members of Bacillariophyceae.
25. **Zooplankton:** A total of 17 numbers of zooplanktons were found Zooplanktons. Density of zooplankton was present in the range of 23 – 79 ind. l⁻¹. The diversity index ranged between in a narrow range at all the sites. It indicates the poor diversity of zooplankton in the Gongri River.
26. Four benthos were found during the study period in the Gongri HEP area. Seventeen numbers of algae were also found in the area.
27. **Fisheries:** The commercial fisheries are non-existent in the project area. Fishing by individuals is only practiced during the lean season in the Gongri River close to the confluence of Rahung and Mohan camp by the anglers and the traditional fishing. The inaccessible terrain is also one of the reasons that the fishermen are not able to operate their fishnets very effectively. fish species like the Botia. Dario, B. bendelisis, B. bola , Punitus Chola, Tor tor, Tor putitora, Danio sp., Garra gotyla gotyla, Anguilla are found in the river. Near the Gongri HEP there were no particular area which can be designated as the spawning ground of the fishes.



28. The state fisheries department has accorded No Objection Certificate for the proposed project with the condition of providing fish ladder and fisheries conservation plan.

2.2. Socio-economic Environment

2.2.1. Demographic configuration of affected Villages

29. Demographic details of project villages has been summarised in **table 2.3** which is an out come of Census of India, 2001. The total population of these villages is 2704 (Male: 1401, female 1303 respectively)

Table 2.3 Demographic Details of Project Affected Villages

Villages	Total House Holds	Total Population	Total Male	Total Female
Dirang	293	1245	644	601
Namshu	110	460	238	222
Thembang	62	301	156	145
Rahung	164	698	363	335

2.2.2. Literacy Profile of Affected Villages

30. The literacy profile of project affected villages is given in table 2.4. The highest literate population was found in Thembang village and Rahung village was the least literate village.

Table 2.4 Literacy Profile of project affected village

Villages	Literate	Illiterate
Dirang Village	38.87	61.13
Rahung	33.81	66.19
Namshu	44.44	55.56
Thembang	45.51	54.49

2.2.3. Occupational Profile of Affected Villages

31. Dirang village has the maximum percentage of main working population with 48.75% whereas Thembang witnesses the least population of main workers with 20.6%. Thembang village has the maximum population of marginal workers whereas Rahung village witnesses highest population of marginal workers. Village Rahung has the highest population % of non-workers whereas Dirang, Namchu and Thembang villages witness non-workers' population % in the range of 50 to 55%.

Comment: Not 'Namchu'

2.2.4. Village wise land requirement and affected households

32. The project envisages acquisition of 48.818 ha. This will affect 16 families and four communities. All families belong to schedule tribe population. The village wise land requirement has been described in following paragraphs.
33. **Dirang Village:** 11 families and one community (Phoichulpa Community) are likely to be affected by the project. The total land



comes to 4.60 ha out of which 1.45 ha is cultivable land and 3.15 ha land has been categorized under barren land by the revenue authorities of the district.

34. **Rahung Village:** only three families are being affected due to the proposed project. Besides land of three communities namely Rahung, Ngoimu & Sharmu Community are also being acquired. The total land estimated to be 24.80 ha and all the land is categorized under barren land.
35. **Thembang Village:** Land of Serthockpa and Tsering Merkpa Communities is getting affected in Thembang village. The total land comes to 11.95 ha and all the land is categorized under barren land
36. **Namchu Village:** Land of 2 families is getting affected in this village. The total land belonging to these families is barren land. No cultivated land is getting affected. Apart from families' land, community is also getting affected.

3. ANTICIPATED ENVIRONMENTAL IMPACTS AND ITS MITIGATION MEASURES

3.1. Impact on Water Environment

Construction phase

37. Sewage from labour colony: Sewage generated from labor camp /migrant population will be treated through septic tanks. Thus, no significant impact on water quality of river Gongri is envisaged during construction phase.
38. Effluent from crushers and other sources: The effluent from the crushers and other sources, like adit, tunnel, would contain high suspended solids. It is proposed to treat the effluents in settling tanks. Thus, no significant impact is envisaged.

Operation Phase

39. Effluent from project colony: During operation phase, only a small number of O&M staff will reside in the colony. The sewage generated would be provided biological treatment before discharge.
40. Sediments: The proposed project is envisaged as a runoff the river scheme with a barrage. At regular intervals, the gates of the barrage shall be opened to flush the sediments. Moreover, the sediment load at the barrage site is quite low. Thus, in the proposed project, sedimentation problems are not anticipated.
41. The river stretch downstream of the barrage site upto the confluence point of tail race discharge will have reduced flow upto the confluence of tail race tunnel. In the intervening stretch, the flow shall be implemented by (i) releases of flushing discharges from desilting chamber, (ii) contribution of flow from various streams/nallahs in the confluence of tail race disposal and (iii) gates of barrage will remain open leading to continuous flow in the downstream river stretch during monsoon months. The reduction in flow or drying of the river in the intervening stretch is not likely to have any adverse impact on the



downstream users. This is mainly because of the fact that settlements/villages within this dry stretch are not dependent on the water of river Gongri, as the villagers use water of small streams or nallahs flowing adjacent to their habitation.

3.2. Air Quality

42. Pollution due to fuel combustion: The major construction equipment would be operated through electricity. Therefore, fossil fuel combustion would be minimal. Diesel would be used only in contingency. The DG sets likely to be used will have adequate stack height as per prescribed norms of CPCB. The fuel used will be low sulphur diesel. Thus, no significant impact on ambient air quality is expected as a result of operation of various construction equipment.
43. All construction material will be transported through covered vehicle. All vehicles engaged in transportation will be regularly maintained.
44. Emissions from various crushers: During crushing operations, there would be emissions of dust particles. Minimal impact is expected during construction phase. Further, the labour camps would be located on the leeward side of the crusher with respect to predominant wind directions.

3.3. Noise Environment

45. Temporary increase in ambient noise is anticipated due to various construction activities, maintenance workshops and vehicles & heavy equipment. Hill cutting activity shall increase impulsive noise and vibration level. Impact due to noise may be reduced by (i) maintenance of equipments (ii) regulating timing at blasting sites (iii) stationary noise making equipments shall be placed along un-inhabited stretches (vi) PPEs to the workers. Due to absence of any habitat of wild animals near proposed blasting sites, this impact will be minimal. No impact on noise environment is anticipated during operation phase

3.4. Impact on Land and Soil

46. **Impacts due to quarrying:** In a hilly terrain, quarrying is normally done by cutting a face of the hill. A permanent scar is likely to be left, once quarrying activities are over. With the passage of time, they become a potential source of landslide. Thus it is necessary to implement appropriate slope stabilization and quarry reclaiming measures. Adequate measures have been suggested in EMP.
47. **Impacts due to muck disposal:** A large quantity of muck is expected to be generated as a result of tunneling operations, construction of approach road for adits, etc. The same requires to be suitably disposed. Normally, muck is deposited in low lying areas or depressions. Proper disposal and reclamation has been suggested as a part of EMP
48. **Impacts due to land acquisition:** The total land to be acquired for the project is 48.81 ha. A part of this land is required for labour camps, quarry sites, muck disposal storage of construction material, siting of



construction equipment, which will be required temporarily and returned once the construction phase is over. Permanent acquisition of land is required for barrage axis, submergence area, project colony, etc. Adequate compensation package has been formulated in R&R plan.

3.5. Impact on Biological Environment

3.5.1. Terrestrial Ecology

49. **Increased human interferences:** A large population is likely to congregate in the area during the project construction phase. This population residing in the area may use fuel wood (if no alternate fuel is provided). Therefore, alternate fuel should be provided to such population. Further, community kitchens should be provided using LPG or diesel as fuel.
50. **Loss of vegetation:** Compensatory afforestation (detailed in EMP) will be taken up in close consultation with forest department to compensate the adverse impact due to loss of vegetation/trees.
51. **Disturbance to wildlife:** The operation of various construction equipment and blasting is likely to generate noise. These activities can lead to some disturbance to wildlife population. Since there is no habitat of any wild animals such disturbance in the close does not fall in the migratory routes of animals. Mitigation measures to minimize such impacts have been suggested in the EMP.

3.5.2. Aquatic Ecology

52. Aquatic life may get disturbed due to increased siltation and turbidity due to debris/muck generated during construction phase and otherwise erosion due to clearance of vegetation. All measures shall be taken to avoid/check siltation/erosion.
53. The implementation of the project would bring about significant changes in the riverine ecology, as the river transforms from a fast-flowing water system to a quiescent lacustrine environment. Amongst the aquatic animals, it is the fish life which would be most affected. The migratory fish species are likely to be adversely affected due to obstruction created by the proposed barrage. With the completion of barrage, flow in the downstream stretch of the river would be reduced considerably more so during the lean period. A fish management Plan has been suggested to be implemented during operation of the project.

3.6. Socio-Economic Impact

54. No negative social impact is envisaged except minor land acquisition. Rather the project will benefit the local population in terms of enhanced social and physical infrastructure, increased employment opportunities, more power availability, fisheries rights in the reservoir etc. The total land requirement for the project is 48.81 ha. All are privately owned or under community land. The land acquisition does not entail any loss of establishment/ structure. The impact due to land acquisition has been summarised below in table 3.1.



Table 3.1 Summary of Social Impacts

Particulars	Details
Total land Acquisition	48.18 ha
Total Private/Community	48.18 ha
No. Affected Villages	4
No. of Project Affected Families	15
Total Home Oustees	Nil
Total No. of Pvt. Structures	Nil
No. of SC Families	Nil
No. of Schedule tribe Families	15

3.7. Impacts due to Construction Camp

55. Poor sitting and improper management of construction camp may lead to several adverse impacts on environment viz. (i) loss of vegetation due to use of wood as fuel source for cooking (ii) deterioration in nearby surface water bodies' quality (iii) compaction and contamination of soil due to uncontrolled disposal of solid waste (iv) unhealthy condition due to unsafe drinking water supply to labourers and discharge of sewage. All construction camp shall be provided with all basic infrastructures in terms of sanitary facilities, solid waste and sewage disposal and storm water management etc.

4. ENVIRONMENTAL MANAGEMENT PLAN

4.1. Compensatory Afforestation and Bio diversity Conservation Plan

56. **Compensatory Afforestation:** There are no conservation/ preservation areas in the form of any wildlife sanctuary, national park, etc. in the vicinity of the proposed project. The project, therefore, does not pose any threat to an ecosystem or species of conservational significance. The total land required for the project is 48.818 ha which is categorised as community land. No forest land is required for project purpose, except 2.21 ha of river body in proposed reservoir.

57. The total forest loss including submergence area and other project appurtenance is about 2.21 ha. It is proposed to afforest double the amount of forest land being acquired for the project. Thus, a total of 4.5 ha of land needs to be afforested. The compensatory afforestation work is to be done by Forest Department. The cost of compensatory afforestation for this species in an area of 4.5 ha would be Rs. 0.27 million @ Rs. 60,000/ha. In addition, project proponents will also pay cost of trees and NPV as decided by the forest department.

58. **Conservation of threatened Species:** During vegetation survey of the study area (refer chapter on Biological Environment – Terrestrial Ecology) one rare species namely *Ulmus lancifolius* was observed. The density of this species in influence zone and submergence zone is of the order of 5.4 and 24 trees/ha respectively. It is proposed to afforest an area of 20 ha @ 1100 trees/ha with this species. The propagation and cultivation method for this species has been standardized by the State Forest Research Institute (SFRI), Itanagar. The cost of afforestation for this species in an area of 20 ha would be Rs. 1.40 million @ Rs. 70,000/ha.



59. **Budgetary Provision:** A total provision of Rs. 11.47 million has been earmarked for biodiversity conservation measures. The details are given in Table-2.1.

Table 4.1 Budget for implementation of biodiversity conservation measures

Item	Cost (Rs. million)
Compensatory Afforestation	0.27
Afforestation of threatened species	1.40
Anti-poaching measures	9.80
Total	11.47

4.2. Catchment Area Treatment Plan

60. The catchment area considered for treatment under the proposed is 5391.9 ha. The catchment area has been divided into 35 sub-watersheds out of which only 28 are under treatable category since remaining are snow fed or do not fall under high erosion intensity rate category. In the present study 'Silt Yield Index' (SYI), method has been used. CAT plan has been suggested for very high and high erosion category, as a part of the present EIA study, the expenses of which have to be borne by project proponents. The area under severe erosion categories is 4511.44 ha and very severe is 880.55 Ha. The cost required for Catchment Area Treatment is Rs. 66 million which have to be borne by project proponent. The following aspects shall be covered as a part of the CAT plan:

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

4.3. Fisheries Management Plan

61. No large scale fishing activities take place. The consultation held with the local people and fisheries department establishes that fish density is comparatively low in the area. The general experience in fish catch revealed that the effort per man-hour in 1km stretch is 1 to 2 kg.
62. **Release of Minimum Flow:** It is proposed to maintain 15% of monthly minimum flow observed in the months of December – February for the sustenance of fishes. The discharge shall be supplemented by contribution small khads and streams in the intervening river stretch.
63. **Sustenance of Endemic Fisheries:** trout and mahaseer are the migratory species observed in river Gongri. The barrage on river Gongri will be a barrier to the free movement of fish species. Therefore, a provision of fish ladder has been made in the barrage. The cost for the fish ladder shall be estimated during detailed design stage of the project.
64. **Supplementary Stocking:** Commercial fishing is not in vogue in the project area. Mahaseer and trout are the migratory species observed in the project area.. The barrage to be developed as a part of the project will act as a barrier to the free movement of fish species. It is proposed to implement supplementary stocking programmes for the project area. In



addition to reservoir area, it is proposed to stock river Gongri for a length of 10 km each on the upstream and the downstream side of the barrage site. The rate of stocking is proposed as 100 fingerlings of about 30 mm size per km. For reservoir area, the rate of stocking could be 200 fingerlings of about 30 mm size per ha. The stocking can be done annually by the Fisheries Department, state Government of Arunachal Pradesh. To achieve this objective, facilities to produce seed of trout need to be developed at suitable sites. Provision of Rs 11.75 million has been earmarked for the Fisheries Development Plan.

4.4. Public Health Delivery System

65. In a hydroelectric project, there is requirement of large work force. This migration/congregation of population may pose several health problems/risk in the area during construction phase of the project. To avoid minimize such impact, the project will have adequate public health delivery mechanism which will include following major components viz:

- Residential Colonies for Workers
- Medical and Healthcare Facilities
- Prevention of vector borne diseases
- Proposed Health Facilities at Construction sites
- Immunization and Health Check-up Camps
- Infrastructure facilities

Detailed arrangement/mechanism has been discussed in the EMP report. The total budgetary provision has been estimated to be 20.83 million.

4.5. Environmental Management Plan for Labour Camps

66. The labour camps shall have the following facilities:

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

A total amount of Rs. 20.10 million has been earmarked for implementation of various measures in labour camps.

4.6. Muck Management Plan

67. An amount of 765,500 cum of the excavated material (muck with 45% swelling factor) will be generated. Out of this 90,500 cum muck shall be utilised in construction of various project components and rest of the muck i.e., 675000 cum of muck is to be dumped and rehabilitated at designated dumping sites in scientifically acceptable manner. Provision of protection walls with deep foundations will be made so that muck will not flow and washed away in the river Masonry work, create work and check dam will also be provided wherever necessary in order to avoid the



chances of soil erosion and to ensure flow of silt, free water. Besides these engineering measures, proper plantation will be done at the dumping sites for reclamation of the dumping areas. The total expenditure required for stabilization of muck disposal sites has been estimated to be of the order of Rs. 26.28 million.

4.7. Reclamation of Quarry Sites/ Restoration and Landscaping of Working Area

68. **Measures before quarrying:** The top 6-12" of soil will be removed before starting the quarrying activity or any other surface disturbances. The removed top soil will be kept separate and stock piled so that it could be reused subsequently for the rehabilitation of quarry sites after the completion of quarrying activity.
69. **Measures after Quarrying:** The major consideration to be made during post quarrying are
- Diversion of Run-off:
 - Filling of the Depressions:
 - Construction of Retaining Walls/ Support Structures
 - Rocks for Landscaping
 - Laying of the Top Soil
 - VAM Fungi for Soil Reclamation
 - Re-vegetation
- The detailed methodologies for all above components have been covered in EMP
70. **Restoration and Landscaping of Working Areas:** Three locations have been selected for the development of office area and colonies, locations have also been identified for project components and construction facilities. These areas will be highly disturbed due to clearing of the vegetation and forests.
- The choice of the tree species for plantation will depend upon the topography of the area required to be regenerated after the construction activities. In general indigenous species like *Pinus roxburghii*, *Pinus walichiana*, *Thuja* sp. *Populus* sp., *Punica granatum* (ornamental).
 - Proper roads and lanes would be provided inside the colony area. The open area will be covered with the vegetation.
 - Retaining walls will be built to avoid the landslides and slips. Proper channels would be provided inside the colony to drain out the rain/ domestic water.
 - Parks and play grounds for children would be developed in and around the colony area.
 - 3 rows of trees at 5 m (with in a row) x 3 m (between rows) along both sides of the road would be planted. The species found locally and useful to the local residents would be preferred.
71. **Landscaping and restoration plan:** The working area of barrage site, power house complex colony area has been selected for beautification of



the project area after construction is over. There would be sufficient open space in power house complex and colony area. Forested area in the power house complex would provide aesthetic view and add to natural seismic beauty. The beautification in the colony area would be carried out by development of flowering beds for plantation of ornamental plant, small park, etc.

4.8. Solid waste Management Plan for Colonies and Labour Camps

72. Adequate Solid waste collection and disposal facility will be provided during construction and the operation phase as detailed in EMP.

4.9. Measures for Air and Noise Pollution Control

73. **Air:** Various measures have been suggested in EMP in detail to control the air pollution from different sources. Important among them are (i) maintenance of construction vehicle and equipment (ii) use of low sulphur diesel and adequate stack height for DG sets (iii) transportation and storage of unconsolidated construction material (iv) waters sprinkling at earthwork (v) installation of crushers and batching/hotmix plant away from settlement area etc. An amount of Rs. 5.34 million is earmarked for air pollution control measures.
74. **Noise:** Workers operating in high noise areas/ activities should be provided with effective personal protective measures such as ear muffs or ear plugs to be worn during periods of exposure. The other measures to control noise could be (i) equipment and machineries should be maintained regularly to keep the noise generation at the design level (ii) silencers and mufflers of the individual machineries to be regularly checked by the project proponent;(iii) implementation of measures to control noise and DG sets (iv) exposure of workers to high noise areas, should be limited as per maximum exposure periods specified by OSHA. An amount of Rs. 1.0 million has been earmarked for control of noise.

4.10. Water Pollution Control

75. It is recommended to construct settling tanks of adequate size at two or three sites to settle the suspended impurities in the effluents generated from crushers and tunnelling sites. The sludge from the various settling tanks can be collected once in 15 days and disposed at the site designed for disposal of solid wastes from the labour camps. The sludge after drying could also be used as cover material for landfill disposal site. A total of Rs.0.5 million has been earmarked for construction of settling tanks for treatment of effluents from crusher and tunnelling.
76. It is recommended to provide a suitable Sewage Treatment Plant (STP) to treat the sewage generated from the colony. The cost required for construction of sewage STP in the project colony has already been covered in the budget earmarked for construction of the project colony. The estimated cost for installing STP is Rs.2.5 MILLION.

4.11. Reservoir RIM Treatment Plan

77. Green belt around the reservoir would be created to avoid erosion of soil and prevention of land slips from the direct draining catchment into the reservoir. The creation of green belt on either side of the reservoir



will ensure protection of the reservoir rim area from any minor slips due to fluctuation in the water level. The slopes on both the banks will be planted with suitable tree species for creation of a green belt around the reservoir rim. In areas with moderately steep slopes indigenous, economically important, soil binding tree species will be planted, which are able to thrive well under high humidity and flood conditions. A proposed scheme of plantation around the reservoir has been given in EMP report.

78. A provision of Rs.0.23 million @ Rs.60,000 per ha including the cost of nursery, plantation and fencing has been made. The plantation for this purpose will be carried out with the participation of the State Forest Department.

4.12. Disaster Management Plan

79. Hydro Electric Project ensures a large number of potential benefits, but it also creates a structure with potential hazards, which may result from its failure. When huge volume of water stored transforms into a flood wave, which may cause severe damages to the lives and properties situated downstream. Gongri Hydro Electric Project being a R-o-R scheme having barrage as diversion structure is less disaster prone in nature. Although suitable safety measures has been considered under the disaster management plan. Adequate budgetary provision i.e. 4.35 million has been made to encounter potential disaster due to the project

4.13. Energy Conservation Measures

80. All measures will be taken to save energy to the extent viz; regular maintenance of vehicle and equipments and use energy efficient luminaries, avoid idling of vehicles during construction phase.
81. During operation phase, it is recommended to increase solar energy in the colonies, use of energy efficient electrical fittings, use of motors with higher efficiency and variable drives, better architectural design to maximise the use of day light etc.

4.14. Resettlement and Rehabilitation Plan

82. The Resettlement and Rehabilitation Plan has been prepared in consistent to The National Rehabilitation and Resettlement Policy (NRRP), 2007. There are altogether 4 villages/revenue villages from where private land/community land is likely to be acquired for the proposed project. A total of about 48.81 ha of land proposed to be acquired affecting 16 families and 4 communities. No displacement is envisaged due to the proposed project. All project affected families belong to Schedule tribe population. The total estimated cost for implementing R&R has been estimated to be 44.12 millions.

4.15. Environmental Monitoring Plan

83. Environmental Monitoring plan for both construction and operation phase have been summarised below in Table 4.2 and Table 4.3



Summary Environmental Impact Assessment of 90MW Gongri Hydro Electric Project at
West Kameng District of Arunachal Pradesh

Table 4.2 Environmental Monitoring Plan for Construction Stage

S. No.	Item	Parameters	Frequency	Location
1.	Effluent from septic tanks	pH, BOD, COD, TSS, TDS	Once every month	Before and after treatment from Sewage Treatment Plant
2.	Water-related diseases	Identification of water related diseases, adequacy of local vector control and curative measure, etc.	Three times a year	Labour camps and colonies
3.	Noise	Equivalent noise level (L_{eq})	Once in three months	At major construction sites.
4.	Air quality	SPM, RPM, SO ₂ and NO _x	Once every season	At major construction sites
5.	Ecology	Qualitative & Quantitative assessment of flora and fauna.	Once every year	Near major construction sites
6.	Muck disposal	Status of various muck disposal sites including status of plantation, various engineering control structures,	Once every year	Muck disposal sites

Table 4.3 Monitoring Plan for Operation Phase

S. No.	Items	Parameters	Frequency	Location
1.	Water	pH, Temperature, EC, Turbidity, Total Dissolved Solids, Calcium, Magnesium, Total Hardness, Chlorides, Sulphates, Nitrates, DO. COD, BOD, Iron, Zinc, Manganese	Thrice a year	<ul style="list-style-type: none"> 1 km upstream of barrage site Reservoir area 1, 5 and 10 km downstream of Tail Race discharge
2.	Effluent from Sewage Treatment Plant (STP)	pH, BOD, COD, TSS, TDS	Once every week	<ul style="list-style-type: none"> Before and after treatment from Sewage Treatment Plant (STP)
3.	Erosion & Siltation	Soil erosion rates, stability of bank embankment, etc.	Twice a year	-
4.	Ecology	Status of afforestation programmess of green belt development	Once in 2 years	-
5.	Water-related diseases	Identification of water-related diseases, sites, adequacy of local vector control measures, etc.	Three times a year	<ul style="list-style-type: none"> Villages adjacent to project sites



Summary Environmental Impact Assessment of 90MW Gongri Hydro Electric Project at West Kameng District of Arunachal Pradesh

S. No.	Items	Parameters	Frequency	Location
6.	Aquatic ecology	Phytoplanktons, zooplanktons, benthic life, fish composition	Once a year	<ul style="list-style-type: none"> 1 km upstream of barrage site Reservoir area 1 and 5 km downstream of Tail Race discharge
7.	Landuse	Landuse pattern using satellite data	Once in a year	Catchment area
8.	Soil	pH, EC, texture, organic matter	Once in a year	Catchment area

4.16. Environmental Cost Estimates

84. The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs. 232 million. The details are given in 4.4.

Table 4.4 Cost for Implementing Environmental Management Plan

S. No.	Item	Cost (Rs. million)
1.	Catchment Area Treatment	66.50
2.	Compensatory Afforestation NPV, Cost of Trees and Bio-diversity conservation	11.47
3.	Public health delivery system	20.83
4.	Environmental Management in labor camp	20.10
5.	Fisheries Management	11.75
6.	Reservoir Rim Treatment	0.20
7.	Muck management	26.28
8.	Restoration and Landscaping of construction sites	7.39
9.	Resettlement and Rehabilitation Plan	44.12
10.	Water Pollution Control	0.50
11.	Air pollution control	5.34
12.	Noise control measures	1.00
13.	Environmental Monitoring during construction phase (Refer Table-16.2)	6.86
14.	Provision for consultancy services for CDM	5.00
15.	Disaster Management Plan	4.35
Total		231.69 say, Rs.232 million

4.17. Cost for Implementing Environmental Monitoring Programme

85. The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs.16.37 million. The construction period for estimation of cost for implementation of Environmental Monitoring programme during construction phase has been taken as 4 years. The details are given in Table-16.2.



Table 4.5 Cost for Implementing Environmental Monitoring Programme During Construction phase

S. No	Item	Cost (Rs. million/ year)	Total cost 4 Years with 10 % escalation (Rs. million)
1.	Water quality	0.10	0.46
2.	Air quality	0.38	1.76
3.	Muck disposal	0.40	1.86
4.	Ecology	0.50	2.32
5.	Incidence of water related disea	0.10	0.46
	Total	1.48	6.86

The cost required for implementation of the Environmental Monitoring Programme at operation phase is of the order of Rs.1.16 million/year. The details are given in Table-16.3.

Table 4.6 Cost for Implementing Environmental Monitoring Programme during operation phase

S. No	Item	Cost (Rs. million/year)
1.	Water quality	0.24
2.	Effluent form STP	0.31
3.	Soil Erosion	0.20
4.	Ecology	0.10
5.	Incidence of water related diseases	0.10
6.	Land use pattern	0.30
	Total	1.25

4.18. Project Benefits:

86. The 90MW Gongri Hydro Power Project proposes to have several benefits. Among them few are discussed herein. The project will enhance the power scenario of the state and the country as a whole. This project in the West Kameng District will improve the social and physical infrastructure in the project area and its surroundings. After the project implementation Tourism will also get a boost indirectly. Significant employment will be generated during construction phase. Further, the catchment area treatment plan will lead to enhanced vegetation profile which in turn will reduce soil erosion. Because of the project, fisheries will be benefited (reservoir fisheries) as lacustrine environment is better than riverine environment for fisher to propagate.
87. One of the key benefits of the hydel power project is being renewable source of energy they are environment friendly. CO₂ emissions from Hydel power projects are far less than thermal power plants.

4.19. Additional Studies

88. As per the approved TOR, Resettlement & Rehabilitation studies have been undertaken. Besides, other relevant studies like disaster management plan and note on CDM has been also been incorporated as a part of the studies.