ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

KAMALA HYDROELECTRIC PROJECT (1720 MW)

KAMLE, KRA DAADI & KURUNG KUMEY DISTRICT, ARUNACHAL PRADESH

(Sector 1(c); Cat "A")

Executive Summary

September, 2025

Prepared for:

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QCI Certificate No.	**NABET/EIA/25-28/RA 0415**
Laboratory	**AGSS Analytical and Research Lab (P) Ltd.** **An ISO-9001 : 2015 Accredited Laboratory** **(NABL Accredited Testing Laboratory)**
Baseline Data Monitoring Period	**Winter (December 2024 - January 2025)**
	Pre-monsoon (April 2025 – May 2025)
	Monsoon (June 2025 – July 2025)

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

1.0 INTRODUCTION

Environmental Impact Assessment (EIA) report of **Kamala Hydroelectric Project (HEP)** with an installed capacity of 1720 Megawatt (MW) has been prepared with the objective to present the baseline status of various environmental parameters in project surrounding and to assess the impacts of the project on the surrounding area and to suggest mitigation and management measures to minimize such impacts.

The Ministry of Environment, Forests & Climate Change (MoEF&CC), Government of India has granted Terms of Reference (ToR) for the Kamala HEP under the provisions of the EIA Notification 2006 and its amendments vide ToR Identification No.: TO24A0501AR5622743N dated 07/08/2024. The report has been prepared in accordance with the approved ToR by MoEF&CC for obtaining Environmental Clearance.

Kamala HEP has been indicated to NHPC Ltd. vide Ministry of Power letter dated 22.12.2021 for its development and Government of Arunachal Pradesh (GoAP) approved allotment in favour of NHPC Ltd. on 21.07.2023. Subsequently, A Memorandum of Agreement was signed between GoAP and NHPC Ltd. on 12.08.2023 for development, commissioning, implementation, operation and maintenance of Kamala HEP on Build, Own, Operate and Transfer (BOOT) basis for a lease period of 40 years from the commercial operation date (COD).

2.0 PROJECT LOCATION & APPROACH

Kamala HEP is proposed on Kamla River, a major right bank tributary of Subansiri River, which is further a major tributary of the Brahmaputra. Mainly the project components fall in Kamle district and major reservoir area in Kamle & Kra Daadi district. A small portion of land is required to be acquired for flood moderation purpose falls in Kurung Kumey district.

The proposed dam site is located around 4 km upstream of suspension bridge and newly constructed 70-R bridge at Tamen village in Kamle District of Arunachal Pradesh, which is around 20 km from Raga, the District Headquarter of Kamle District and 55 km from Ziro, the District Headquarter of Lower Subansiri District. Ziro is about 130 km from North Lakhimpur, the District Headquarter of Lakhimpur District and 116 km from Itanagar, Arunachal Pradesh. Nearest Airport (Donyi Polo) is at Hollongi, Itanagar and nearest rail head is Naharlagun (Itanagar). The powerhouse site of project is located approx. 500 m downstream of the Dam axis.

The dam site is approachable through both the banks by a non-metalled road on left bank and black top road on the right bank at a higher elevation. The left bank road takes off from the Tamen-Daporijo Road near Tamen bridge at Tamen village & right bank road from Boasimla village near Tamen.

Location map of the project is given as **Figure 1**.

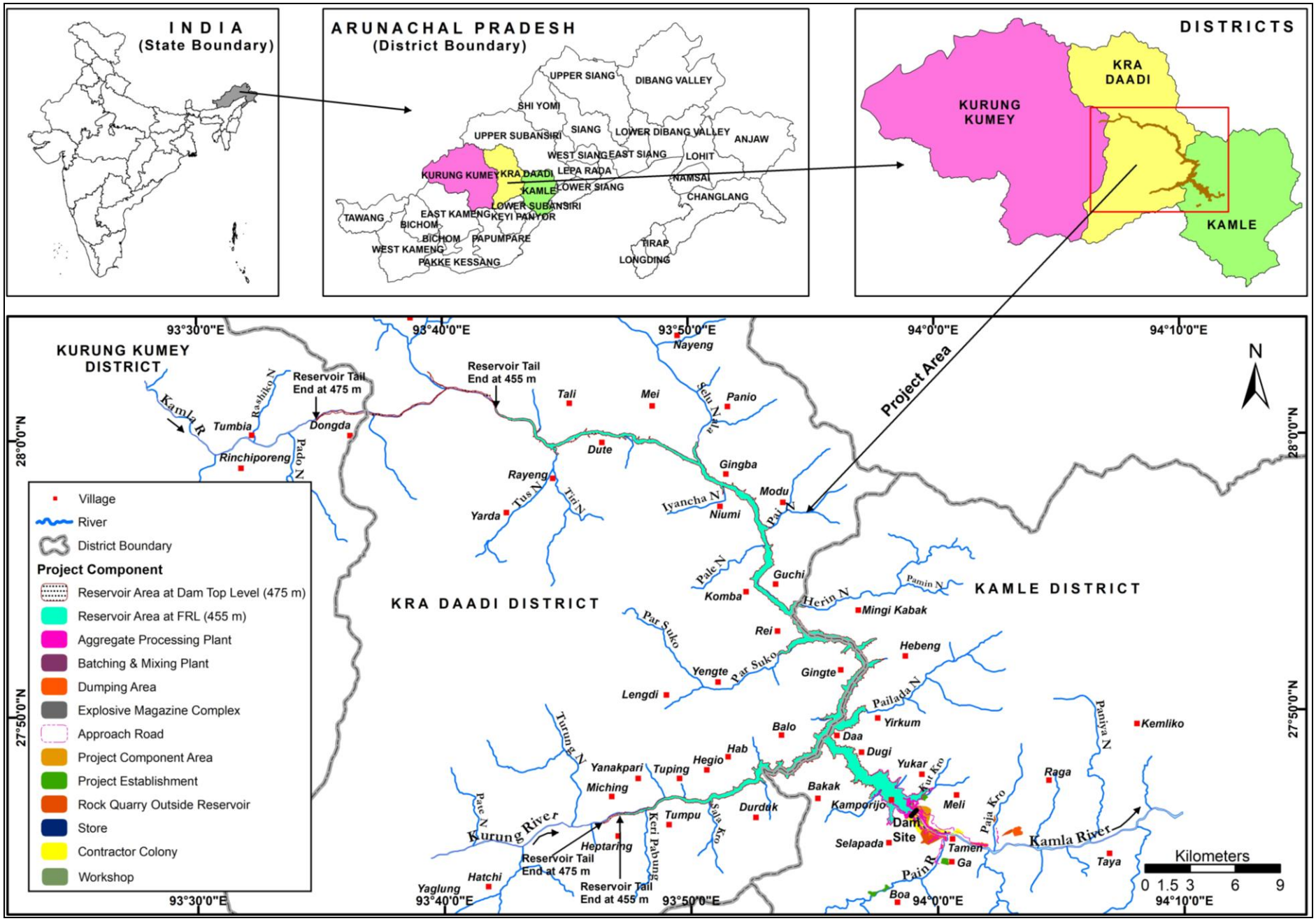

Figure 1: Location Map of Kamala HEP

3.0 PROJECT DESCRIPTION

Kamala HEP is proposed as a Storage Project and envisages the construction of a 216m high dam from the deepest foundation level with objective of power generation and Flood moderation considering exclusive storage of 15 m above FRL. The main aspects of the project are proposed as below:

- To facilitate river diversion, upstream and downstream cofferdams have been located at about 250m u/s and 325m d/s of dam axis.
- Three diversion tunnels with length of 915 m, 1100 m and 1315 m.
- A concrete Gravity dam 216m high from its deepest foundation level and 628 m long at dam top level EL 475 m. Reservoir levels are FRL- EL 455 m, MWL -EL 470 m and MDDL - EL 430 m.
- Spillway consisting of 7 bays of 6.0 m (width) x 10.5m (height) main spillway, an auxiliary spillway of opening 6.0 m (Width) X 13.0 m (Height) and 5 No. under sluice bays 4.0m (width) x 4.5 m (height)
- Power intake four numbers. Three Power Intake opening is 2 Nos x 5.1 m (Width) x 11.5 m (Height) and fourth one of opening 2 Nos x 5.5 m(Width) X 12.5 m (Height) at invert level EL 405 m.
- Four No HRT in which, HRT-1, HRT-2 & HRT-3 are Horse Shoe Shaped with 11.5 m diameter, while HRT-4, Horse Shoe Shape has a diameter of 12.5 m. Length of HRTs varies from 515 to 832 m.
- Eight nos. of Pressure shafts (PS), circular steel lined, Six nos. PS-1, PS-2, PS-5 to PS-8 are of size 7.1 m and two nos. PS-3 & PS-4 of size 6.5 m. Auxiliary unit penstock 2.5 m bifurcate from PS-1 at lower bottom portion.
- Underground power house cavern of size 380m (L) x 24m (W) x 59.4 m (H) housing 8 nos. of main units of 210 MW each and an auxiliary unit of 40 MW.
- Transformer cavern of size 375m (L) x 16.5m (W) x 27m (H) located d/s of power house cavern.
- Draft Tube Gate Operation Chamber of size 276m (L) x 7m (W) x 12 m (H).
- Eight nos. Unit TRT, each of size 7.5 m Horse shoe shape and 210 m to 240 m long
- D/s surge cavern of size 276m (L) x 12m (W) x 42.85m (H) further d/s of Draft Tube Gate Operation Chamber.
- Four nos. of main TRT of size 10.0 m, Horse shoe shape of length varying from 300m to 450m and auxiliary unit TRT of size 3.5 m, Horse shoe shape of length 333m.
- To facilitate the construction and operation of the project components, suitable Adits and Access tunnels have been proposed.

Salient features of the project are given in **Table 1**. Project layout plan is shown in **Figure 2.**

Table 1: Salient Features of the Project

LOCATION	
State	Arunachal Pradesh
District(s)	Project components in Kamle district; Reservoir in Kamle, Kra Daadi and Kurung Kumey districts
River	Kamla

Dam Site	4km upstream of Tamen Village 27° 46'18"N, 93°59'19"E
HYDROLOGY	
Catchment Area	7213 sq km
Probable Maximum Flood (PMF)	17416 cumec
River Diversion Flood (1 in 25 Non-Monsoon)	4054 cumec
Glacier lake outburst flood (GLOF)	1663 cumec
Average Rainfall	1025 mm at Tamen
Water availability	Annual average flow- 706.76 cumec Annual yield - 22288.4 MCM
Ecological Release during Lean period	28.45 cumec
RESERVOIR	
Maximum Water Level (MWL)	El. 470.00m
Full Reservoir Level (FRL)	El. 455.00m
Minimum Draw Don Level (MDDL)	El. 430.00m
Gross Storage at MWL	2365.70 MCM
Gross Storage at FRL	1927.60 MCM
Gross Storage at MDDL	1304.00 MCM
Surcharge Storage	438.10 MCM
Live Storage	623.60 MCM
Surface Area at FRL	2775 Ha
Reservoir Length	65km along Kamla and 17km along Tributary Kurung River
DIVERSION TUNNELS	
Number	3 nos.
Diameter	11.0m, Horse shoe shaped
Length	915m to 1315m
COFFERDAMS	
Height of upstream cofferdam	43m
Height of downstream cofferdam	23m
DAM	
Type	Concrete Gravity
Average river bed level	El. 275.00m
Deepest Foundation level	El. 259.00m
Top of Dam	El. 475.00m
Height above deepest foundation	216m
Length of dam at top	628m
SPILLWAY	
Main Spillway	
Number of bays	7 nos.
Crest Elevation	El. 365.00 m
Opening Size	6.0m (W)x 10.5m (H)
Energy Dissipation	Trajectory Bucket
Auxiliary Spillway	
Number	1 no.
Crest Elevation	El. 446.00m
Opening Size	6.0m (W)x 13.0m (H)
Under Sluice	
Number and Size	5 nos., 4m (W)x4.50m (H)
Crest elevation	310.0m
Arrangement for E-Flow	
During monsoon and Pre & Post monsoon	Through Main Power house units
During Lean period	Through Auxiliary unit of Power house
E-Flow Outlet	Auxiliary unit TRT outlet at plunge pool
POWER INTAKE	
Number	4nos

Invert elevation	El. 405.00m
Size of Gate opening in each Intake	
HRT-1,2 & 3	2 nos. 5.1m (W) x11.5m (H)
HRT-4	2 nos. 5.5m(W)x12.5m(H)
HEADRACE TUNNEL	
Number	4 nos., concrete lined
Diameter & Shape	
HRT-1,2 & 3	11.5m Horse Shoe Shape
HRT-4	12.5m Horse Shoe Shape
Length	515m to 832m
Design discharge/Discharge 10%overload	
HRT 1	350.47 Cumec/ 385.5cumec
HRT 2 ,3 & 4	320 Cume/ 352cumec
PRESSURE SHAFT	
Number	8 nos. Steel Lined
Diameter & Shape	
PS 1, PS 2 & PS 5 to PS 8	7.1m Circular
PS 3 & PS4	6.5m Circular
Design discharge/ Discharge 10%overload	190.47/ 209.5 cumec for PS 1 160/176 cumec each for PS 2 to 8
Vertical Height	127 m each
Horizontal Length	172 m each
Auxiliary unit Penstock	2.5 m Circular
Length	48 m
POWERHOUSE	
Type	Underground
Installed Capacity	Total - 1720 MW
	8 X 210 MW (Main Unit)
	1 x 40 MW (Auxiliary Unit)
Type of Turbine	Vertical Axis Francis
Number of Units	8 x210MW +1x 40 MW
Design discharge per unit for Main Units	160 cumec
Design discharge for Auxiliary Units	30.47cumec
Cavern Size	380m (L) x 24m (W) x 59.4 m (H)
Turbine centre line elevation Main unit & Auxiliary unit	EL 270.0m/ 271.30m
MIV/ Runner Removal Floor level Main unit & Auxiliary unit	EL 262.10m / 266.80m
Turbine Floor level Main unit & Auxiliary unit	EL 274.40m
Generator Floor level Main unit & Auxiliary unit	EL 278.9m
Operating Floor & Service Bay level Main unit & Auxiliary unit	EL 285.30m
Rated Net Head Main unit & Auxiliary unit	144.50 m
Annual Energy in 90% dependable year	6983.64 MU
Annual Energy in 90% dependable year with 95% machine availability	6869.92 MU
TRANSFORMER / GIS CAVERN	
Size	375m (L) x 16.5m (W) x 27m (H)
Transformer floor level	El. 285.30m
GIS floor level	El. 298.00m
DRAFT TUBE GATE OPERATION CHAMBER	
Size	276m (L) x 7m (W) x 12m (H)
Gate operation level	El. 311.00m
Gate Shafts	8 nos. 6.2m(L) X 1.5m(W) X48.7m(H)
	1no. 2.9m(L) X 1.5m(W) X48.7m(H)

Gate opening Size and numbers	
Main Unit	8 nos, 6.2m (W) x 7.5m (H)
Auxiliary unit	1 no. 2.9m ((W) 3.50m(H)
DOWNSTREAM SURGE CAVERN	
Size	276m (L) x 12m (W) x 42.85m (H)
Maximum Up Surge Water Surge Level	El. 297.50m
Minimum Down Surge Water Surge Level	El. 270.50 m
Unit TRT	
Unit TRT Size	
Main Unit	8 nos. 7.5 m Horse Shoe Shape
Auxiliary unit	1 no. 3.5 m Horse Shoe Shape
Length	210 to 240 m
Gate Numbers and Size	
Main Unit	8 nos., 6.2m (W) x 7.5m (H)
Auxiliary unit	1 no, 2.9m (W) 3.50m (H)
TAILRACE TUNNELS	
Number	
Main Unit	4
Auxiliary unit	1
Diameter & Shape	
Main Unit	10m, Horse Shoe Shape
Auxiliary unit	3.5m Horse Shoe Shape
Lengths	
Main Unit	300 to 450m
Auxiliary unit	333m
Level corresponding to PMF+GLOF	EI. 308.20m
Tail water Level all units running	El. 285.58m
Tail water Level all units running with discharge 10% overload	El. 285.80m
Tail water Level one unit running	El. 278.91m
Gate Numbers and Size	
Main Unit	2nos, 6m(W)x 10.0m(H) in each TRT
Auxiliary unit (Near Plunge Pool)	1 no. 3.5m (W) x 3.50m(H)- Auxiliary unit
Gate operation chamber for TRT	7.0m D-shape , EL310.2m
CONSTRUCTION ADIT/ ACCESS TUNNEL	
Adit to HRT & Pressure shaft top	7m x 9.5m. D-shaped, 457m length
Adit to pressure shaft top Erection gallery	7m x 9.5m. D-shaped, 466m length
Adit to lower horizontal Pressure Shaft	7m (W) x 9m (H) 580.5m length
Main Access Tunnel (MAT) to Powerhouse	8m dia. D-shaped, 800m long
Access Tunnel to Transformer Hall	8m dia. D-shaped, 95m long
Access Tunnel to Draft tube GOC	7m dia. D-shaped, 144m length
Adit to Powerhouse cavern top	7m dia. D -shape, 430m long
Adit to Transformer cavern top	7m dia. D- shape, 70m long
Adit to top of d/s surge cavern	7m dia. D-shaped, 110m long
Adit to TRT	7m dia. D-shaped, 625m
Adit to Gate operation chamber for Auxiliary unit TRT	7m dia. D-shaped, 75m long
POTHEAD YARD	
Type	Outdoor
Elevation	EI. 440.00m
Size	Pothead Yard 135m (L) x 50m (W) DG Area 65m (L) x 30.6m (W)

Source: DPR of Kamala HEP

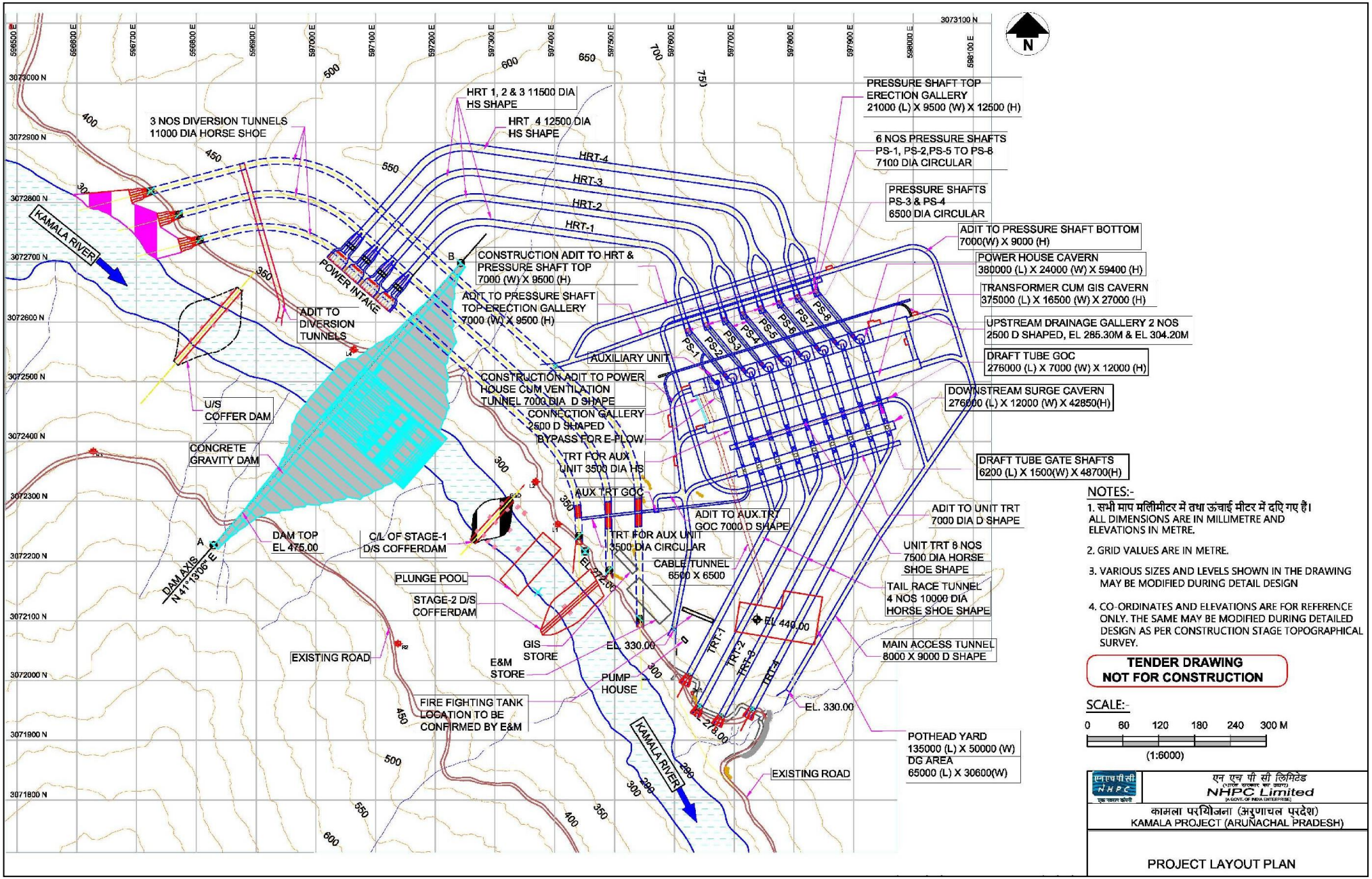

Figure 2: Project Layout of Kamala HEP *(Source: DPR of Kamala HEP)*

3.1 Land Requirement

The estimated land requirement during scoping clearance was 4001.67 ha. After detailed survey and investigation the land requirement for Kamala HEP is optimized to 3858.8904 ha, out of which, 3278.0904 ha is forest land and remaining 580.80 ha is non-forest land. The submergence area at FRL 455 m will cover 2665.00 ha.

Of the total 3858.8904 ha land required for the project, 116.00 ha is required temporarily and 3742.8904 ha is required for permanent acquisition. The details are shown in **Figure 3** & **Figure 4** and given in **Table 2** & **Table 3**.

Table 2: Permanent Land Requirement for the Project

S. No.	Description	Zone#	Area (ha)
1	Reservoir Submergence Area below FRL EL 455m	Zone-1A	2665.00
2	Reservoir Area between FRL EL 455m & EL 475m (Dam Top Level)	Zone-1B	669.89
3	Project Component Area	Zone-2	140.00
4	Project Establishment	Zone-3A*	20.00
		Zone-3B **	28.00
		Zone-3C	12.00
5	Clay Area inside Reservoir	Zone-4A to 4F***	0.00
6	Quarry Area inside Reservoir Area	Zone-4G to 4J***	0.00
7	Quarry Area outside Reservoir Area	Zone-5A	71.00
		Zone-5B	5.00
		Zone-5C	13.00
8	Dumping Area	Zone-6A1	4.00
		Zone-6A2	4.40
		Zone-6B	22.00
		Zone-6C	32.60
9	Explosive Magazine Complex	Zone-7	1.00
10	Permanent Roads	R-1, R-3, R-8, R-9, R-19	55.00
	Total Area		**3742.8904**

Source: DPR of Kamala HEP & survey conducted at Project

 # For location of Zones refer Figure 4

** Area already acquired by NHPC for Kamala HEP.*

*** Colony area zone '3B' of 28 ha is tentatively identified along with another area above the upstream area of dam location approximately 28 ha. Acquisition shall be subjected to government approval and other technical feasibility.*

**** Zone lies inside another zone for which the requirement of land is assessed separately*

Table 3: Temporary Land Required for the Project

S. No.	Description	Zone#	Area (ha)
1	Construction Facility Area		
	i) Left Bank Area	Zone-8A	25.0
	ii) Right Bank Area	Zone-8B	48.0
2	Contractor's Colonies	Zone-9A	3.0
		Zone-9B	4.0
		Zone-9C	10.0
3	Area for Temporary Roads		
	i) R-2	-	6..0
	ii) R-5A	-	2.0
	iii) R-7	-	18.0

S. No.	Description	Zone#	Area (ha)
4	Batching Mixing Plant	BMP-1	10.2*
		BMP-2	
5	Aggregate Processing Plant	APP-1	3.0*
		APP-2	15.0*
6	Stores	S-1	2.5*
		S-2	2.5*
		S-3	2.5*
7	Workshops	W-1	0.5*
		W-2	0.7*
		W-3	1.0*
8	Penstock Yard	PY	2.5*
	Total Area		**116.0**

 # For location of Zones refer Figure 4
** Zone lies inside another zone for which requirement of land assessed separately*

3.2 Proximity to Protected Area

Tale Wildlife Sanctuary (WLS) is the nearest protected area to the proposed project. The nearest component of the project, i.e., the Project Establishment Area located in Zone 3B, is at an aerial distance of about 7.6 km from the boundary of Tale WLS. Notably, no project component falls in any notified protected area. Since the project falls within a 10 km buffer zone from the boundary of Tale WLS and the final ESZ notification is pending, Wildlife Clearance is applicable.

4.0 DESCRIPTION OF THE ENVIRONMENT

Data on the existing environmental parameters in the study area delineated as per the approved ToR for EIA studies by MoEF&CC were collected to understand the present setting of the environment at the project site. The field surveys for the collection of primary data were conducted between December 2024 and July 2025 covering winter, pre-monsoon/summer, and Monsoon seasons to collect data/ information on various environmental and social parameters. A map of the study area prepared as per the approved ToR is given in **Figure 5**. The base line status is described briefly in the following sections.

4.1 Physiography

The study area exhibits a rugged physiography with elevations ranging from 259 to 2944 m. A significant portion of the area lies between 500 and 1500 m, indicating a predominance of mid-altitude terrain. The slope analysis shows that the terrain is largely moderately steep, with about 45% of the area falling in the steep slope category (15°–30°) and another 38% under steep slopes (30°–45°).

4.2 Land Use/ Land Cover

The land use/landcover classes were followed as per the National Remote Sensing Centre (NRSC) classification. The land use and land cover of the study area have been classified into ten categories. The predominant land cover is forest, with Very Dense Forest, Moderately Dense Forest and Open Forest together accounting for about 90% of the total area.

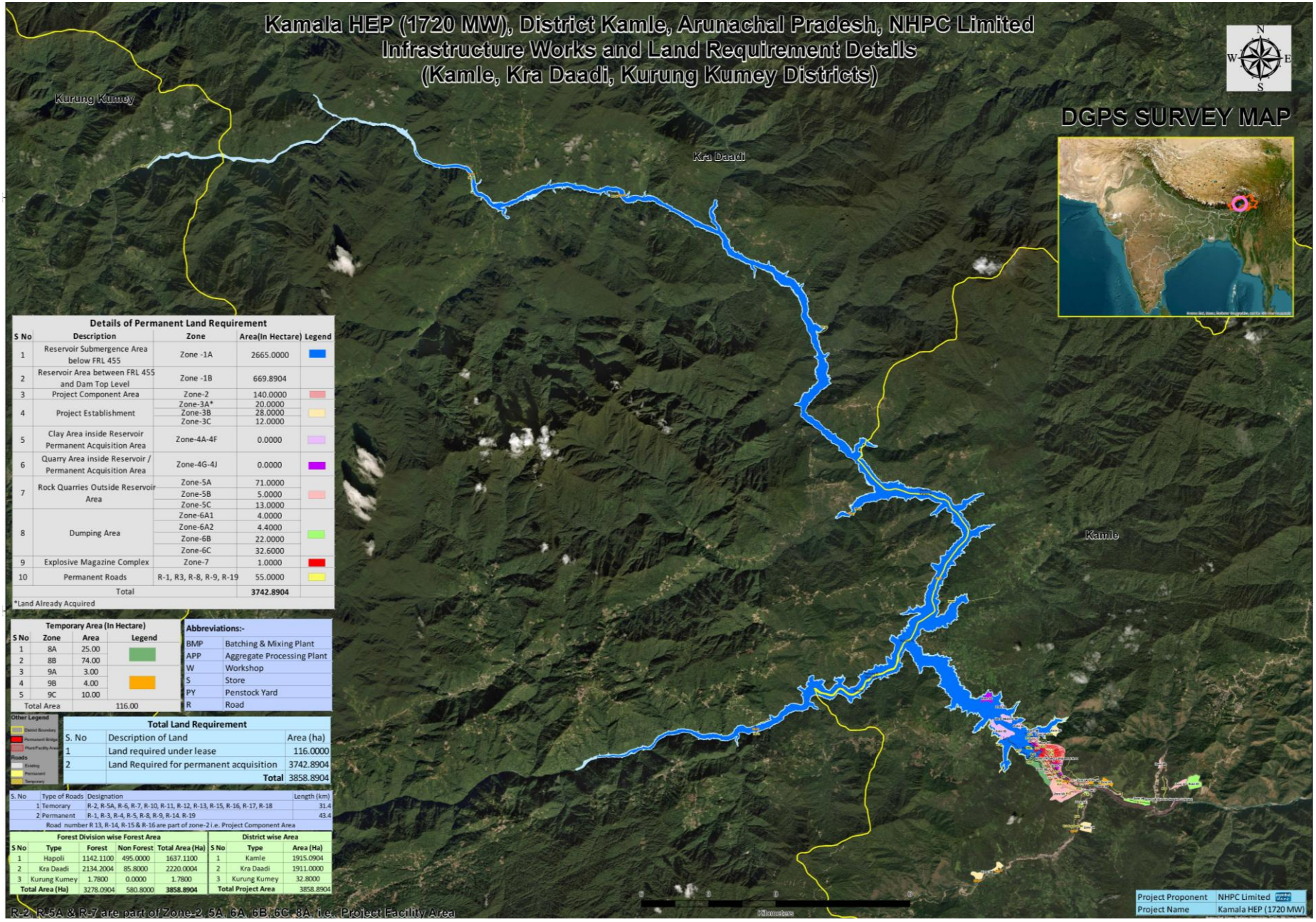

Figure 3: Map showing Infrastructure Works and Land Requirement Details of the Project

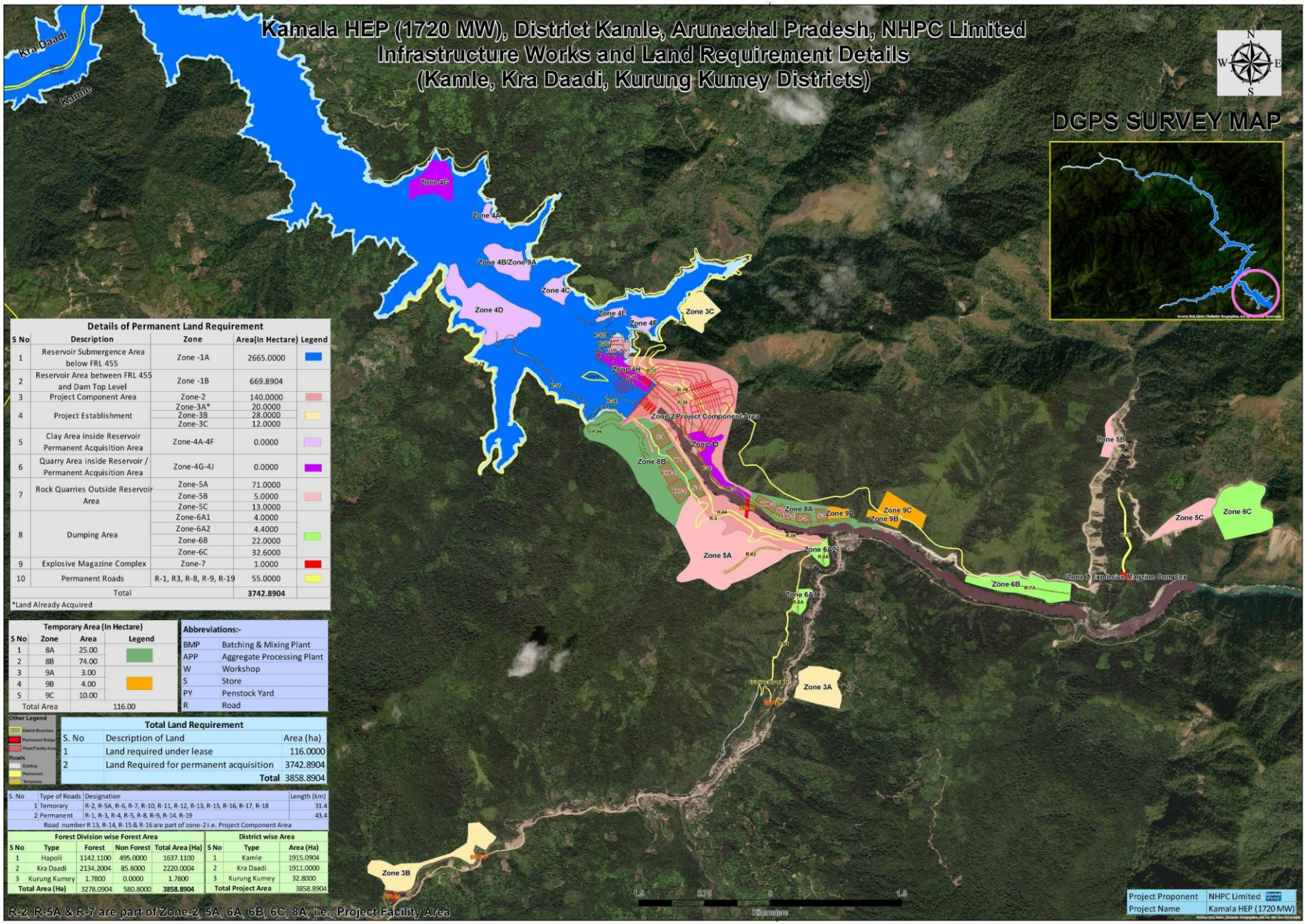

Figure 4: Map showing Infrastructure Works and Land Requirement Details of the Project

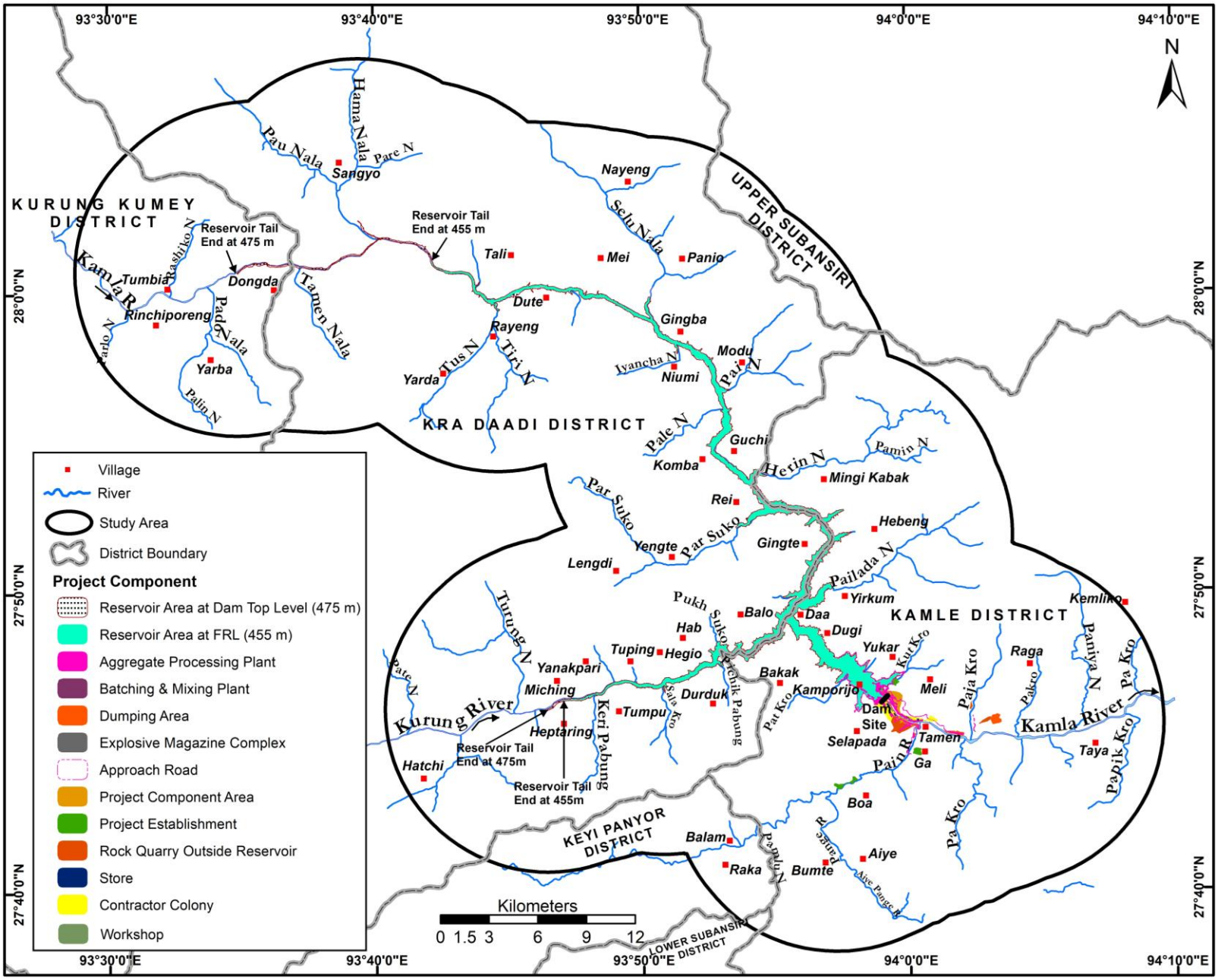

Figure 5: Map showing Study Area of the Project

4.3 Geology

The project area is located in Lesser Himalaya and exposed with gneisses belonging to Daporijo/Ziro Gneiss of Bomdila Group. The granite gneiss rockmass is exposed along the road section between Hapoli- Tamen and Daparijo in the Kamla/Subansiri valley. In the Kamla River basin, the rocks of Ziro Gneisses consist of mainly biotite gneiss, augen gneiss, garnetiferous sillimanite hornblende gneiss, mica schist, leucogranite and amphibolite. They are bounded by Sippi thrust in the north-west, which has brought the low grade metasedimentaries of Niumi Formation in juxtaposition with high grade gneisses. The south-east boundary is defined by unconformable contact with the low-grade metasedimentary rocks of Khetabari Group.

4.4 Seismicity

Project area falls under Seismic Zone-V as per India's seismic zoning map of India prepared by the Bureau of Indian Standard.

4.5 Hydrology

The project envisages construction of 216 m high dam from deepest foundation level on Kamla River with a gross storage capacity of 1927.6 MCM at FRL 455 m. The reservoir surface area at FRL is estimated as 26.65 Km2 whereas the reservoir length is around 65 km along Kamla River and 17 Km along tributary Kurung River.

CWC approved average 10-daily water availability series at project site for the period 1980-81 to 2009-10 is extended up to the year 2022-23 based on the observed discharge data at Tamen G&D site on River Kamla & observed discharge data of Gerukamukh G&D site on River Subansiri.

A design flood value Probable Maximum Flood (PMF) of 17416 m3/sec based on 2-day Probable Maximum Precipitation (PMP) and 24 hour temporal distribution has been approved by CWC, Hydrology (NE) Directorate vide their file no. T-11013/10//2023-HYD(NE) Dte, dated 08-12-2023.

Regarding sedimentation, as advised by CWC vide letter no. 4/372/2011-hyd (NE)/69, dated 14/3/12 & 4/372/2011-hyd(NE)/182, dated 06/7/12 during the clearance of KHPCEL DPR, sediment studies of the projects in North-East region are carried out with sediment rate of 1 mm/ year (including bed load) and the same has been adopted for Kamala HEP.

4.6 Meteorology

The study area of the project lies in the Kamle, Kra Daadi and Kurung Kumey districts of Arunachal Pradesh. The temperature in the study area starts rising in February and attains its maximum value in June and then decreases. The relative humidity is generally medium to high throughout the year, humidity in the study area is close to 90% in June, July, August and September. The area receives maximum rainfall during the south-west monsoon i.e., between June and September about 68.0 % of the annual average rainfall is received during these months. The wind speed is higher during the spring and summer as compared to the monsoon and winter periods. The average maximum wind speed of 2.7 m/s is observed during April month.

4.7 Soil

The study area features diverse soils, with the most common types being Fine Typic Palehumults (35.18%) and Fine-loamy, Umbric Dystrochrepts (17.66%). These soils vary in depth and drainage, ranging from coarse-loamy, moderately stony soils on steep slopes to fine-loamy, calcareous soils on gentler slopes. Physico-chemical properties reveal sandy clay loam and loamy sand textures, with bulk density between 1.82 to 1.97 g/cc, porosity from 37.2% to 44.7%, and water holding capacity between 36.8% and 42.3%.

Most of the area has neutral to slightly alkaline soil reaction and electrical conductivity (168–219 µS/cm). The soil fertility in the study area, in general, is based upon Nutrient Index in terms of NPK, the concentration of Nitrogen and Phosphorus is in 'Medium' range in all three seasons, whereas Potassium is found to be in 'Low' range in all the sites. Overall, the soils are in good health, with moderate fertility that supports vegetation and stable land productivity.

4.8 Ambient Air Quality

The air quality baseline of the project area, a predominantly rural zone with limited vehicular traffic and no industrial presence, indicates generally clean ambient air. Air quality was monitored over three seasons—winter, pre-monsoon, and monsoon at six locations. Key pollutants assessed were $PM_{2.5}$, PM_{10}, SO_2, and NO_2.

The results of monitoring show that $PM_{2.5}$, PM_{10}, SO2, and NO2 levels at all the sites are well within the Residential & Rural area permissible limits prescribed by National Ambient Air Quality Standard 2009 notified by CPCB. Air quality was also assessed using 24h averages of $PM_{2.5}$, PM_{10}, SO_2, and NO_2 levels in the AQI calculator of CPCB. The results shows that Ambient Air quality at all the monitored locations in the study area fall under 'Good' category.

4.9 Noise Quality

Noise levels were monitored across 08 sites in the study area, and results were compared with the Central Pollution Control Board (CPCB) norms under the Noise Pollution Rules, 2000. The daytime noise level was recorded beyond the permissible limit of residential area (55 dBA) at most of the sites due to movement of vehicles and operation of machineries for road construction. However, the noise level at night time remains below the permissible limit (45 dBA) as per Ambient Air Quality Standards in Respect of Noise is notified under Noise Pollution (Regulation and Control) Rules, 2000.

4.10 Traffic Density

Traffic volume was assessed through field surveys conducted in different seasons, with data recorded for heavy, light, and two-wheeled vehicles. The traffic movement was relatively higher in the pre-monsoon season as compared to the monsoon and winter seasons. Density of light motor vehicles like car, jeep & taxi and two-wheeler vehicle are higher in the area.

4.11 Water Quality

The data on water quality has been collected to evaluate surface and ground water quality in study area. The water quality in the study area, in general, is good. This is primarily due

to the absence of any industrial establishment and low population density in the project area.

A. Surface Water Quality

Surface water quality was assessed at eight locations across three seasons—winter, pre-monsoon, and monsoon. The pH varied from 7.25 to 8.12 in winter, 7.15 to 8.03 in pre-monsoon season and 7.36 to 8.17 in monsoon season. The value of Dissolved Oxygen ranged from 8.1 to 10.3 in winter season, 7.8 to 9.9 in pre-monsoon season and 9.2 to 10.8 in monsoon season. All the heavy metals were below detectable limits. The total coliform count detected below 2 MPN/100 ml in all the studied locations in all the seasons.

According to the Central Pollution Control Board's criteria, the water qualified as Class 'A', meaning it is suitable as a drinking water source without conventional treatment but requires disinfection. Based upon CPCB guidelines as well the calculated WQI, the water quality in the study area falls under 'Good' to 'Medium' category.

B. Ground Water Quality

Groundwater quality was analyzed from six sites. According to BIS standards for Drinking Water (2012), all the Groundwater samples collected from the study area fall within permissible limits of the same. Also, the Drinking Water Quality Index calculated for ground water DWQI, shows that all the samples of groundwater quality fall in 'Excellent' water quality class.

4.12 Floristic Diversity

Forest Types

According to Champion and Seth's classification, forest in the study area falls under tropical semi-evergreen forest, tropical moist deciduous forest, and Himalayan dry temperate forest.

Taxonomic Diversity

A total number of 155 plant species, belonging to 69 family, were sighted and recorded during the study period from the study area.

However, the detail inventory of plant species reported from the study area has been done based on primary survey and same has also been supplemented with available secondary data. Based on this, a list of 313 species of flowering plants (angiosperms), 12 species of gymnosperms, 11 species of pteridophytes, 5 species of bryophytes and 5 species of lichens were compiled which includes plant species growing mostly in forested areas, scrub land, near agricultural fields and settlements, abandoned land, etc. This list includes 77 species of trees, 65 species of shrubs, 121 species of herbs, 20 species of climbers and 30 species of grasses.

As per the Red Data Book of Indian Plants published by BSI, four RET plant species were reported from the study area. These species are *Coptis teeta* (Vulnerable), *Cymbidium eburneum* (Vulnerable), *Livistona jenkinsiana* (Endangered), and *Rhynchoglossum lazulinum* (Rare). No plant species endemic to the project study area has been reported.

As per the IUCN Red List criteria, among these species, *Adinandra griffithii* is listed under Critically Endangered (CR) category, *Canarium strictum, Coptis teeta* & *Taxus wallichiana* are listed under Endangered (EN) category, *Mesua ferrea, Piper pedicellatum, Picea brachytyla & Pinus merkusii* are listed under Vulnerable (VU), and *Abies spectabilis* is listed under Near Threatened (NT) category of IUCN ver. 2025-1.

Based on Wildlife (Protection) Amendment Act, 2022 (WPAA), *Coptis teeta* and *Taxus wallichiana* are listed as 'Schedule III' species.

Major agricultural crops grown include rice, maize, millet. In addition, villagers also practice horticulture, cultivating crops such as citrus, pineapple, banana, apple, walnut, and kiwi.

4.13 Faunal Diversity

The study area was surveyed for mammals, birds, butterflies, and herpetofauna across various habitat types and altitudes, despite difficult terrain restricting systematic transects.

Mammals: No direct sightings were recorded, but 44 species are reported from literature. During the faunal survey, no mammalian species were spotted. However, the local people have confirmed the presence of the species like Leopard, Black Bear, Sambar, Wild Boar, Golden Jackal, Northern Red Muntjak, and Rhesus macaque near forest area, agriculture fields and settlements.

Birds: Only 9 bird species were sighted during survey. On the basis of field survey and forest working plan, an inventory of 42 bird species has been prepared.

Butterflies: During the field surveys, 12 species of butterflies were recorded from the study area. While based on secondary literature and finding of field studies a list of 26 species has been prepared.

Herpetofauna: 12 reptile and 3 amphibian species were reported from the study area.

Conservation Status:

- Based on WPAA, 2022, 29 mammalians, 01 bird species, 2 species of herpetofauna species are listed under schedule I.
- As per the IUCN Red List of Threatened Species (version 2025-1), in case of mammals, Wild Dog (*Cuon alpinus*), Indian Pangolin (*Manis crassicaudata*), Hoolock Gibbon (*Hoolock hoolock*) and Slow Loris (*Nycticebus coucang*) are listed under Endangered (EN) category, Sambhar (*Rusa unicolor*), Clouded Leopard (*Neofelis nebulosa*), Fishing Cat (*Prionailurus viverrinus*), Hog Badger (*Arctonyx collaris*), Black Bear (*Ursus thibetanus*), Bear Cat (*Arctictis binturong*) and Stump Tailed Macaque (*Macaca arctoides*) are listed under Vulnerable (VU) category, and Goral (*Naemorhedus goral*), Asiatic Golden Cat (*Catopuma temminckii*), Common Leopard (*Panthera pardus*), Marbled Cat (*Pardofelis marmorata*), Assamese Macaque (*Macaca assamensis*) and Black Giant Squirrel (*Ratufa bicolor*) are listed under Near Threatened (NT) category.

Fish fauna: During field surveys, *Schizothorax richardsonii*, *Tor putitora, Opsarius barna, Silonia silondia, Glyptothorax ater* and *Neolissochilus hexagonolepis* were captured from Kamla River and its tributaries. The information on fish species reported from the study

area was also collected from the local fishermen, which was confirmed with the various secondary sources. A total of 11 species could be confirmed from the area.

The river features high water velocity and predominantly boulder substrates, especially during snowmelt and rains, which limit habitat diversity and aquatic fauna production. High turbidity and fine silt also negatively impact small fish and fry.

4.14 Social Environment

Socio-Economic Profile of the Study Area

The proposed project is located in Kamle, Kra Daadi and Kurung Kumey Districts of the state of Arunachal Pradesh. The project area is located in a remote and hilly terrain inhabited mainly by Scheduled Tribe (ST) communities. The Nyishi tribe is one of the largest tribes of Arunachal Pradesh and present in the proposed project study area.

The Kamala HEP will affect areas in three districts of Arunachal Pradesh: Kamle, Kra Daadi and Kurung Kumey. A total of 126 villages will be affected – 33 in Kamle, 87 in Kra Daadi and 6 in Kurung Kumey. The most affected area is Kamle district, where the submergence area includes three villages: Poku and Bam on the left bank of the Kamla River, and Kamporijo on the right bank. These villages are likely to be completely submerged.

As per the survey conducted in 2024-25 for the Kamla Hydroelectric Project, a total of 29932 people live in 126 project affected villages spread across Kamle, Kra Daadi and Kurung Kumey districts of Arunachal Pradesh. The overall sex ratio is 1061 females per 1000 males.

The literacy rate in the affected villages of Kamle district is 66.99%, whereas in Kra Daadi it is 63.88% and in Kurung Kumey it is 69.34%. The majority of households depend on agriculture and allied activities as their primary occupation. The cropping system is mainly rain-fed, as there is adequate rainfall during the monsoon months. There are no large-scale irrigation systems or canals. rearing of Pigs, Cows, goats and Mithun and poultry farming contribute to the local economy. Jhum cultivation (shifting cultivation) is the primary occupation here, where they grow millet, rice, maize and vegetables. Hunting and fishing are traditional activities, although these are restricted due to conservation laws.

4.15 Tourism, Religious and Archaeological Importance Places

The project area, inhabited primarily by the Nyishi community, has many culturally significant sites that are integral to their spiritual and social life. Although no officially recognized historical or archaeological sites exist, each village has cultural sites such as community festival sites, traditional fishing sites, prayer centers, churches, and ancestor memorials.

5.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1 Ambient Air Quality

Construction Phase

During the construction phase of the project, potential sources of air pollution include increased vehicular traffic, dust from unpaved roads, and combustion of fuelwood by

workers. Currently, the ambient air quality in the area is good, as there are no major pollution sources. However, construction activities such as operation of equipment, crushers, concrete batching plants, and material handling are expected to generate dust and gaseous emissions, which may temporarily affect air quality.

Diesel combustion in construction machinery primarily emits SO_2, and although particulate emissions are minimal due to low ash content, appropriate stack heights are needed to disperse emissions effectively. Crushers and other plants may emit fugitive dust, especially under windy conditions, potentially affecting nearby areas. Additionally, handling and storage of construction materials like sand and aggregates may release dust, particularly in dry weather. While such emissions are difficult to eliminate entirely, their impact can be minimized through proper mitigation and dust control measures.

Operation Phase

In hydroelectric power projects, air pollution occurs mainly during the project construction phase. During the operation phase, no major impacts are envisaged on the air environment.

5.2 Noise Environment

During the construction phase of the project, noise will be generated primarily from construction equipment, vehicles, blasting activities, and stationary equipment such as concrete batch plants. Equipment like excavators, loaders, and trucks are expected to produce noise levels ranging from 70-90 dB(A), which will decrease with distance. Blasting, limited to small sections of the tunnel and shaft, will create short-term noise levels of 75-85 dB(A) but will be mitigated by attenuation factors. Noise from increased vehicular traffic and equipment may affect nearby workers but is unlikely to impact villages, as there are no settlements near the work areas. Blasting may also cause ground vibrations, but measures like blast hole design and muffling mats will reduce these effects. Noise impacts on workers will be managed by limiting exposure times and providing protective equipment.

No major impacts are envisaged on the noise environment during the project operation phase.

5.3 Water Environment

Construction Phase

During the construction phase of the project, water pollution can arise from various sources such as effluents with high turbidity from crushers, sewage from labor camps, and the discharge of oil and grease from machinery. Wastewater from the labor camps, if untreated, could deteriorate water quality in nearby surface and groundwater sources, leading to waterborne diseases. The wastewater from construction plants and workshops, as well as the effluent from crushers, may contain suspended solids and pollutants like oil, which can affect water bodies if not treated. Muck disposal near water bodies can also increase turbidity, harming aquatic life, though efforts will be made to use muck for construction purposes to minimize this impact. Sewage treatment facilities will be set up in labor camps, and effluent from crushers will be treated before discharge to ensure compliance with environmental standards. Overall, the project will implement measures to control water pollution and mitigate any adverse effects.

Operation Phase

During operation phase the obstruction created by the dams would hinder the migration of fish species especially *Schizothorax* sp., *Tor* sp. and other migratory fish species. To mitigate and minimize the impact on aquatic life provision of E-flow has been made. Environment flow requirements during monsoon, pre & post monsoon and lean seasons are met by operating units (main and auxiliary unit) 24 hours in full/part load throughout the seasons, which will provide the sufficient discharge downstream side.

As per Cumulative Impact and Carrying Capacity Study (CI&CC) of Subansiri Basin including downstream impacts carried out by CWC in 2015, minimum environmental flow has been considered as 20% of the average flow in monsoon, pre & post monsoon and lean period of 90% dependable year respectively. Accordingly, minimum environmental flow of 28.45 cumec for lean months, 220.54 cumec for monsoon months and 93.14 cumec for the remaining months have been considered in the studies.

5.4 Land Environment

Construction Phase

The total land requirement for the Kamala HEP is estimated to be 3858.89 (3742.89 ha permanent and 116.0 ha temporary). Construction of various project components of Kamala HEP will result in permanent land-use changes, including loss of agricultural land and vegetation. These effects will be addressed through compensation to landowners and ecological restoration measures like greenbelt development and biodiversity conservation.

Construction activities will generate significant muck; some of which will be reused, while the rest will be disposed of in designated areas to avoid environmental issues such as water pollution and soil erosion.

Around 3000 temporary workers will generate various types of waste, including municipal, biomedical, hazardous, and e-waste. Waste management systems and sewage treatment will be implemented according to regulatory standards. Quarrying in hilly areas may cause long-term visual and geological impacts, which shall be mitigated by slope stabilization.

Operation Phase

During the operation phase, no impacts are envisaged on land as this phase will entail only operation and maintenance of turbines, powerhouse, etc.

5.5 Flora and Fauna

Construction Phase

Impact on Terrestrial Flora:

About 3278.09 ha forest land will be diverted for the construction of the project components.

During peak construction phase a population of around 3000 including technical staff and workers, are likely to congregate in the area.

Workers residing in the area may tend to use fuelwood, if no alternate fuel is provided. The workers may also tend to cut trees to meet their requirements for the construction of

houses and space heating. Thus, it is necessary to provide alternative fuel, training and awareness; and implement adequate surveillance to mitigate the adverse impacts on terrestrial flora during the project construction phase.

Impact on Terrestrial Fauna:

Forest in the area provide habitat for various wild animals, birds and other faunal species. On the basis of field survey and secondary literature, forest in the area provide habitat to 44 species of mammals, 42 species of birds and many other faunal species in wild as well as surrounding area. Increased human activity could also impact the terrestrial ecosystem. To mitigate these effects, controlled blasting and strict surveillance are proposed. Measures will also be taken during construction to minimize disturbance to both terrestrial and avian species, ensuring protection of the surrounding habitat.

Operation Phase

During the operation phase of Kamala HEP, environmental impacts are expected to be largely positive. Restoration of construction and muck disposal areas, greenbelt development, and implementation of biodiversity and wildlife conservation plans will enhance local flora and fauna. Increased greenery and moisture from the reservoir may benefit bird populations.

5.6 Fish Fauna

Project may impact aquatic life, particularly the migratory *Schizothorax* species found upstream and downstream of the dam. To mitigate these effects, a Fisheries Management Plan and provisions for maintaining environmental flow have been included in the Environmental Management Plan.

5.7 Socio-Economic Environment

a) Positive Impacts on Socio-Economic Environment

The Kamala HEP is expected to generate several socio-economic benefits for local communities during both construction and operation phases. These include increased employment opportunities through marginal jobs and petty contracts, enhanced local infrastructure such as education, healthcare, and transportation, and reduced reliance on natural resources due to alternative provisions by the developer. Additionally, large-scale investment and NHPC's local area development initiatives will contribute to overall regional upliftment.

b) Negative Impacts on Socio-Economic Environment

- Such projects, besides positive socio-economic impacts, may cause social and cultural conflicts due to influx of outside population during construction (about 8 years). Developers should work with local leaders, Panchayat, and NGOs to minimize these conflicts.
- Agriculture is the main source of livelihood; acquisition of agricultural land will impact social environment and may change occupational profiles.
- Land use changes will reduce grazing land, negatively affecting livestock and cattle rearing.
- Loss of wildlife habitat may lead to human-wildlife conflicts such as crop raiding and livestock loss.

  These impacts can be mitigated by implementing biodiversity conservation, wildlife management, and green belt development plans.

- Increased disease incidence risk exists due to large-scale labor influx, temporary camps, increased mobility, and local population participation/resettlement.
  However, these health impacts are expected to be short-term, limited only during construction phase.

6.0 Mitigation Measures For Air, Water And Noise Pollution

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

Control of Air Pollution:
To control air pollution, measures such as installing wet scrubbers on crushers, maintaining DG sets with standard chimney heights, water spraying on work sites, providing masks, ensuring proper ventilation, conducting regular air quality monitoring, and using controlled blasting are essential.

Control of Noise Pollution:
Control strategies for increase in Noise level include using acoustic enclosures for DG sets, providing hearing protection to workers, maintaining equipment regularly, using noise barriers, opting for quieter machinery, planting vegetation around residential areas, and monitoring ambient noise at regular intervals.

Control of Water Pollution:
To mitigate the impact of construction activities on water quality, septic tanks, soak pits, settling tanks, and grease traps should be installed. Oil interceptors must be used at fueling and washing zones, and wastewater should be treated per environmental guidelines to prevent contamination.

A lump sum budget **Rs. 160.00 lakh** (**@Rs. 20.00 lakh/year for 8 years**) has been proposed for the mitigation measures for control of air, noise and water pollution during project construction phase.

7.0 ENVIRONMENTAL MONITORING PROGRAMME

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

Environment monitoring is proposed for a period of 8 years commensurate with the construction period of the project. If the construction period is extended, the monitoring period will also be extended accordingly and additional budget provided. The monitoring program for the proposed project will be undertaken to meet the following objectives:

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

A total of **Rs. 414.0 lakh** have been allocated to implement various activities envisaged under Environmental Monitoring Programme.

8.0 ADDITIONAL STUDIES

8.1 Resettlement & Rehabilitation Plan

The total land to be acquired/diverted for the project is 3858.8904 ha, out of which 116.00 ha is required under lease and 3742.8904 ha is required for permanent acquisition.

Land required for the project is spread over 3 districts viz. Kamle, Kra Daadi and Kurung Kumey. Kamle has 33 affected villages, Kra Daadi has 87 affected villages and Kurung Kumey has 6 affected villages. Draft SIA study has identified 5440 Project Affected Families (PAFs). Out of the 5440 PAFs, 1391 PAFs belongs to Kamle district, 3954 PAFs belongs to Kra Daadi district and 95 PAFs belongs to Kurung Kumey district.

The present R&R plan has been prepared for the purpose of EIA study only. The plan addresses the compensation package as per the provisions of RFCTLARR, 2013.

The financial requirement for implementation of the Rehabilitation and Resettlement plan and Economic Development Package works out to be **Rs. 394.00 crore**. This is budgetary estimate and actual estimate as prepared by the district administration.

8.2 Corporate Environment Responsibility

A provisional budget of **Rs 30.00 crore** has been allocated for Corporate Environment Responsibility activities in the project-affected region. The specific activities will be finalized based on feedback from public consultations and in coordination with local authorities.

8.3 Public Consultation

On completion of draft EIA report and its executive summary in English and vernacular language, report will be submitted to Arunachal Pradesh State Pollution Control Board to initiate the process of Public Consultation. On completion of Public Consultation process, major issues raised during Public Consultation process and response will be covered in this section.

9.0 PROJECT BENEFITS

Hydropower is a clean, renewable energy source that provides reliable peaking power, enhancing grid stability. It helps to meet the country's growing energy demand sustainably and offers additional benefits like tourism and recreation. Also, the proposed project drive socio-economic development by improving healthcare, education, communication, and infrastructure, benefiting local communities. They create job opportunities and promote new markets, overall improving the quality of life in the project area.

10.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

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

NHPC Limited is the project proponent/implementing agency for the entire scheme. The overall responsibility for implementation of the EMP measures rests with NHPC Limited

through the implementing agency and their contractors. The Environment Manager of NHPC Limited reporting directly to the project head shall ensure the coordination and implementation of the EMP measures.

10.1 Catchment Area Treatment Plan

The Catchment Area Treatment (CAT) plan focuses on controlling erosion in the catchment area of a water resource project to prolong the reservoir's lifespan. Erosion can significantly reduce reservoir life, so preventive measures are essential for stabilizing the catchment.

For the Kamala HEP, the total free draining catchment area thus calculated comes out to be 4462.56 sq km (446256.07 ha). The plan involves analysing erosion characteristics of the terrain and recommending measures to reduce erosion.

The CAT plan has already been approved by the State Forest Department. The estimated cost of implementation of Catchment Area Treatment Plan for the free draining catchment area as defined above is **Rs. 5726.05 lakh**, of which Rs. 1252.52 lakh has been kept for Hapoli Forest Division, Rs. 3112.33 lakh has been kept for Kra Daadi Forest Division and Rs. 1361.20 lakh has been kept for Kurung Kumey Forest Division.

10.2 Compensatory Afforestation Plan

Total forest land requirement for diversion for non-forest use i.e. for the construction of Kamala HEP is 3278.0904 ha. Application for forest clearance vide proposal number: FP/AR/HYD/IRRIG/ 469328/2024 dated 04.04.2025 has been submitted.

Compensatory afforestation is proposed to be undertaken on 6556.180 ha (twice of affected forest area) in degraded forest land identified in Madhya Pradesh State. The total cost estimated for compensatory afforestation is Rs. 458.93 crore. In this context, Govt. of Madhya Pradesh has accorded Technical Sanction (TS) with respect to the implementation of Compensatory Afforestation to be undertaken.

The total cost of NPV for the diversion of 3278.0904 ha of forest land is Rs. 470.95 Crore.

The total cost of the compensatory afforestation plan, and NPV, is **Rs. 929.88 crore**.

10.3 Biodiversity Conservation & Wildlife Management Plan

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

Habitat conservation measures

- Afforestation and Enrichment plantation.
- Farm Forestry
- Development and Management of Grasslands
- Biological fence (Bamboo species, *Agave americana*, etc.) around the habitation and around the agriculture fields adjoining to forest area to control human wildlife conflict
- Awareness Programme

Management measures

- Prevention of Forest Fire: Training and Infrastructure facilities
- Rejuvenation and Maintenance of Natural Water Springs in Wildlife Habitat
- Support/Provision of veterinary care, cages, recuse centers, etc.
- Support to Monkey Sterilization Programme
- Training and capacity building
- Strengthening of infrastructural facilities of forest department
- Monitoring & evaluation

The proposed plan has already been approved by State Forest Department. The total budget allocated focusing on Biodiversity and Wildlife Conservation and Management Plan including conservation and management measures for Schedule-I species is **Rs. 3286.04 lakh**. State Forest Department shall be the executing agency for implementation of the proposed mitigation measure under Biodiversity Conservation and Wildlife Management Plan in the surrounding of proposed project site.

10.4 Fisheries Development Plan

The Fisheries Development Plan focuses on conserving and enhancing local fish resources while supporting community livelihoods.

Key objectives are enriching riverine fish fauna, stocking reservoirs, upgrading government fish farms, supporting private aquaculture, and enhancing local fishing skills. Major actions include:

- Continuing stocking of river stretches to boost biodiversity and fish populations.
- Regular reservoir stocking.
- Establishment of hatchery to supply quality fingerlings and support private farms.
- Promoting freshwater aquaculture with financial aid, training, and subsidized seed to generate employment and reduce wild stock pressure.
- Providing skill development and training to fishermen and women's groups.
- Maintaining mandatory environmental flow (11.32 cumec) downstream to sustain aquatic ecosystems.

The Arunachal Pradesh State Fisheries Department will lead implementation, monitoring, regulation enforcement, and management. The total budget is **Rs. 405.44 lakh,** allocated to these various interventions to sustain fisheries resources and enhance socio-economic benefits in the project area.

10.5 Muck Management Plan

The total muck generation from the Kamala HEP is estimated at approximately 87,08,800.0 Cum, out of which 26.92 lakh m^3 shall be utilized as construction material. Considering the swelling factor of 38% for net excavated material, the total quantity of muck to be disposed is worked out as 105.95 lakh m^3. A total of 63.00 ha of land has been allocated for muck disposal in 4 different locations. The total storage capacity of muck disposal sites is 198.93 lakh m^3.

The plan has been prepared in consultation with Forest department. The estimated cost for implementing the proposed slope stabilization and muck disposal measures (engineering

and biological) has been estimated as **Rs. 5936.74 lakh.**

10.6 Landscaping and Restoration of Construction Sites

The Landscaping and Restoration Plan for the proposed project focuses on mitigating impacts caused during construction, which includes extensive excavation, underground tunnelling, and setting up temporary job sites and colonies. Key activities like quarrying, construction of infrastructure, and road development will disrupt natural habitats, necessitating systematic restoration measures post-construction.

Overall, **Rs. 1997.50 lakh** is budgeted for the comprehensive restoration plan, to be implemented with the support of forest departments.

10.7 Reservoir RIM Treatment

Kamala HEP is proposed to be as a storage project with objective of power generation and flood moderation considering exclusive storage of 15m above FRL. At full reservoir level, the total submergence area is 2665.0 Ha. The slopes along the rim are steep and covered under dense forest. Erosion at certain degraded slopes are anticipated in the reservoir area.

Geological map of the reservoir area indicates that a large part of the reservoir rim is occupied by hard and competent gneissic rock. In general, the reservoir rim appears to be stable, no large landslides or potential unstable zones except for a few small slides around reservoir rim and along the road cuts have been observed in the area.

For stabilization of slopes various engineering and bio-engineering measures have been made under Reservoir Rim Treatment Plan. The afforestation and enrichment plantation along the rim is proposed under Catchment Area Treatment Plan (CAT Plan) approved by State Forest Department The cost of various activities involved in reservoir rim treatment plan is **Rs. 514.50 lakh**.

10.8 Green Belt Development

The Green Belt Development Plan for proposed project focuses on environmental enhancement through plantations along roadsides, dam and powerhouse sites, crusher areas, colonies, and office complexes. In addition to plantation of approx. 20,000 saplings proposed on restored muck disposal sites (45 ha), around 3,000 trees will be planted over 6.0 ha area proposed under green belt development plan.

To ensure the supply of plant material proposed under green belt development plan financial provision has been kept for strengthening and upgradation of forest nurseries in the area. The total cost for the plan, including nursery development and maintenance, is estimated at **Rs. 182.50 lakh**.

10.9 Sanitation and Solid Waste Management

Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management for disposal. The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed as per the SPCB guidelines. Various aspects of solid waste management include:

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

The waste generated from the project area will be collected, segregated and disposed off in line with the provisions laid down in Solid Waste Management Rules, 2016. Additionally, provision is kept for reclamation of the landfill, for a Sewage Treatment Plant (15 KLD) and two covered mini trucks for transportation of waste material and their operational costs. Further provisions are kept for awareness and training programs and for tools and implements.

A total budget of **Rs. 395.80 lakh** has been proposed for the Solid Waste Management Plan

10.10 Public Health Delivery System

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

- Ambulance: 2 no. with all the basic Medicare facilities and small DG set, etc. to cater for villages in the project area.
- Budget for running the ambulance including driver, fuel and maintenance for 8 years.
- Two first-aid post including sheds, furniture and basic equipment.
- Budget for running the first aid posts including cost of medico, para-medico/Nurses and attendant, consumables, etc. for 8 years.
- Budget for strengthening existing medical facilities.
- Budget for Health Awareness/ Vaccination Camps for 8 years.

Budgetary estimates for public health delivery system to be implemented have been worked out as **Rs. 448.00 lakh.**

10.11 Energy Conservation Measures

The existing facilities will become insufficient for supply of kitchen fuel for the migrant population during the construction of the project. Therefore, the project authorities would make adequate arrangements such as Community kitchen, Supply of Kitchen fuel, efficient cooking facilities and solar lantern either directly by developer or through contractor to reduce the pressure on natural resources in the project area and minimize impacts on this count. A total budget of **Rs. 478.00** lakh have been proposed under Energy Conservation Plan.

10.12 Labour Management Plan for their Health and Safety

Construction work has many associated risks and health impacts for the workers who are directly exposed to such health and safety risks. Therefore, there is a need to prepare complete health and safety documents for workers either by project proponent/contractor and proponent shall ensure its implementation. A detailed plan will be prepared covering the above activities before start of construction work. A tentative budget of **Rs**. **147.00 lakh** for labour management have been proposed under EMP.

10.13 Disaster Management Plan

Dam break analysis for Kamala HEP has been carried out for following hydrodynamic simulations due to occurrence of:

- Design flood with Dam break with initial reservoir level at FRL of the dam
- Design flood without dam in place (virgin condition)

From the result of Dam Break Modeling, it is evident that in worst-case scenarios of FRL, up to about 39.5 km d/s of the Dam (upto MDDL level of 181 m of Lower Subansiri Project), flood wave elevation to the maximum reaches in about 2.25 hour from start of breach thus having very little time for rescue, hence Disaster Management Plan should concentrate on preventive actions and emergency preparedness, rescue action planning and implementation of same. In case of Dam break scenario, 4 villages are likely to be partially affected.

The estimated total cost of execution of disaster management plan including the equipment would be **Rs. 800.0 lakh**.

10.14 Watershed Development Plan

As per the scope of work outlined in the ToR for the Watershed Development Plan, area comprises of 10 km radius of the project was demarcated. This area measures 2,070.88 sq. km. Upon analysis, it was found that approx. 77% of this area falls under the free draining catchment area of the Kamala HEP, while the remaining 23% lies within the free draining catchment area of the Subansiri Lower HEP.

The major components of Watershed Development Works, particularly Biological Measures and Soil & Water Conservation Measures, have already been comprehensively covered under these CAT Plans. Additionally, under the CAT Plan for Kamala HEP budgetary provision of Rs. 16.05 Crore has been made to include the other components of Watershed Development Plan such as Entry Point, Livelihood Activities, Production System & Micro Enterprise, Monitoring & Evaluation etc.

Given the overlap between the area proposed for the Watershed Development Plan and the areas already covered under the CAT Plans for Kamala and Subansiri Lower HEPs, as well as the sparsely population across the region, it is evident that adequate watershed development measures have already been planned and/or implemented.

11.0 SUMMARY OF COST

The capital and recurring costs involved for implementation of Environmental Management Plan for the Project is **Rs. 63291.57 lakh** as summarized in **Table 4**. Cost of Compensatory Afforestation and Net Present Value (**Rs. 92988.00 lakh**) estimated as a part of forest diversion is summarized in **Table 5**.

Table 4: Cost for Implementing Environmental Management Plan

S. No.	EMP COMPONENTS	Capital Cost (Rs. in lakh)	Recurring Cost (Rs. in lakh)								Total Cost (Rs. in lakh)
			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	
1	Catchment Area Treatment Plan	5726.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**5726.05**
3	Biodiversity Conservation & Wildlife Conservation Plan	3286.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**3286.04**
4	Fisheries Development Plan	405.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**405.44**
5	Muck Dumping and Management Plan	423.00	1855.10	1639.60	927.75	245.83	221.10	222.61	201.60	200.15	**5936.74**
6	Landscaping, Restoration of Construction Sites	15.00	99.12	99.12	297.38	396.50	594.75	198.25	198.25	99.13	**1997.50**
7	Reservoir Rim Treatment Plan	514.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**514.50**
8	Green Belt Development Plan	0.00	5.00	5.00	18.00	25.50	36.00	55.00	20.00	18.00	**182.50**
9	Sanitation and Solid Waste Management Plan	158.00	29.75	29.75	29.75	29.75	29.70	29.70	29.70	29.70	**395.80**
10	Public Health Delivery System	120.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00	**448.00**
11	Energy Conservation Measures	81.00	49.63	49.63	49.63	49.63	49.62	49.62	49.62	49.62	**478.00**
12	Labour Management Plan	35.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	**147.00**
13	Disaster Management Plan	600.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	**800.00**
14	Pollution Control and Mitigation Measures	0.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	**160.00**
15	Environmental Monitoring Program	0.00	51.75	51.75	51.75	51.75	51.75	51.75	51.75	51.75	**414.00**
16	Rehabilitation and Resettlement Plan	39400.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**39400.00**
17	Corporate Environment Responsibility (CER)	3000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**3000.00**
	Total	**53764.03**	**2190.35**	**1974.85**	**1474.26**	**898.96**	**1082.92**	**706.93**	**650.92**	**548.35**	**63291.57**

Table 5: Cost for Compensatory Afforestation and Net Present Value

S. No.	Other Components*	Capital Cost (Rs. in lakh)
1	Compensatory Afforestation	45893.00
2	Net Present Value (NPV)	47095.00
	Total	**92988.00**

* As per Part-II of forest diversion proposal