Greenko Energies Private Limited
CIN: U40109TG2000FTC034990

GEPL/DFO-EDS reply/SPSP/230804 **Dated 04.08.2023**

To

Deputy Conservator of Forests
Baran Territorial Forest Division
Rajasthan

Sub: Diversion of 407.8227 Ha (Old extent-413.9002 Ha). forest land for the development of Shahpur (1800 MW) Pumped Storage Project by M/s Greenko Energies Private Limited (GEPL) in Baran Territorial Forest Division, Baran District of Rajasthan State (Online Proposal No. FP/RJ/HYD/121439/2021)-reg

Ref: Your Office EDS letter dated 04.08.2023.

Dear Sir,

With reference to above mentioned subject matter, reply to the observations of O/o PCCF Jaipur communicated vide your above referred EDS letter is herewith submitted for your kind consideration and further necessary action.

Thanking you,
Yours faithfully,

For **Greenko Energies Pvt. Ltd.**

Authorized Signatory

Encl: As above

Regd. Office: Plot No.1071, Road No.44, Jubilee Hills, Hyderabad-500033, Telangana, Ph: 040-40301100, Fax: 040-40301101, Email: info@greenkogroup.com

Reply to EDS raised by O/o Jaipur vide letter dated 04.08.2023 regarding diversion of forest land for the construction of Shahpur Pumped Storage Project (1800 MW) by M/s Greenko Energies Private Limited, Hyderabad in Baran Forest Division, Baran District of Rajasthan State (Online proposal No. FP/RJ/HYD/121439/2021).

#	Observation	Remarks
1	In the proposal by the Deputy Conservator of Forests, the crop density has been marked as 0.39 while in the proposed area it is proposed to give compartment-wise canopy density.	• Reply to be furnished by DCF, Baran.
2	In the proposal by the Deputy Conservator of Forests, 57 hectares of forest area is sensitive to soil erosion, but no measures have been mentioned to remove it.	• Mitigation measure to control soil erosion have been considered under catchment area treatment plan prepared (CAT Plan) and copy of same is enclosed at **Annexure-I.** Further UA undertakes to implement any other safeguard measures as suggested by concerned DCF.
3	The legal status of the proposed forest area/Conservation reserve status and recommendations have not been made in the site inspection report by the Deputy Forest Conservator of Forests.	• Reply to be furnished by DCF, Baran.
4	Non-forest land sub-forest conservator Iganap stage by the user agency in the proposal. It is being given in the area under Jaisalmer, so ensure that all actions related to non-forest land such as compensatory tree plantation (non-forest land and residual plant forest land) are done according to the guidelines of the Government of India. Accordingly, it is proposed to remove all other compensation schemes by attaching KML file, DGPS Map, CA Scheme and suitability certificate (individually patch wise)	• Reply to be furnished by DCF, Baran.
5	It is not clear on what basis the tree plantation has been presented by the Deputy Conservator of Forests in RDF in 615 hectares. The Chief Conservator of Forests, Kota, in his recommendation, should prepare and attach a plan for	• Reply to be furnished by DCF, Baran.

#	Observation	Remarks
	preparing a mixed forest in the equivalent forest land adjacent to the proposed diverted forest land.	
6	The proposed area is a part of Conservation Reserve, the said fact has not been mentioned anywhere by the Deputy Conservator of Forests, while it has been mentioned by the Chief Conservator of Forests, Kota. Due to the proposed forest area being in the Conservation Reserve, the permission of the Chief Wildlife Warden is necessary as per the rules.	• Reply to be furnished by DCF, Baran.
7	The proposed area is a part of the protected area, so five times the NPV will be payable as per rules.	As per the Circular No.5-3/2011-FC(Vol-I) dated 6th January, 2022 of MoEF&CC NPV shall be charged to the extent of ten times of the normal NPV payable in the case of National Parks and five times in the case of Sanctuaries. Since the proposed area for diversion for the present project does not fall in the above categories, it is requested that normal NPV is applicable in the present case.
8	The proposal has been described by the User Agency as Site Specific, which cannot be accepted. Examination and analysis (forest land and technical parameters) of various options made in the proposed project is proposed to be uploaded.	Detailed note is attached as **Annexure-2**
9	In the Cost Benefit Analysis, a profit of 967 crores has been marked for earning a revenue of 1974 crores per year, but it is not clear that after earning a revenue of 1974 crores per year for 99 years, the profit will be only 987 crores. Will happen	Revised Cost Benefit analysis is enclosed as **Annexure-3**.
10	Status part of Environment Clearance. It is proposed to be updated.	Obtaining Environment Clearance is in process.

Reply to EDS raised by O/o Jaipur vide letter dated 04.08.2023 regarding diversion of forest land for the construction of Shahpur Pumped Storage Project (1800 MW) by M/s Greenko Energies Private Limited, Hyderabad in Baran Forest Division, Baran District of Rajasthan State (Online proposal No. FP/RJ/HYD/121439/2021).

#	Observation	Remarks
11	According to condition number 8 and 13 in the TOR issued in order of environmental approval, Conservation Plan and Biodiversity Plan have been sought, which have not been attached online.	Conservation plan and Biodiversity plan are attached as **Annexure-4** to this reply.
12	Water will be taken from the Kuno river for the above proposal, for this the permission of the Water Resources Department is attached in hard copy but it is proposed to be uploaded in the offline part.	Permission from WRD department to draw water from Kuno river has been uploaded in Part-I (reply to EDS dated 25.08.2021) of FC proposal.
13	The proposed reservoir in the project will be built on the tributaries and drains of the Kuno river, whose catchment area will also come in the proposal. There is no mention of the calculation of catchment area and its treatment.	Catchment area has been assessed and CAT plan has been prepared and given in enclosed **Annexure-1.** The same is also uploaded at section. M of the Part-I.

N. Gopi Krushna

Gopi Krushna N
Deputy General Manager (DGM)
Authorised Signatory
Greenko Energies Private Limited

Date: 04-08-2023
Place: Hyderabad

Gopi Krushna Nikku
Authorised Signatory

CATCHMENT AREA TREATMENT PLAN

FOR

SHAHPUR STANDALONE PUMPED STORAGE PROJECT

SUBMITTED TO

Greenko Energies Pvt. Ltd.

Greenko Hub, # 13, Hitech City,
Madhapur, Hyderabad-500081

PREPARED BY

R S Envirolink Technologies Pvt. Ltd.

403, BESTECH CHAMBER,
B-BLOCK, SUSHANT LOK-I, GURGAON
PH. +91-124-4295383; www.rstechnologies.co.in

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1.0 INTRODUCTION

1.1 General

Shahpur Standalone Pumped Storage Project (PSP) with an installed capacity of 1800 MW / 10800 MWH storage capacity is located at Shahabad Tehsil, Baran District, Rajasthan. It envisages creation of upper reservoir & lower reservoir which are located away from all existing natural river systems and have negligible catchment areas. The project sites are accessible from NH-76 road close to Mahuri Khera from where Shahpur village road takes off; and is at a distance of approximately 6 Km. Nearest railhead is Baran Railway Station, about 77 kms from project site and nearest Airport is Gwalior Airport, about 200 km from project site The powerhouse is located near Shahpur village, which is in Shahabad Tehsil of Baran district.

This scheme envisages non-consumptive re-utilization of water by re-circulation. The water from the proposed lower reservoir will be pumped up and stored in the proposed upper Reservoir and will be utilized for power generation. The Geographical co-ordinates of the proposed upper reservoir are at longitude 77° 10' 55.78"E and latitude is 25° 11' 25.21"N and that of proposed lower reservoir are 25°11'40.00"N and 77° 11' 50.00"E. The project location map is enclosed as **Figure 1**.

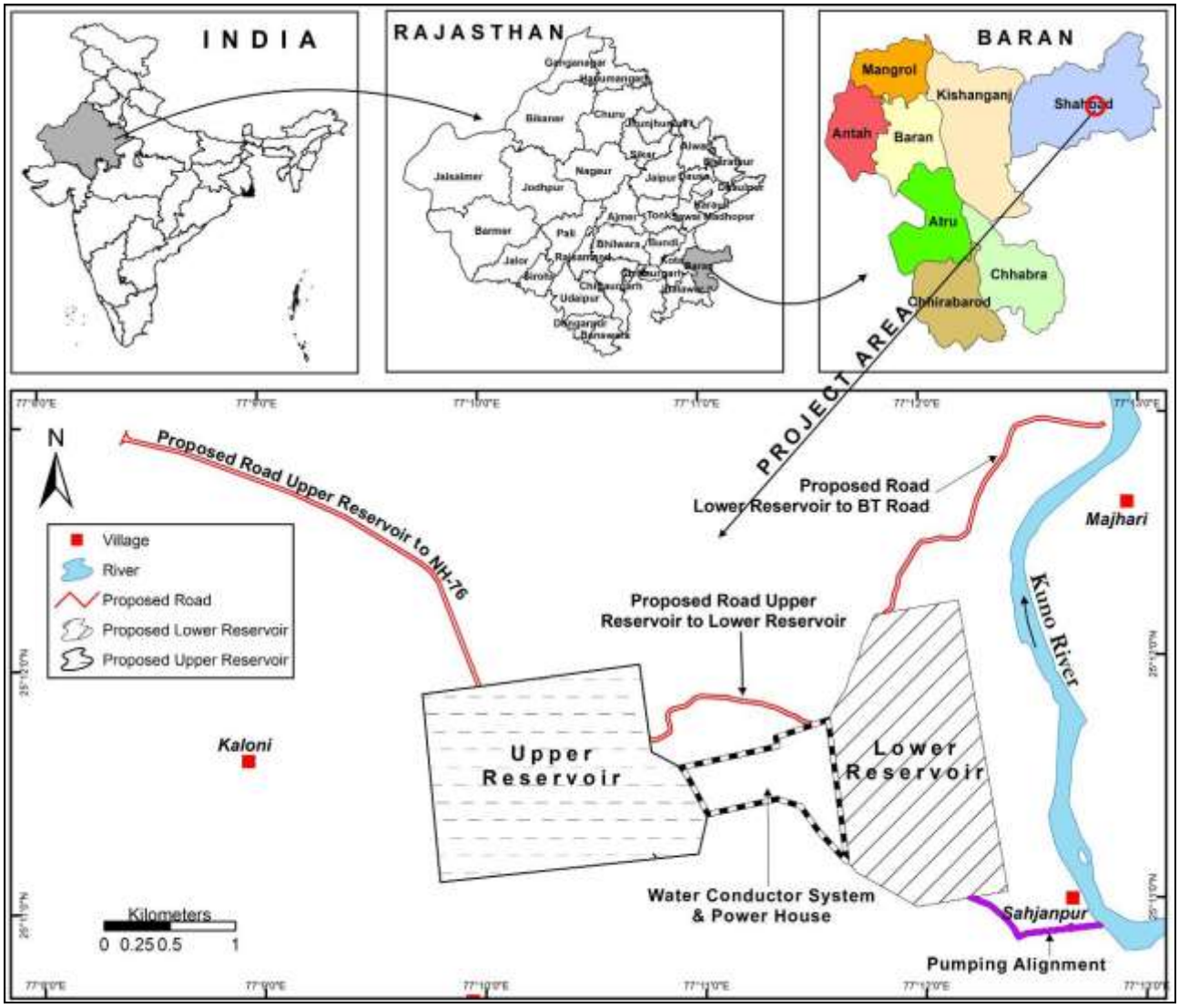


Figure 1: Location Map of Shahpur Standalone Pumped Storage Project

The Shahpur Standalone Pumped Storage Project envisages construction of both upper reservoir and lower reservoir in Baran district of Rajasthan and involves construction of rockfill embankment with avg height of 24.5 m for the length of 5309 m for creation of Shahpur PSP upper reservoir with 1.21 TMC gross capacity and construction of rockfill embankment with avg height of 26.5 m for the length of 2937 m for creation of Shahpur PSP lower reservoir with 1.05 TMC gross capacity. Total 6 numbers of Independent Head Race Pipe / Pressure Shaft with one pressure Tunnel bifurcating into two-unit pressure tunnel convey water between Lower and Upper reservoirs. Surface Power/Pump House will be located at about 830 m from the intake structure and shall be equipped with six vertical shaft reversible Francis type units composed each of a generator/motor and a turbine/pump having generating/pumping capacity of 300 & 150 MW/330 & 165MW.

1.2 Salient Features

The salient features of the proposed Shahpur Standalone Pumped Storage Project are given in **Table 1**.

Table 1: Salient Features of Shahpur Standalone Pumped Storage Project

1		Name of the Project	Shahpur Standalone Pumped Storage Project (5 x 300 MW + 2 x 150 MW)
2		**Location**	
	a	Country	India
	b	State	Rajasthan
	c	District	Baran
	d	Village near Powerhouse	Shahpur
3		**Geographical Co-Ordinates**	
	a	Shahpur Standalone PSP Upper Reservoir- (Now Proposed)	
		Latitude	25°11'25.21"N
		Longitude	77°10'55.78"E
	b	Shahpur Standalone PSP Lower Reservoir - (Now Proposed)	
		Latitude	25°11'40.00"N
		Longitude	77°11'50.00"E
4		**Access to Project Site**	
	a	Airport	Gwalior Airport – 200 km from project site
	b	Railway Station	Baran Railway Station, 77 km from project site
	c	Road	NH 76 – 6Kms
	d	Port	Kandla Port - 980 km from project site
5		**Project**	
	a	Type	Standalone Pumped Storage Project
	b	Storage Capacity	10800 MWH
	c	Rating	1800 MW
	d	Peak Operation Duration	6 hours
6		**Shahpur Standalone PSP - Upper Reservoir**	
	a	Live Storage	1.01 TMC (28.60 MCM)
	b	Dead Storage	0.20 TMC (5.66 TMC)
	c	Gross Storage	1.21 TMC (34.28 TMC)
7		**Upper Reservoir**	
	a	Full Reservoir level (FRL)	EL 507.00 m

	b	Min. Draw Down Level (MDDL)	EL 490.00 m
	c	Top Bund Level (TBL)	EL 510.00 m
	d	Type of Embankment	Asphalt Faced Rockfill Embankment
	e	Max. Height of Embankment	30 m
	f	Average Height of Embankment	24.5 m
	g	Length at the top of Embankment	5309 m
	h	Top width of the Embankment	10.0 m
	i	Type of Power Block	Gates with Concrete Breast Walls
	j	Top Level of Power Block	510.00 m
	k	Maximum Height of Power Block	38.5 m
	l	Length at the top of Power Block	162.0 m
	m	Top width of Road at Power Block	10.0 m
8		**Shahpur Standalone PSP - Lower Reservoir**	
	a	Live Storage	1.01 TMC (28.32 MCM)
	b	Dead Storage	0.05 TMC (1.42 MCM)
	c	Gross Storage	1.05 TMC (29.74 MCM)
9		**Lower Reservoir**	
	a	Full Reservoir level (FRL)	EL 349.00 m
	b	Min. Draw Down Level (MDDL)	EL 328.00 m
	c	Top Bund Level (TBL)	EL 352.00 m
	d	Type of Embankment	Asphalt Faced Rockfill Embankment
	e	Average Height of Embankment	26.5 m
	f	Length of Embankment	2937 m
10		**Intake Structure**	
	a	Type	Diffuser Type
	b	No. of Vents	3 nos.
	c	Size of Each Intake	24.00 m (W) x 11.2 m (H) including piers
	d	Length of each Intake	38.98 m (covered with RCC slab at top up to Intake Gate)
	e	Elevation of Intake center line	EL 476.30 m
	f	Elevation of Intake bottom	EL 472.55 m
	g	Design Discharge of each Intake (Turbine mode)	220.04 cumec for 300 MW Unit and 220.50 cumec for 150 MW Units
	h	Trash rack type	Vertical with inclination of 15°
	i	Size of Trash Rack	3 nos. of 7.00 m (W) x 11.60 m (Inclined Height) for each unit
	j	Numbers & Size of Intake Service Gate	6 nos. of 6.20 m (W) x 7.50 m (H)
	k	Numbers & Size of Intake Emergency Gate	1 set – 6.20 m (W) x 7.50 m (H) with Moving Gantry Crane
11		**Head Race Pipe /Pressure Shafts**	
	a	Type	Finished steel lined - circular
	b	Number of Head Race Pipe / Pressure Shaft	Total 6 No. of Independent Head Race Pipe / Pressure Shaft with one pressure Tunnel bifurcating into two unit pressure tunnel
	c	Diameter of Horizontal Pressure Tunnel	7.5 m
	d	Diameter of unit Pressure Tunnel	5.3 m
	e	Length of Head Race Pipe / Pressure Shaft	830 m (6 nos.) Length of Head Race Pipe from Intake to Vertical Pressure Shaft - 663 m Length of Vertical Pressure Shaft - 72 m Length of Horizontal Pressure Tunnel - 95 m
	f	Length of Unit Pressure Tunnel	About 50 m each

	g	Design Discharge of each Head race Pipe / Pressure Shaft	220.04 cumec for 300 MW unit and 220.50 cumec for 150 MW units
	h	Design Discharge of each unit Pressure Tunnel	110.25 cumec
	i	Maximum velocity in the Head Race Pipe / Pressure shaft	4.99 m/sec
	j	Maximum velocity in the Unit Pressure Tunnel	4.99 m/sec
12		**Powerhouse**	
	a	Type	Surface Pit Type Powerhouse
	b	Centre line of Unit	EL 298.0 m
	c	Dimensions (Excluding service bay)	196.166 m (L) x 28.5 m (W) x 61.5 m (H)
	d	Size of Service Bay	40 m (L) x 28.5 m (W)
	e	Service Bay Level	EL 313.72 m
	f	Size of Unloading Bay	25m (L) x 28.5 m (W)
	g	Unloading Bay Level	EL 336.70 m
13		**Tail Race Tunnel**	
	a	Type & Shape	Concrete Lined – Circular
	b	Number of Tunnels	7 Nos.
	c	Dia. of Tunnel for 300 MW Unit	8.50 m
	d	Dia. of Tunnel for 150 MW Unit	6.20 m
	e	Length of the Tunnel	179 m for 8.5 m dia as well as for 6.2 m dia
	f	Design Discharge for 300 MW Unit	220.04 cumec
	g	Design Discharge for 150 MW Unit	110.25 cumec
14		**Tailrace Outlet**	
	a	Type	Diffuser Type
	b	No. of Outlet	7 Nos.
	c	Size of each outlet	For 300 MW Unit - 24.00 m (W) x 12.50 m (H) including piers For 150 MW Unit - 18.00 m (W) x 9.0 m (H) including piers
	d	Length of each Outlet	31.40 m (covered with RCC slab at top up to Intake Gate)
	e	Elevation of outlet center line	For 300 MW Unit - EL + 315.30 m For 150 MW Unit - EL + 314.15 m
	f	Elevation of Outlet bottom	EL + 311.05 m for 300 MW as well as 150 MW unit
	g	Trash rack Type	Vertical with inclination of 15°
	h	Size of Trash rack	For 300 MW Unit - 3 sets of 7.0 (W) x 12.94 m (Inclined Height) for each unit For 150 MW Unit - 3 sets of 5.0 (W) x 9.32 m (Inclined Height) for each unit
	i	Tailrace outlet Service Gate	5 nos. of 6.00 m (W) x 8.50 m (H) and 2 nos. of 4.20 m (W) x 6.20 m (H)
	j	Tail Race outlet Emergency Gate	1 set - 6.00 m (W) x 8.50 m (H) 1 set - 4.20 m (W) x 6.20 m (H) with one common Gantry Crane
15		**Tailrace Channel**	
	a	Type	Trapezoidal shape with concrete lined
	b	Bed Width	140.0 m
	c	Length of channel	717 m
	d	Full Supply Depth	6.8 m
	e	Bed Slope	1:6400
	f	Side Slope	1H:6V
16		**Electro-Mechanical Equipment**	

	a	Pump Turbine	Francis type, vertical shaft reversible pump-turbine
	b	Total No of units	5 nos. (5 X 300 MW) + 2 nos. (2x150 MW)
	c	Total Design Discharge (Turbine Mode)	1320.70 cumec (5 x 220.04 cumec + 2 x 110.25 cumec)
	d	Rated Net Head in Turbine mode	154.73 m for 300 MW unit and 154.41 m for 150 MW unit
	I	**300 MW Turbines**	
	a	Total No of units	5 Units (All fixed Speed)
	b	Turbine Design Discharge	220.04 cumec
	c	Pump Capacity	330 MW
	d	Rated Pumping Head	162.56 m
	e	Rated Pump Discharge	190.96 cumec
	f	Synchronous Speed	187.50 rpm
	II	**150 MW Turbines**	
	a	Total No of units	2 Units (All Fixed Speed)
	b	Turbine Design Discharge	110.25 cumec
	c	Pump Capacity	165 MW
	d	Rated Pumping Head	163.21 m
	e	Rated Pump Discharge	95.10 cumec
	f	Synchronous Speed	250.00 rpm
	III	**Generator-Motor**	
	a	Type	Three (3) phases, alternating current synchronous generator motor semi umbrella type with vertical shaft
	b	Number of units	5 Units (5 x 300 MW) and 2 Units (2x150 MW)
	c	Rated Capacity	Generator – 300 MW & 150 MW Pump Input – 330 MW & 165 MW
	d	Rated Voltage	18.0 kV
	IV	**Main Power Transformer**	
	a	Type	Outdoor Single-Phase Power transformers with On Load Tap Changer (OLTC)
	b	Number of units	23 Nos. i.e., 3 nos. per unit & 2 no spare
	c	Rated Capacity of each unit	16 no. (3x5 Working +1 Spare) of Single Phase, 18 kV/400kV, 123 MVA and 7 no. (2 x 2 Working + 1 spare) of Single Phase, 18 kV/400kV, 62 MVA
	d	Rated Voltage	Primary – 18.0 kV; Secondary - 400 kV adjustable range of the secondary voltage: ±10% in steps of 1.25%
17		**400 KV Gas Insulated Switchgear**	
	a	Type of GIS	Indoor Type
	b	No. of GIS units	1 No.
	c	Location	Inside GIS building above ground
	d	Scheme	Double Bus Scheme with coupler and sectionalizer
18		**Power Evacuation**	
	a	Voltage Level (kV)	400 kV
	b	No. of Transmission Lines	One no. 400 kV double circuit transmission lines
	c	Conductor	Quad Moose
	d	Total Length	One 400 kV Double Circuit Transmission Line of length 75 km (approx.) from PSP will be connected to **400/765 kV PGCIL substation at New Shivpuri of Madya Pradesh State** for

			evacuation of stored power during generating mode and for supply of power during pumping mode.
19		**Estimated Cost-Cr**	
	a	Civil & Other works	4782.91
	b	E&M Works including Transmission	3096.20
	c	IDC & Others	1842.65
		Total Project Cost with IDC	9721.76

Source: Feasibility Report of Shahpur Standalone Pumped Storage Project

2.0 NEED FOR CATCHMENT AREA TREATMENT

It is a well-established fact that reservoirs formed by dams on rivers are subjected to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entrainment, transportation, deposition and compaction of sediment. The steady erosion and sediment in reservoir reduce its capacity, and thus affecting the water availability for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment adversely affects the land productivity in the area. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above-mentioned adverse effects of soil erosion in general for normal hydroelectric projects (run of the river schemes). However, in the instant case of pumped storage project which are located away from normal river course and involves no catchment area, CAT plan is not applicable. But considering the surrounding area which are prone to soil erosion, it was felt that preparation of CAT plan will helps to mitigate soil erosion around the project area.

Soil erosion can be defined as detachment, transportation and deposition of soil particles from one place to other by means of transporting agent like air, water or animals. Soil erosion is mainly affected by rainfall intensity and runoff, slope gradient and length, soil erodibility and vegetation cover (landuse pattern). Therefore, study of erosion and sediment yield from catchments are of great importance. Soil erosion leads to:

- loss in production potential
- reduction in infiltration rates
- reduction in water-holding capacity
- loss of nutrients
- increase in tillage operation costs
- reduction in water supply

To control the rate of soil erosion in the catchment, Catchment Area Treatment (CAT) is an ineluctable part. The CAT plan pertains to preparation of a management plan for treatment of erosion prone areas through adequate preventive measures. An effective CAT plan is a key factor to make the project eco-friendly and sustainable. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above mentioned adverse process of soil erosion. CAT plan essentially consists of following steps.

1. Calculation of soil erosion using Revised Universal Soil Loss Equation (RUSLE), combined with Remote Sensing (RS) and Geographic Information System (GIS) technologies.
2. Prioritizing the areas for treatment using Silt Yield Index (SYI).

3. Planning of suitable erosion control measures.
4. Cost estimation for CAT plan.

3.0 METHODOLOGY ADOPTED FOR THE STUDY

The various steps, covered in the study, are as follows:

- Defining study area
- Defining data requirement
- Data acquisition and preparation
- Output presentation

The above mentioned steps are briefly described in the following paragraphs:

3.1 Defining Study Area

Purpose of the study is preparation of CAT plan for the Catchment Area of Shahpur Standalone Pumped Storage Project. Since the project involves construction of two different reservoirs therefore catchment area of both the reservoirs has been considered as study area. The total catchment area of both the reservoirs is **6.48 sq km**. In order to plan watershed management and to formulate action plans it requires subwatershed delineation, therefore, catchment area was further delineated into subwatershed. For the delineation of subwatershed, Watershed Atlas of India prepared by Soil and Land Use Survey of India (SLUSI) has been referred.

Soil and Land Use Survey of India (SLUSI) has Watershed Atlas of India under digital environment using GIS and produced a Digital Watershed Atlas (DWA) where the delineation and codification of watersheds in the country has been undertaken in GIS environment. The delineation for DWS has been done in seven stages starting with Water Resource Regions and their subsequent division and subdivisions into Basins, Catchments, Subcatchments, Watersheds, Subwatersheds and Microwatersheds in decreasing size of the delineated hydrologic unit.

As per Watershed Atlas of India, catchment areas of both the reservoirs falls in a two subwatersheds. Catchment area of lower reservoir falls in a single subwatershed, coded as 2D1B5f. Whereas, catchment area of upper reservoir falls in two subwatersheds, coded as 2D1B5f and 2D1B5c. The nomenclature of the subwatersheds forming the catchment area has been assigned as follows: Region (2) “Ganges drainage”; Basin (2D) “Chambal”; Catchment (2D1) “Chambal up to Banas confluence”; Subcatchment (2D1B); Watershed (2D1B5) “Kunu”; Subwatershed 2D1B5c and 2D1B5f **(**refer **Figure 2)**.

3.2 Defining Data Requirement

Soil loss has been calculated through RUSLE (Revised Universal Soil Loss Equation) model which is computed by the following equation:

Soil Loss (A) = R*K*LS*C*P

Wherein;

A = Soil loss (Tons/ha/year)

R is Rainfall & Runoff Erosivity Factor (MJ mm/ha-1/h-1/year-1), which depends upon the annual average rainfall in mm. Data required for R factor is rainfall intensity.

K is Soil Erodibility Factor (Tons/ha/h/ha-1/MJ-1/mm-1), which depends on the organic matter, texture permeability and profile structure of the soil. Also, it is a constant value for each soil type. Data required for K factor is soil type.

LS is Topographic Factor (dimensionless) which depends upon flow accumulation and steepness and length of slope in the area. Data required for LS factor is slope length and slope gradient.

C = Vegetation Cover and Crop Management Factor (dimensionless), which is the ratio of bare soil to vegetation and non- photosynthetic material. It is a constant value for each land use category. Data required for C factor is land use/ land cover.

P is Conservation Supporting Practice Factor (dimensionless), which takes into account specific erosion control practices like contour bunding, bench terracing etc.

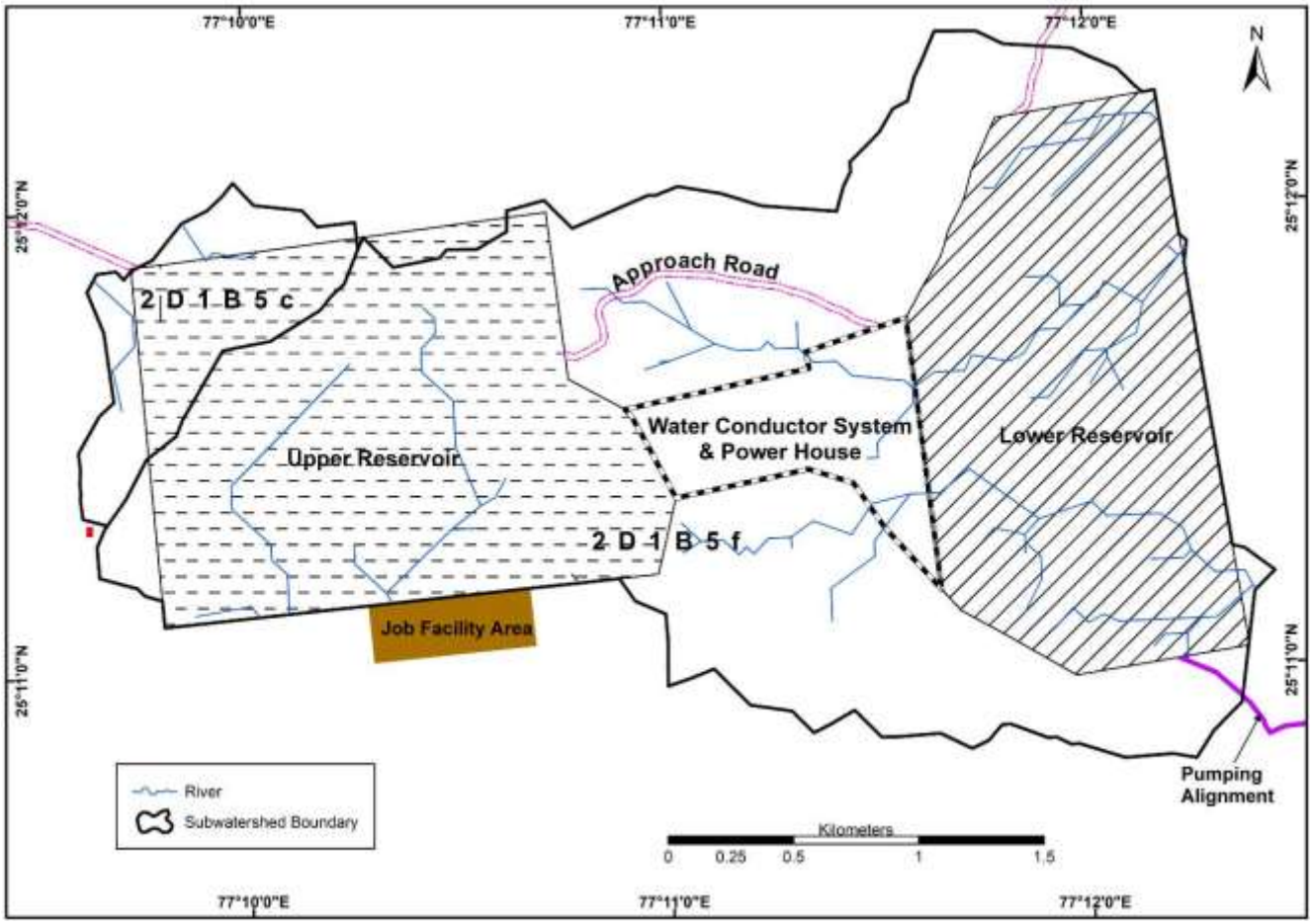


Figure 2: Catchment Area Map of Shahpur Standalone Pumped Storage Project

3.3 Data Acquisition and Preparation

The data on various aspects was collected from different sources. Soil map of the Catchment Area was prepared from soil map of Rajasthan procured from Regional Centre of National Bureau of Soil Survey & Land Use Planning (NBSS&LUP), New Delhi. For the preparation of DEM and preparation of Slope map, Shuttle Radar Topography Mission (SRTM) 3 Arc-Second

Global Digital Terrain Elevation Data (DTED) has been used. For the preparation of land use/ land cover, forest cover map prepared by Forest Survey of India, map prepared by National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO) of Dept. of Space with Partner Institutions viz., State Remote Sensing Application Centre, Dept. of S&T, Govt. of Rajasthan has been used. The rainfall data in the Catchment Area has been sourced from Climatic Research Unit (CRU), a component of the University of East Anglia and one of the leading institutions concerned with the study of natural and anthropogenic climate change.

3.3.1 Rainfall Erosivity (R) Factor

R factor is a function of the falling raindrop and rainfall intensity and is estimated as the product of the kinetic energy (E) of the raindrop and the maximum intensity of rainfall (I30) over duration of 30 min in a storm. The erosivity of rain is calculated for each storm, and these values are summed up for each year. In this study, the storm wise rainfall data were not available for the computation of rainfall erosivity factor (R); therefore, the relationship between seasonal value of R and average rainfall has been used. The rainfall erosivity factor has been defined as R = 81.5 + 0.38X, where, R is the average seasonal erosivity factor (MJ mm/ha^{-1}/h^{-1}/year^{-1}), and X is the annual average rainfall (mm).

For the estimation of rainfall erosivity in the Catchment Area, average rainfall of 10 years has been taken from the High-resolution gridded CRU datasets. In the absence of site specific periodic data, CRU data from the year 2011 to 2020 has been used for the calculation of R factor. In and around the Catchment Area, average rainfall of 10 years have been taken from the rain gauge station for the estimation of rainfall erosivity. The rainfall erosivity factor (R) has been calculated using equation R = 81.5 + 0.38X for annual average rainfall of observed and simulated data. The value of R i.e. 384.51 has been adopted in this study to calculate soil erosion using RUSLE.

3.3.2 Soil Erodibility (K) Factor

The K factor is an expression of the inherent erodibility of the soil or surface material at a particular site under standard experimental conditions. It is a function of the particle-size distribution, organic-matter content, structure, and permeability of the soil or surface material. Prior to deciding the K values, soil map for the area is prerequisite. Soil map procured from NBSS&LUP, Nagpur was digitized. Mapping Unit 351, characterised by deep, moderately well drained, fine soils on very gently sloping plateau with clayey surface, slight erosion covers 71.73% of the catchment area. Rest 28.27% of the catchment area is covered by Mapping Unit 340, characterised by rock-outcrops; associated with: shallow, well drained, loamy-skeletal soil, on very gently sloping foot slopes, severely eroded. Soil map has been shown in **Figure 3**. The legend for soil mapping unit classes is given in **Table 2**. As per the soil map of the Catchment Area, the soil can be classified in two categories. Shallow with loamy skeletal texture and severe erosion have high K value i.e. 0.325, because they are less susceptible to particle detachment and they produce runoff at high rates. Deep with fine texture and slight erosion have low K value i.e. 0.15.

Table 2: Description of Soil Mapping Units in the Catchment Area

Mapping Unit	Description	Taxonomic Classification	Area (ha)	Area (%)
340	Rock-outcrops; associated with: Shallow, well drained, loamy-skeletal soil, on very gently sloping foot slopes,	• Rock-outcrops • Lithic Ustochrepts	183.18	28.27

Mapping Unit	Description	Taxonomic Classification	Area (ha)	Area (%)
	severely eroded.			
351	Deep, moderately well drained, fine soils on very gently sloping plateau with clayey surface, slight erosion; associated with: Deep, well drained, fine soils, moderately eroded.	• Typic Chromusterts • Typic Chromusterts	464.82	71.73
	Total		**648.00**	**100**

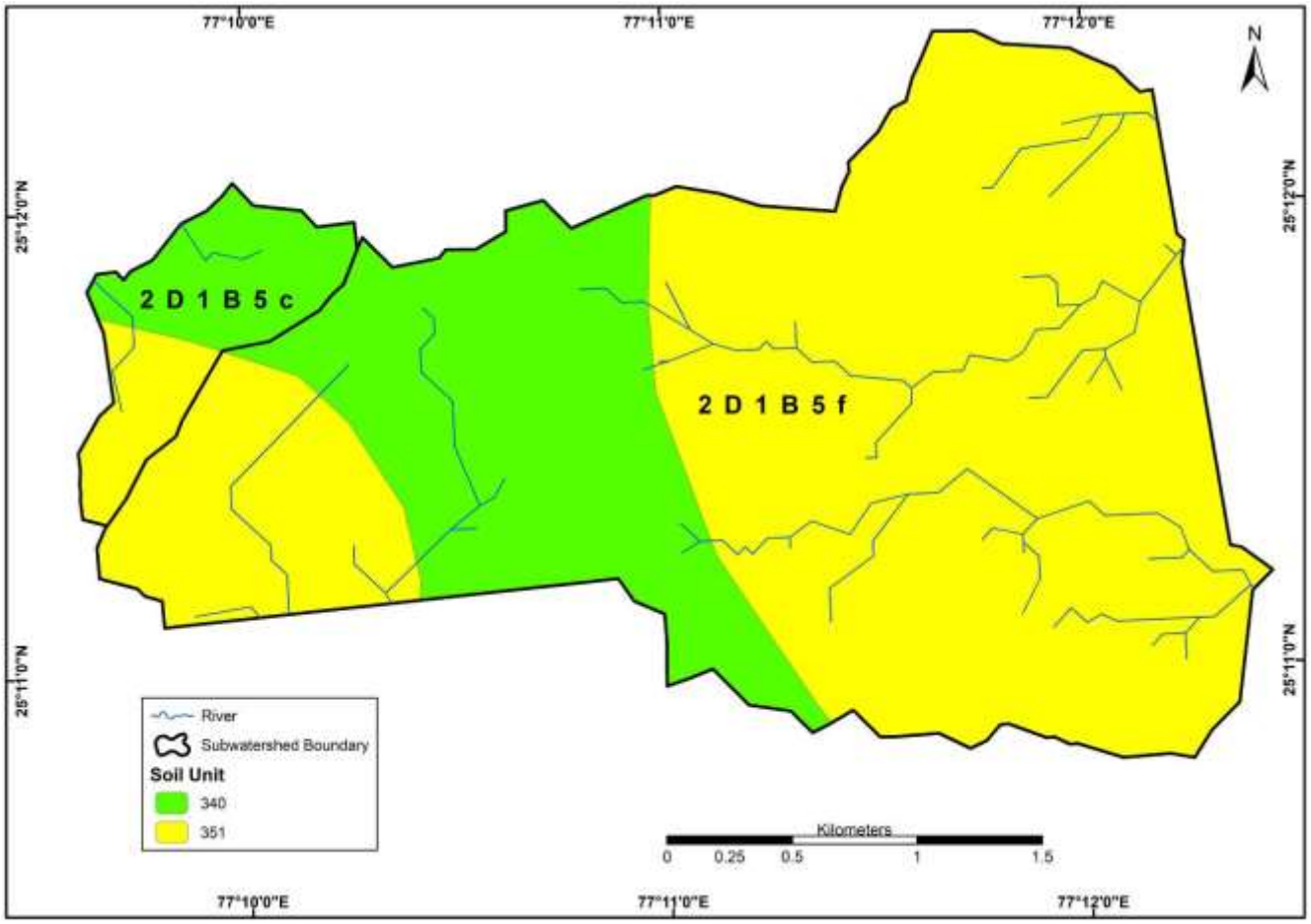


Figure 3: Soil Map of Catchment Area
(For details of Soil Unit legend refer Table 2)

3.3.3 Topographic (LS) Factor

The LS factor is an expression of the effect of topography, specifically hill slope length and steepness, on rates of soil loss at a particular site. The value of 'LS' increases as hill slope length and steepness increase, under the assumption that runoff accumulates and accelerates in the down-slope direction. Digital Elevation Model (DEM) and Slope of a particular area is prerequisite for LS factor. As already discussed, Shuttle Radar Topography Mission (SRTM) 3 Arc-Second Global Digital Terrain Elevation Data (DTED) has been used for DEM and the same DEM has been used for the preparation of slope map. The LS factor prepared for the Catchment Area is given at **Figure 4**.

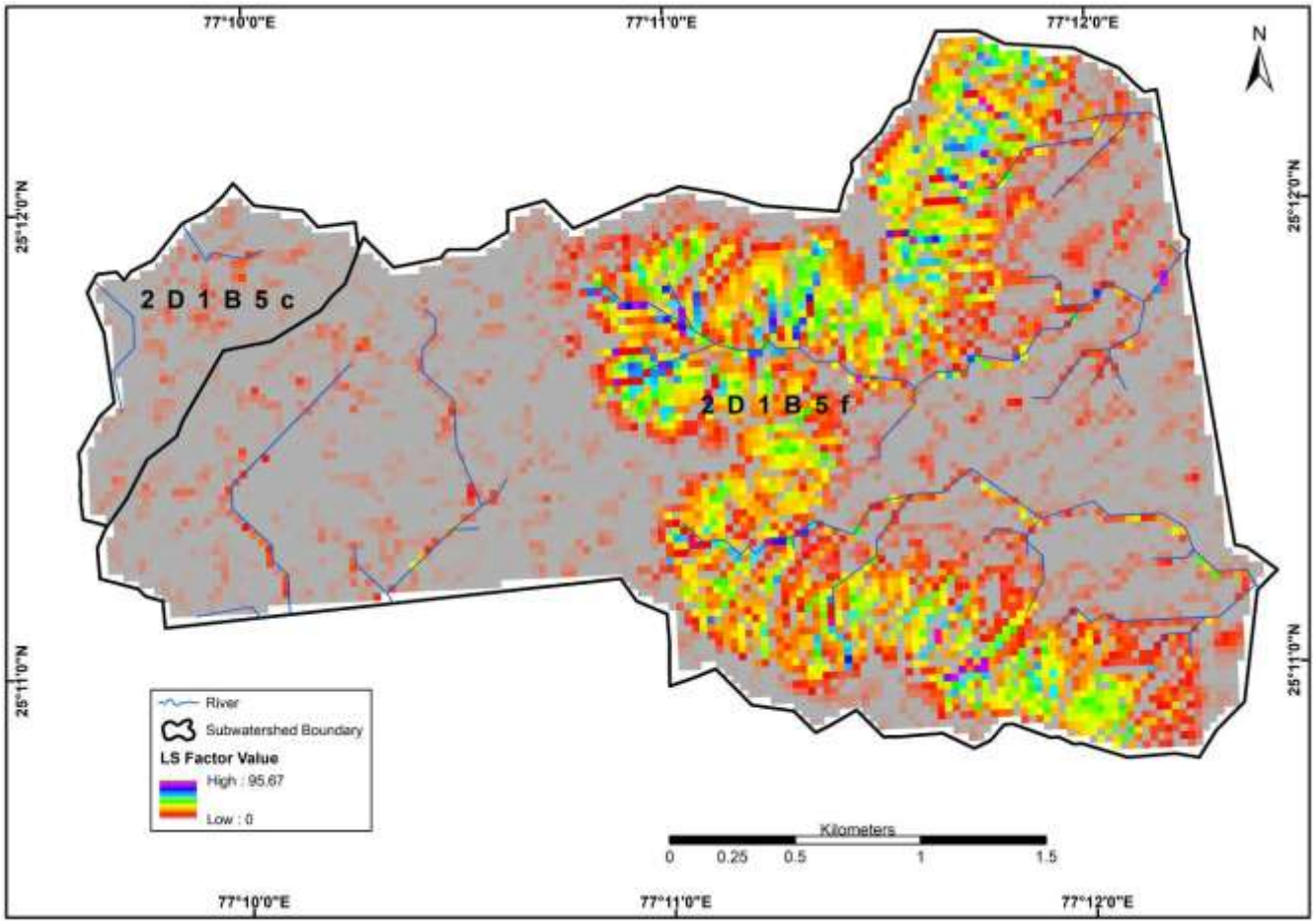


Figure 4: LS Factor Map of Catchment Area

3.3.4 Crop Management (C) Factor

The C factor is an expression of the effect of surface cover and roughness, soil biomass, and soil-disturbing activities on rates of soil loss at a particular site. The value of C decreases as surface cover and soil biomass increase, thus protecting the soil from rain splash and runoff. In the present study, forest cover map prepared by Forest Survey of India and land use/land cover map prepared by National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO) of Dept. of Space with Partner Institutions viz., State Remote Sensing Application Centre, Dept. of S&T, Govt. of Rajasthan has been used in the allocation of C factor for different land use classes.

The classified land use/ land cover map of the Catchment Area is shown as **Figure 5**. The land use/ land cover pattern of the Catchment Area has been given in **Table 3**. As can be seen from the map and table, the land use/ land cover pattern can be classified into six classes, out of these, majority of the area i.e. 41.04% is covered by Open Forest, followed by Moderately Dense Forest, covering 27.38%. Fallow Land is covering 12.92% of the area. Scrub Land is covering 11.78% of the area. Agricultural Land is covering 6.84% of the area. Rest 0.04% of the area is covered by Waterbody.

Table 3: Area Falling Under Different Land Use/ Land Cover Classes

Land use/ Land cover Classes	Area (ha)	Area (%)
Moderately Dense Forest	177.43	27.38
Open Forest	265.93	41.04
Scrub Land	76.36	11.78

Land use/ Land cover Classes	Area (ha)	Area (%)
Agricultural Land	44.31	6.84
Fallow Land	83.70	12.92
Waterbody	0.27	0.04
Total	**648**	**100**

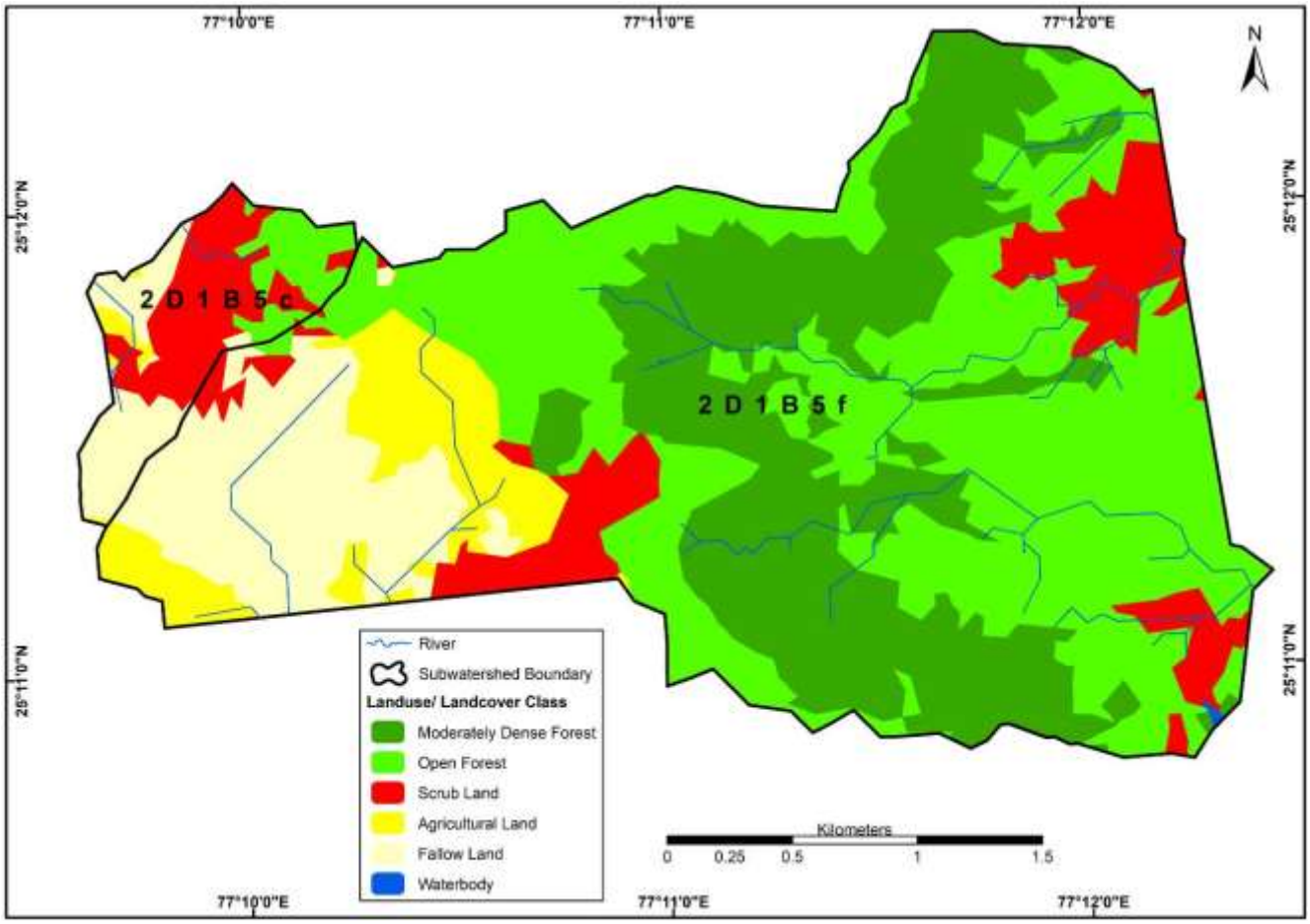


Figure 5: Land use/ Land cover Map of Catchment Area

3.3.5 Conservation Support Practice (P) Factor

The P factor is an expression of the effects of supporting conservation practices, such as contouring, buffer strips of vegetation, and terracing, on soil loss at a particular site. It is the ratio of soil loss with specific support practice to the corresponding loss with up-or down-slope cultivation. In the present study, the P factor has been considered as 1.

3.4 Output Presentation

A thematic map for soil loss of the Catchment Area has been prepared using RUSLE model mentioned in the above section. The Catchment Area was then demarcated into different soil erosion intensity mapping units or classes based upon the extent of soil loss (see **Table 4 & Figure 6**). The Catchment Area under different Erosion Intensity categories is given in **Table 4**. As can be seen from the figure and table, around 44% of the catchment area is prone to less than 1 tons/ha/annum soil erosion, i.e. under negligible erosion intensity category and around 5% of its area is prone to Severe and Very Severe soil erosion.

Table 4: Area falling under different Erosion Intensity Categories

S. No.	Soil loss in tons/hectare/annum	Erosion Intensity Category	Area (ha)	Area (%)
1	<1	Negligible	283.58	43.76
2	1-5	Slight	120.02	18.52
3	5-10	Very Low	63.90	9.86
4	10-20	Low	72.83	11.24
5	20-40	Moderate	75.68	11.68
6	40-80	Severe	25.86	3.99
7	>80	Very Severe	6.12	0.95
Total			**648.00**	**100**

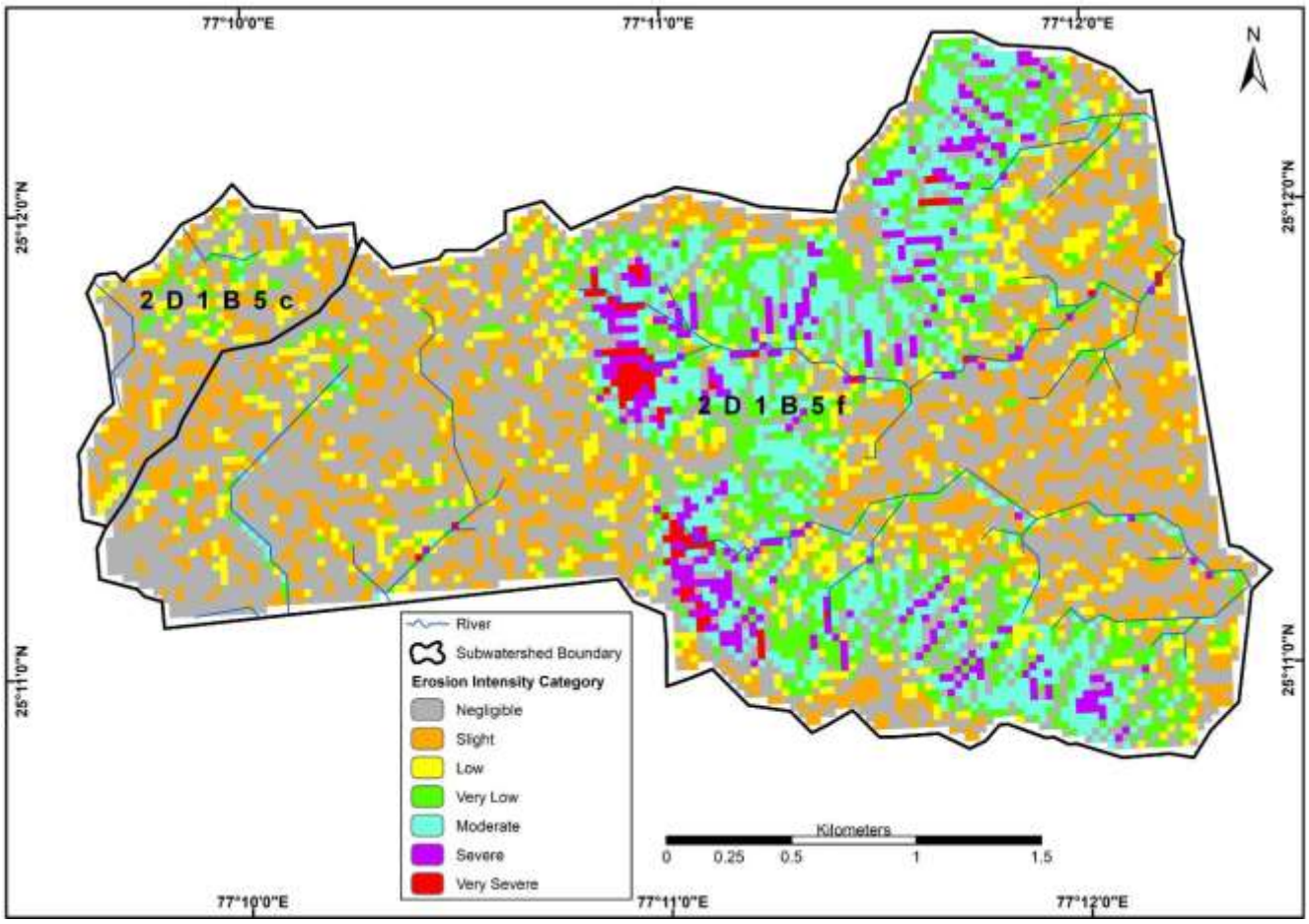


Figure 6: Erosion Intensity Map of Catchment Area

3.5 Prioritization

`Silt Yield Index' (SYI), method conceptualized by Soil and Land Use Survey of India (SLUSI) is being used for prioritization of smaller hydrologic units within river valley project areas. Since the catchment area is only 6.48 sq km and could be delineated into only two subwatersheds therefore, it is proposed to consider same priority for both the subwatersheds.

4.0 TREATMENT PLAN

4.1 Area to be taken up for Treatment

Areas under severe and very severe erosion intensity category will be taken up for treatment. To arrive at such an area, first of all areas under severe and very severe erosion intensity category were extracted, which comes out to be **31.98 ha** (refer **Table 5**). Thereafter, areas

under severe and very severe erosion intensity category falling within the proposed project components such as lower reservoir, upper reservoir, water conductor system, etc. were removed as once the project is constricted this area will not be available for treatment. The area thus arrived at and considered as treatable area comes out to be 25.91 ha (or say **26** ha).

From the map given at Figure 6 it can be seen that the areas under severe and very severe erosion intensity category falls under 2D1B5f subwatershed only. Further, the landuse and landcover classes falling inside this 25.91 ha of severe and very severe erosion intensity category area are Moderately Dense Forest (18.81 ha) and Open Forest (7.10 ha).

The period for implementing Catchment Area Treatment Plan interventions including maintenance has been taken as 7 years. It is proposed to prepare micro plans, establish administrative setup and implement other entry point activities in the first year itself, followed by implementation of treatment measures in second year. Maintenance period (only for biological measures) will be for subsequent 5 years.

4.2 Treatment Measures

Watershed management is the optimal use of soil and water resources within a given geographical area so as to enable sustainable production. It implies changes in land use, vegetative cover, and other structural and non-structural action that are taken in a watershed to achieve specific watershed management objectives. The overall objectives of watershed management programme are to:

- increase infiltration into soil;
- control excessive runoff;
- manage & utilize runoff for useful purpose.

4.2.1 Biological Measures

The biological measures would comprise of:

- Normal Afforestation
- Aided Natural Regeneration

4.2.1.1 Normal Afforestation

A well stocked forest is the best insurance against soil loss as well as for ecological rehabilitation. It is therefore proposed to increase the vegetation cover in the tract. For this, patches of scrub forest falling under severe and very severe erosion intensity category shall be brought under afforestation. The locality factors prevalent in the area such as fires, grazing etc. are fairly adverse to the establishment of plantations. Thus, special and intensive efforts are needed to ensure the success of afforestation work. Owing to the above enumeration factors, the plantation will require higher levels of maintenance also. This will include raising of multi-tier mixed vegetation of suitable local species. 1100 plants per hectare will be planted under this scheme. Planting will be done in pits. Earth work should be done well in advance. Plants should be healthy with strong stems. Planting should be done in June when the water supply starts. RCC fence posts with 4 strand barbed wire fencing, interlaced with thorny bushes will be done in the plantation areas. Further, it is assessed that it is essential to make provision for soil and moisture conservation measures in the areas proposed for afforestation. Provision had been made for undertaking various necessary soil and moisture

conservation measures in these areas. Provision is also made for five years maintenance of afforestation undertaken as part of the Sub-watershed management. For providing the maintenance it is assumed that mortality during first year will be 25 per cent and will reduce to 20 per cent during second year and to 15 per cent during third, fourth and fifth year. The unit cost for afforestation including maintenance cost for five years is estimated to be Rs 86,380 per ha consisting of Rs 58,900 for plantation and Rs 27,480 for maintenance for five years. The detailed estimate is furnished in **Annexure-I**. The area to be brought under normal afforestation is **7 ha**.

4.2.1.2 Aided Natural Regeneration

In moderately dense forests, conditions are conducive to natural regeneration provided some sort of assistance is provided. Such area shall be taken up under this component. The areas shall be closed to reduce biotic interference. Ground surface will be cleared of slash, debris and felling refuse to afford a clean seed bed to the falling seed. At certain places some soil raking may also have to be done to facilitate germination of seeds. Where natural regeneration is found deficient. It will be supplemented by artificial planting. Patch sowing in suitable areas may also be done. 250 plants per hectare will be planted under this scheme. The plantation will be maintained for subsequent five years. Wooden fence posts with 4 strand barbed wire fencing, interlaced with thorny bushes will be done in the plantation areas. The unit cost for assisted natural regeneration including maintenance cost for five years is estimated to be Rs. 39,240 per ha consisting of Rs. 25,700 for plantation and Rs. 13,540 for maintenance for five years. The detailed estimate is furnished in **Annexure-I**. The area to be brought under aided natural regeneration is **19 ha**.

4.2.2 Engineering Measures

Gullies in their upper reaches only must be treated to prevent further deepening and widening. The purpose of engineering measures is to reduce the gradient, reduce the flow velocity and protect the stream bank. The water is guided safely from a higher elevation to a lower elevation without causing erosion at the gully/nala bed and banks. The water pools behind the engineering promotes the percolation into the soils. Check dam/ check wall is one such engineering measure. Under the present CAT Plan, dry stone masonry check dams have been proposed. The detailed estimate is furnished in **Annexure-I**. The number of dry stone masonry check dams suggested are **10.**

5.0 OTHER COMPONENTS OF CAT PLAN

Apart from the biological and engineering treatment measures in the Catchment Area there are other aspects of the CAT Plan to be addressed and their cost included in the overall cost estimate of the plan. The charges for operational support, forest protection, social mobilization, documentation and publication, monitoring and evaluation and providing environmental services are some of the integral ingredients which have to be considered and included while formulating the CAT plans.

5.1 Administrative Charges

For an efficient management of forest resources, it is essential that operational support to the Forest Department is adequately developed. Similarly, in remote localities there are no places

for shelter for the staff, people and trekkers. Therefore, a budgetary provision of **Rs. 0.81 lakh** has been kept as administrative charges.

5.2 Provision for Micro Planning

The year-wise areas requiring treatment measures have been suggested but have not been marked. The spatial location of specific treatment to be carried out in the catchment area would require extensive detailing during the implementation of CAT and a provision for micro-planning has been made in the total CAT financial allocation. For this purpose, a provision of **Rs. 0.32 lakh** is being made.

5.3 Monitoring & Evaluation

Monitoring and evaluation will be undertaken as a part of project management. A process of self-evaluation at specified intervals of time will ensure the field level verification of suggested treatment measures and efficacy of the CAT plan.

The year-wise areas requiring treatment measures have been suggested but have not been marked. The spatial location of specific treatment to be carried out in the Catchment Area would require extensive detailing during the implementation of CAT and a provision for micro-planning has been made in the total CAT financial allocation. Thereafter, annual work plan would be prepared well in advance after undertaking initial ground surveys during micro-planning, specifying physical and financial targets, sites, locations and beneficiaries of each component of the project activity. Month-wise work schedule of various items of each component for the financial year would also be prepared in advance and its timely implementation would be ensured. Monthly progress report on all activities would be submitted by the Range Officers to Divisional Forest Officer. The monitoring committee shall be constituted at the project level for this purpose which too would monitor on a regular basis the quality and quantity of works being carried out under the CAT plan area. A provision of **Rs. 0.48 lakh** has been made for this component.

5.4 Contingencies

A provision of **Rs. 1.62 lakh** has been kept under this component for some leeway to adjust any unforeseen expenditure.

6.0 COST ESTIMATE

The estimated cost of implementation of Catchment Area Treatment Plan as defined above is **Rs. 19.39 lakh** and is given at **Table 5**. Year wise physical and financial targets are given in **Table 6**.

Table 5: Estimated Cost of Catchment Area Treatment Plan Implementation

S. No.	Item	Rate (Rs)	Unit	Target	
				Physical	Financial (Rs.)
I	**Biological Measures**				
1	Afforestation				
	i) Creation	58,900	Ha	7	4,12,300.00
	ii) Maintenance for 5 years	27,480	Ha	7	1,92,360.00
2	Assisted Natural Regeneration				

S. No.	Item	Rate (Rs)	Unit	Target	
				Physical	Financial (Rs.)
	i) Creation	25,700	Ha	19	4,88,300.00
	ii) Maintenance for 5 years	13,540	Ha	19	2,57,260.00
	Sub Total I				**13,50,220.00**
II	**Engineering Measures**				
3	Check Dams (DRSM)	26,600	No	10	2,66,000.00
	Sub Total II				**2,66,000.00**
A	**Treatment Cost (Sub Total I + II)**				**16,16,220.00**
III	**Administrative Measures**				
4	Administrative Charges @5% of Total				80,811.00
5	Micro planning @2% of Treatment Cost				32,324.40
6	Monitoring & Evaluation Cost @3% of Treatment Cost				48,486.60
7	Contingencies @10% of Treatment Cost				1,61,622.00
B	**Sub Total III**				**3,23,244.00**
	Total CAT Plan Cost (A + B)				**19,39,464.00**

Table 6: Year Wise Phasing of Physical and Financial Targets

S. No.	Treatment Measures	Year - 1		Year - 2		Year - 3		Year - 4		Year - 5		Year - 6		Year - 7		Total	
		Phy.	Fin. (Rs)	Phy.	Fin. (Rs)	Phy.	Fin. (Rs)	Phy.	Fin. (Rs)	Phy.	Fin. (Rs)	Phy.	Fin. (Rs)	Phy.	Fin. (Rs)	Phy.	Fin. (Rs)
I	**Afforestation Measures (ha)**																
1	**Normal Afforestation**			7	4,12,300											**7**	**4,12,300**
	1st Year maintenance					7	48,160									**7**	**48,160**
	2nd Year maintenance							7	41,090							**7**	**41,090**
	3rd Year maintenance									7	34,370					**7**	**34,370**
	4th Year maintenance											7	34,370			**7**	**34,370**
	5th Year maintenance													7	34,370	**7**	**34,370**
2	**Assisted Natural Regeneration**			19	4,88,300											**19**	**4,88,300**
	1st Year maintenance					19	57,000									**19**	**57,000**
	2nd Year maintenance							19	52,630							**19**	**52,630**
	3rd Year maintenance									19	49,210					**19**	**49,210**
	4th Year maintenance											19	49,210			**19**	**49,210**
	5th Year maintenance													19	49,210	**19**	**49,210**
	Sub Total I			**26**	**9,00,600**	**26**	**1,05,160**	**26**	**93,720**	**26**	**83,580**	**26**	**83,580**	**26**	**83,580**		**13,50,220**
II	**Soil & Water Conservation Measures**																
3	Dry Stone Masonry Check Dams (Nos)			10	2,66,000											**10**	**2,66,000**
	Sub Total II			**10**	**2,66,000**												**2,66,000**
A	**Treatment Cost (Sub Total I + II)**				**11,66,600**		**1,05,160**		**93,720**		**83,580**		**83,580**		**83,580**		**16,16,220**
III	**ADMINISTRATIVE MEASURES**																
4	Administrative Charges @5% of Total		40,406		40,406												**80,811**
5	Micro planning @2% of Treatment Cost		32,324														**32,324**
6	Monitoring & Evaluation Cost @3% of Treatment Cost				34,998		3,155		2,812		2,507		2,507		2,507		**48,487**
7	Contingencies @10% of Treatment Cost				1,16,660		10,516		9,372		8,358		8,358		8,358		**1,61,622**
B	**Sub Total III**		**72,730**		**1,92,064**		**13,671**		**12,184**		**10,865**		**10,865**		**10,865**		**3,23,244**
	Total (A and B)		**72,730**		**13,58,664**		**1,18,831**		**1,05,904**		**94,445**		**94,445**		**94,445**		**19,39,464**

ANNEXURE I

1. Per Hectare Cost Norm for Normal Afforestation

S. No.	Particulars of Work	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Survey & demarcation and preparation of map	Ha.	1	450	**450.00**
2	Bush cutting in the plantation site	Ha.	1	750	**750.00**
3	Interlacing of thorny bushes in B/wire	Rmt	180	3	**540.00**
4	Preparation of inspection path 60 cm wide	Rmt	150	15	**2250.00**
5	Layout of Pits	Ha.	1	500	**500.00**
6	Digging of pits 45x45x45 cm (40% of total)	00	4.4	1200	**5280.00**
7	Digging of pits 30x30x30 cm(60% of total)	00	6.6	900	**5940.00**
8	Filling of pits 45x45x45 cm (40% of total)	00	4.4	200	**880.00**
9	Filling of pits 30x30x30 cm (60% of total)	00	6.6	150	**990.00**
10	Carriage of naked roots plants over a distance of 0.5 km up hill	00	2	100	**200.00**
11	Carriage of plants in P/bags over a distance of 0.5 km up hill	00	3.5	150	**525.00**
12	Planting of entire Plants raised in P/bags	00	7	300	**2100.00**
13	Planting of naked root plants	00	4	200	**800.00**
14	Nursery cost of Plants	Nos	1100	9	**9900.00**
	Total				**31105.00**
15	Soil & moisture conservation works (25% of initial planting cost)		25%		**7776.25**
16	Add cost of RCC fence post and B/Wire			LS	**20000.00**
	Grand Total				**58881.25**
	Or Say				**58900.00**
I	**1st Year Maintenance - 25% Mortality**				
1	Re-digging of Pits 45x45x45 cm	00	1.1	600	**660.00**
2	Re-digging of Pits 30x30x30 cm	00	1.7	450	**742.50**
3	Filling of pits 45x45x45 cm	00	1.1	100	**110.00**
4	Filling of pits 30x30x30 cm	00	1.7	75	**123.75**
5	Planting of P/bags plants	00	1.8	300	**525.00**
6	Planting of naked root plants	00	1.0	200	**200.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	00	0.9	150	**131.25**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	00	0.5	100	**50.00**
9	Nursery cost of Plants	No.	275	9	**2475.00**
10	Repair of fence	Rmt	180	2	**360.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1000.00**
	Total I				**6877.50**
	Or Say				**6880.00**
II	**2nd Year Maintenance - 20% Mortality**				
1	Re-digging of Pits 45x45x45 cm	00	0.9	600	**528.00**
2	Re-digging of Pits 30x30x30 cm	00	1.3	450	**594.00**
3	Filling of pits 45x45x45 cm	00	0.9	100	**88.00**
4	Filling of pits 30x30x30 cm	00	1.3	75	**99.00**
5	Planting of P/bags plants	00	1.4	300	**420.00**
6	Planting of naked root plants	00	0.8	200	**160.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	00	0.7	150	**105.00**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	00	0.4	100	**40.00**
9	Nursery cost of Plants	No.	220	9	**1980.00**
10	Repair of fence	Rmt	180	2	**360.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1000.00**
	Total I				**5874.00**
	Or Say				**5870.00**
III	**3rd Year Maintenance - 15% Mortality**				
1	Re-digging of Pits 45x45x45 cm	00	0.7	600	**396.00**

S. No.	Particulars of Work	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
2	Re-digging of Pits 30x30x30 cm	00	1.0	450	**445.50**
3	Filling of pits 45x45x45 cm	00	0.7	100	**66.00**
4	Filling of pits 30x30x30 cm	00	1.0	75	**74.25**
5	Planting of P/bags plants	00	1.1	300	**315.00**
6	Planting of naked root plants	00	0.6	200	**120.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	00	0.5	150	**78.75**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	00	0.3	100	**30.00**
9	Nursery cost of Plants	No.	165	9	**1485.00**
10	Repair of fence	Rmt	200	2	**400.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1000.00**
	Total I				**4910.50**
	Or Say				**4910.00**
IV	**4th Year Maintenance - 15% Mortality**				
1	Re-digging of Pits 45x45x45 cm	00	0.7	600	**396.00**
2	Re-digging of Pits 30x30x30 cm	00	1.0	450	**445.50**
3	Filling of pits 45x45x45 cm	00	0.7	100	**66.00**
4	Filling of pits 30x30x30 cm	00	1.0	75	**74.25**
5	Planting of P/bags plants	00	1.1	300	**315.00**
6	Planting of naked root plants	00	0.6	200	**120.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	00	0.5	150	**78.75**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	00	0.3	100	**30.00**
9	Nursery cost of Plants	No.	165	9	**1485.00**
10	Repair of fence	Rmt	200	2	**400.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1000.00**
	Total I				**4910.50**
	Or Say				**4910.00**
V	**5thYear Maintenance - 15% Mortality**				
1	Re-digging of Pits 45x45x45 cm	00	0.7	600	**396.00**
2	Re-digging of Pits 30x30x30 cm	00	1.0	450	**445.50**
3	Filling of pits 45x45x45 cm	00	0.7	100	**66.00**
4	Filling of pits 30x30x30 cm	00	1.0	75	**74.25**
5	Planting of P/bags plants	00	1.1	300	**315.00**
6	Planting of naked root plants	00	0.6	200	**120.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	00	0.5	150	**78.75**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	00	0.3	100	**30.00**
9	Nursery cost of Plants	No.	165	9	**1485.00**
10	Repair of fence	Rmt	200	2	**400.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1000.00**
	Total I				**4910.50**
	Or Say				**4910.00**
	Total Maintenance Cost				**27,480.00**
	GRAND TOTAL	**Ha.**	**1**		**86,380.00**

2. Per Hectare Cost Norm for Assisted Natural Regeneration

S. No.	Particulars of Work	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Survey & demarcation and preparation of map	Ha.	1	450	**450.00**
2	Bush cutting in the plantation site	Ha.	1	750	**750.00**
3	Interlacing of thorny bushes in B/wire	Rmt	180	3	**540.00**
4	Preparation of inspection path 60 cm wide	Rmt	150	15	**2,250.00**
5	Layout of Pits	Ha.	1	115	**115.00**
6	Digging of pits 45x45x45 cm (40% of total)	“00	1	1200	**1,200.00**
7	Digging of pits 30x30x30 cm(60% of total)	“00	1.5	900	**1,350.00**
8	Filling of pits 45x45x45 cm (40% of total)	“00	1	200	**200.00**
9	Filling of pits 30x30x30 cm (60% of total)	“00	1.5	150	**225.00**
10	Carriage of naked roots plants over a distance of 0.5 km up hill	“00	0.5	100	**50.00**
11	Carriage of plants in P/bags over a distance of 0.5 km up hill	“00	0.75	150	**112.50**
12	Planting of entire Plants raised in P/bags	“00	1.5	300	**450.00**
13	Planting of naked root plants	“00	1	200	**200.00**
14	Nursery cost of Plants	Nos	250	9	**2,250.00**
	Total				**10,142.50**
15	Soil & moisture conservation works (25% of initial planting cost)		25%		**2535.63**
16	Add cost of RCC fence post and B/Wire			LS	**13,000.00**
	Total Plantation Cost				**25,678.13**
	Or Say				**25,700.00**
	Maintenance				
I	**1st Year - 25% Mortality**				
1	Re-digging of Pits 45x45x45 cm	“00	0.25	600	**150.00**
2	Re-digging of Pits 30x30x30 cm	“00	0.38	450	**168.75**
3	Filling of pits 45x45x45 cm	“00	0.25	100	**25.00**
4	Filling of pits 30x30x30 cm	“00	0.38	75	**28.13**
5	Planting of P/bags plants	“00	0.38	300	**112.50**
6	Planting of naked root plants	“00	0.25	200	**50.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	“00	0.19	150	**28.13**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	“00	0.13	100	**12.50**
9	Nursery cost of Plants	No.	63	9	**567.00**
10	Repair of fence	Rmt	180	2	**360.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1,000.00**
	Total I				**3,002.00**
	Or Say				**3,000.00**
II	**2nd Year - 20% Mortality**				
1	Re-digging of Pits 45x45x45 cm	“00	0.2	600	**120.00**
2	Re-digging of Pits 30x30x30 cm	“00	0.3	450	**135.00**
3	Filling of pits 45x45x45 cm	“00	0.2	100	**20.00**
4	Filling of pits 30x30x30 cm	“00	0.3	75	**22.50**
5	Planting of P/bags plants	“00	0.3	300	**90.00**
6	Planting of naked root plants	“00	0.2	200	**40.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	“00	0.15	150	**22.50**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	“00	0.10	100	**10.00**
9	Nursery cost of Plants	No.	50	9	**450.00**
10	Repair of fence	Rmt	180	2	**360.00**
11	Repair of Inspection path	LS			**500.00**

S. No.	Particulars of Work	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
12	Repair of soil and moisture conservation works	LS			**1,000.00**
	Total II				**2,770.00**
	Or Say				**2,770.00**
III	**3rd Year - 15% Mortality**				
1	Re-digging of Pits 45x45x45 cm	"00	0.15	600	**90.00**
2	Re-digging of Pits 30x30x30 cm	"00	0.23	450	**101.25**
3	Filling of pits 45x45x45 cm	"00	0.15	100	**15.00**
4	Filling of pits 30x30x30 cm	"00	0.23	75	**16.88**
5	Planting of P/bags plants	"00	0.23	300	**67.50**
6	Planting of naked root plants	"00	0.15	200	**30.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	"00	0.11	150	**16.88**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	"00	0.08	100	**7.50**
9	Nursery cost of Plants	No.	38	9	**342.00**
10	Repair of fence	Rmt	200	2	**400.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1,000.00**
	Total III				**2,587.00**
	Or Say				**2,590.00**
IV	**4th Year - 15% Mortality**				
1	Re-digging of Pits 45x45x45 cm	"00	0.15	600	**90.00**
2	Re-digging of Pits 30x30x30 cm	"00	0.23	450	**101.25**
3	Filling of pits 45x45x45 cm	"00	0.15	100	**15.00**
4	Filling of pits 30x30x30 cm	"00	0.23	75	**16.88**
5	Planting of P/bags plants	"00	0.23	300	**67.50**
6	Planting of naked root plants	"00	0.15	200	**30.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	"00	0.11	150	**16.88**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	"00	0.08	100	**7.50**
9	Nursery cost of Plants	No.	38	9	**342.00**
10	Repair of fence	Rmt	200	2	**400.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1,000.00**
	Total IV				**2,587.00**
	Or Say				**2,590.00**
V	**5thYear - 15% Mortality**				
1	Re-digging of Pits 45x45x45 cm	"00	0.15	600	**90.00**
2	Re-digging of Pits 30x30x30 cm	"00	0.23	450	**101.25**
3	Filling of pits 45x45x45 cm	"00	0.15	100	**15.00**
4	Filling of pits 30x30x30 cm	"00	0.23	75	**16.88**
5	Planting of P/bags plants	"00	0.23	300	**67.50**
6	Planting of naked root plants	"00	0.15	200	**30.00**
7	Carriage of plants in P/bags over a distance of 0.5 km up hill	"00	0.11	150	**16.88**
8	Carriage of naked roots plants over a distance of 0.5 km up hill	"00	0.08	100	**7.50**
9	Nursery cost of Plants	No.	38	9	**342.00**
10	Repair of fence	Rmt	200	2	**400.00**
11	Repair of Inspection path	LS			**500.00**
12	Repair of soil and moisture conservation works	LS			**1,000.00**
	Total V				**2,587.00**
	Or Say				**2,590.00**
	Total Maintenance Cost				**13,540.00**
	GRAND TOTAL	**Ha.**	**1**		**39,240.00**

3. Cost Norm for per Dry Stone Masonry Check Dam

S. No.	Particulars of Work	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
1	Excavation in hard soil including 50m lead and 1.5m lift with dressing		18	26	468
2	Collection of boulders at source (max. size 0.014cum), without quarrying i.e. picked up boulder		18	44	792
3	Labour only for boulder soling hand packed excluding consodidation		18	52.8	950.4
4	Collection of rubble for masonry (size 0.014 to 0.06 cum) other than black trap, basalt, organite		36	304	10944
5	Labour only for dry random rubble masonry		36	181	6516
6	Transportation of boulder, late rite, ruble pitching stone lead 4 km		54	100.4	5421.6
7	Bush Planting work		20	50	1000
8	Wedding and soil work (inter cultivation)		20	25	500
	Total				**26592**
	or Say				**26600**

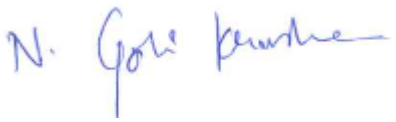
Full title of the Project	:	Construction of Shahpur (1800 MW) Pumped Storage Project by M/s Greenko Energies Private Limited, in Hanumanthkhera, Mungawali villages, G.P-Subhdhara; Baint Village, G.P-Bichi; Sahjanpur Villages, G.P-Kasba Nonera; Kaloni, Shahpur Villages, G.P-Mundiyar; Tehsil-Shahbad; Baran District, Rajasthan.
Proposal no	:	FP/RJ/HYD/121439/2021
Date of Proposal	:	03-02-2021
Diversion Area	:	407.8227 Ha

Undertaking

M/s. Greenko Energies Private Limited hereby affirm and undertakes that mitigation measures for control of soil erosion have been duly included in the Catchment Area Treatment (CAT) Plan of the project. Further, if any additional mitigation measures are suggested by DFO, during construction of the project, the same shall be implemented.

Date: 04.08.2023

Name: Gopi Krushna N



Gopi Krushna N
Deputy General Manager (DGM)
Authorised Signatory
Greenko Energies Private Limited

Place: Hyderabad

Authorized Signatory

Detailed note on
Site selection for Shahpur Pumped Storage Project proposed to be developed by Greenko Energies Private Limited.

Site-Specific requirements:

Pumped Storage Projects (PSP) have very stringent site-specific requirements and thus can only be developed at very few suitable locations. PSPs are site specific projects and have quite stringent requirements from Topographical, Geological, Availability of Water Source and Techno Commercial Viability points of view. Detailed justification and reasons for selecting the present site for the proposed Shahpur PSP are given below:

Topographical:

PSPs require suitable topography where substantial elevation difference is available at close distance i.e., two level areas connected by steep sloping hills.

These locations with elevation difference have to be suitable to create reservoirs of required capacity.

Geological:

Geology of the area of both lower and upper reservoirs must have acceptable geology to be capable of storing water for long duration.

Availability of water Source:

The project requires water to store energy, a water source with sufficient capacity/flow to fill up the reservoir and to supply for losses during operation shall also be available in close proximity.

Techno Commercial viability:

Since these projects operate at around 80% cycle efficiency (i.e., they consume 100 units for 80 units produced) thus techno commercial viability is also one of most important aspects of selection of these sites.

Alternatives Examined:

- Possibility was explored to locate the project near existing big reservoirs so that only one reservoir for the project needs to be constructed for the project. Wherever, other conditions were found to be suitable for setting up of the project, it was observed that areas around all such big reservoirs have been declared as Protected Areas (e.g. Rana Pratap Sagar, Jaismand lake, Bislapur Reservoir & Mahi Reservoir, etc.) and therefore such locations were not considered.
- Possibility was explored near major rivers Mahi & Chambal (and its tributaries) and it was observed that most of the area along Chambal river is forest / protected area and some possibilities existed only around some tributaries subject to other requirements being met, while no suitable locations are available in Mahi River area.

- Most of the hilly areas in Rajasthan have been declared as Protected Areas whereas some other locations are identified as Mining Areas, further restricting the selection of suitable sites for Pumped Storage Project.

1. Sukhpura location

A site was identified near Sukhpura Village in Chittorgarh Distt. Application was submitted for permission for the project at this location to MoEF&CC. But after detailed investigation, the geology of lower reservoir was found to be vulnerable wherein the strata was not found suitable.

2. Teekhi Khera location

Second Site was identified near Teekhi Khera Village in Chittorgarh Distt., but was given up during Pre-Feasibility Report (PFR) stage because water source was not sufficient to meet the project requirement.

3. Shahpur location

The third site identified was near Shahpur Village in Baran district. The Site was found suitable from site-specific requirements for implementation of the project.

Out of the three locations, Shahpur location was found most suitable and has been selected for implementation of the project.

Justification for the selection of Shahpur location:

1) The Site is close to Kuno River, which is one of the most important criteria for selection of PSP location. Kuno river has enough water flow to cater the needs of the project.

2) Area is having elevation difference of about 150m which is ideal for setting up of Pumped Storage Project.

3) No National Park, Wildlife Sanctuary or Tiger Reserve is located near the Proposed Project Site. Also, there is no migratory route of wildlife identified near the proposed site.

4) Forest land proposed for diversion is located at edge of the forest blocks, therefore forest diversion would not lead to fragmentation of forest land.

5) Proposed Site is approachable and can be connected through approach road from National Highway-76, which is located at approx. 3 km. distance from the proposed site.

6) At this location, the requirement of forest land is minimum for the construction of the project.

7) There is no public scheme is existing nor is proposed in the area proposed for the project or which is going to be affected due to the diversion of this forest land.

Other Reasons:

1. There is no alternate (and cost-effective) technology available in the world today that could be employed for the construction of man-made reservoirs at a typical head of 100 meters or more. Even if such technologies were to exist, it is understood that it may result in a significant impact on project cost (2 to 3 times the estimated cost of the project with proposed approach), rendering sale of power generated from the project to be financially unviable, which would defeat the whole purpose of setting up of the project.
2. All existing Pumped Storage projects operational in the country and most of such projects around the world have been built on vast areas of forest land with some of them having large Forest Land - Non-Forest Land ratio with forest land requirement estimated to be 80% ~ 90% of the total land required.

Thus, the proposed location (Shahpur) is the most suitable site due to the available elevation difference (head) of about 150m and the areas required for the construction of the upper and lower reservoirs are in close vicinity of natural water source (River Kuno). Considering all aspects, the project has been proposed at the present location with minimum forest land requirement by carefully planning the layout of the project.

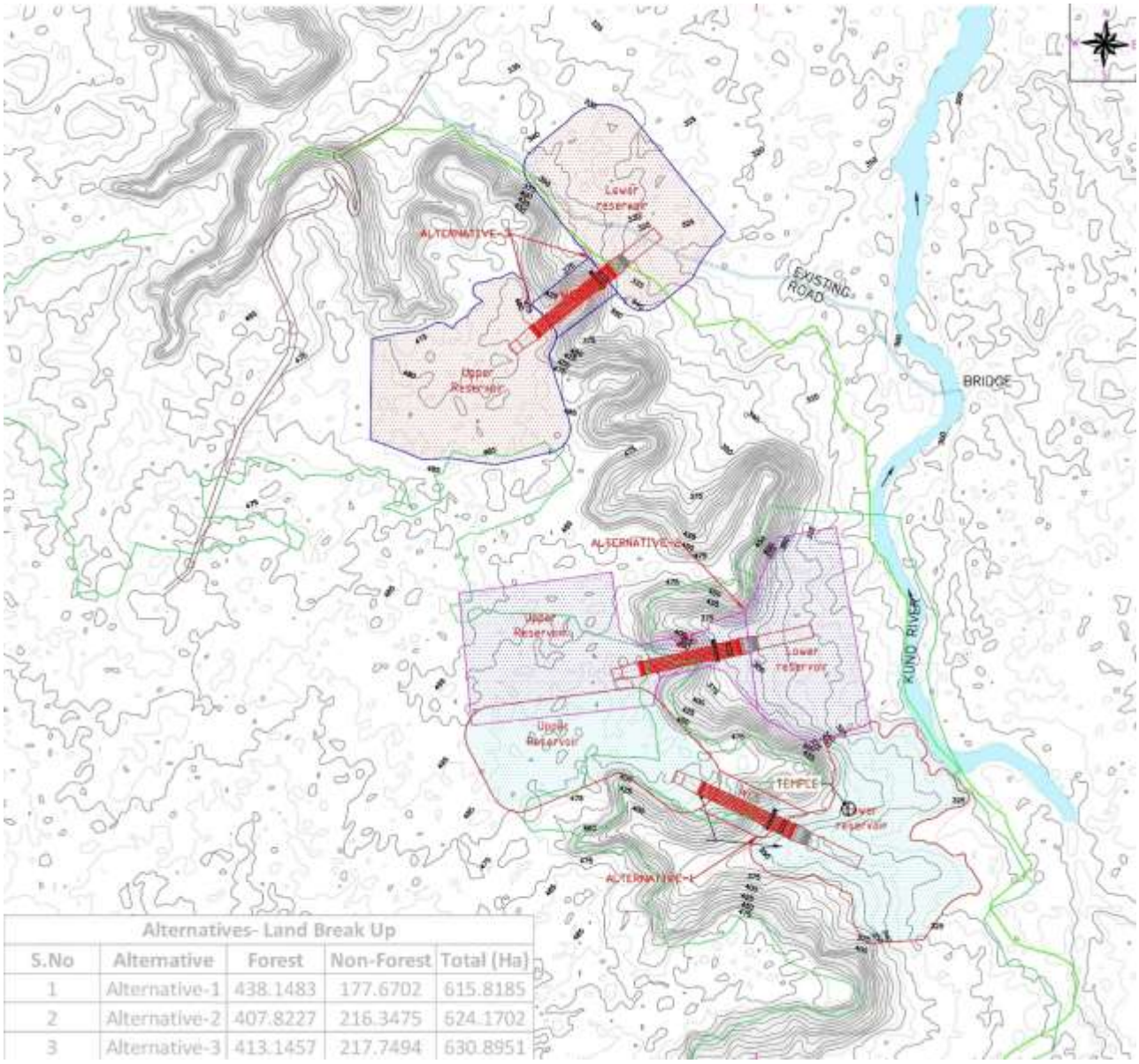
Effort was made to keep the forest area required for the project minimum. Different sites were examined near Shahpur. Three sites have been shortlisted. Detailed examination was done to minimise the forest area requirement and other issues. Details are given below.

Alternative Reservoir Studies:

The following parameters were kept in mind during the optimization study.

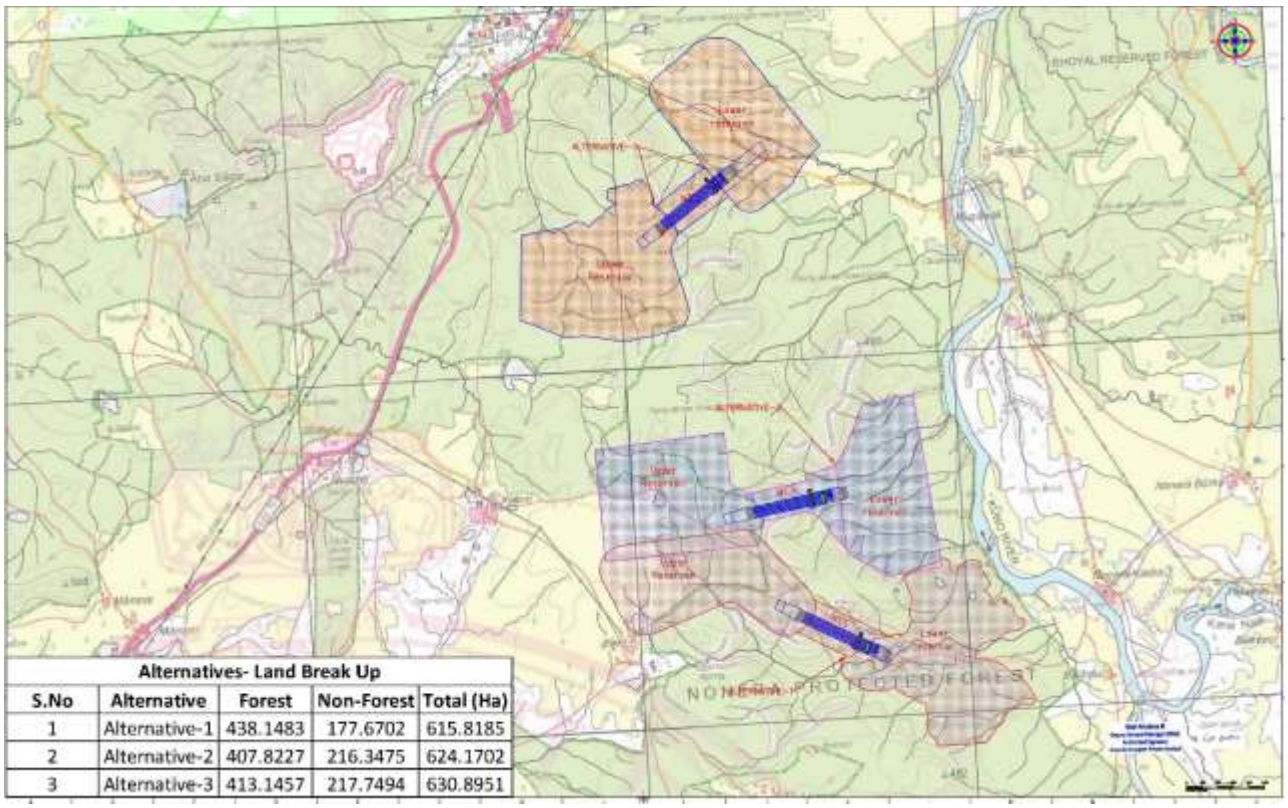
- Topography & Geology
- Accessibility
- Availability of water & its distance for initial filling of lower reservoir
- To meet the minimum storage requirement for 6.0 hours of generation.
- Installed Capacity
- Length & Height of Upper and Lower Reservoir Embankment
- Length of Water Conductor System
- Natural Head between two reservoirs
- L/H Ratio for Water Conductor system
- Type of Powerhouse (surface/ Underground)
- Type of Land (Forest/Non- Forest)

Considering the above points, desk study/reconnaissance survey is carried out based on the SOI toposheets and contours generated from SRTM data. Total three project layout alternatives have been studied and their details are given in the subsequent sections. All the three project layouts are marked on contours generated from SRTM data and toposheets (54G/3 & 54G/4) and are shown in Figure 1 & Figure 2 respectively.



Alternatives- Land Break Up				
S.No	Alternative	Forest	Non-Forest	Total (Ha)
1	Alternative-1	438.1483	177.6702	615.8185
2	Alternative-2	407.8227	216.3475	624.1702
3	Alternative-3	413.1457	217.7494	630.8951

Figure 1: Project Layout Alternatives on the contour plan generated from SRTM data.



Alternatives- Land Break Up

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2	Alternative-2	407.8227	216.3475	624.1702
3	Alternative-3	413.1457	217.7494	630.8951

Figure 2: Project Layout Alternatives on Toposheets (54G/3 & 54G/4).

Geology of Alternative Reservoir Locations

All the Alternate reservoir layouts have similar geological setup. The geology is represented by >40m thick bed of sandstone underlain by shale with intermediate thin beds of sandstone/ siltstone. The Upper Reservoirs rests over the sandstone and the Lower Reservoirs over the shale.

Topographically, the area in general, from Upper Reservoir to Lower Reservoir represents the vertical cut face of sandstone for about 20-25m height followed by slumped rock blocks dominating slopes having dislodged rock blocks of mostly sandstone having slope angles of >45°. Immediately after the moderate to steep slopes of the slumped rock blocks, moderate overburden slopes consisting of rock blocks of sandstone and shale in sandy and silty matrix having slope angle of about 30° is evident which finally merges to the flat horizontal slopes comprising rounded to sub-rounded boulders mixed with angular rock blocks. The slopes towards the Kuno River represent vertical cut sections of thick shale with thin intermediate sandstone/ siltstone bands. The plateau area where the Upper Reservoir is proposed is having an elevation of about El >480m and that of the Lower Reservoir the general elevations are about El >320m in most of the reaches.

Alternative 1

The reservoirs of Alternative-1 are in the southernmost part of the explored region at around 5 kms from NH 76. The upper reservoir is envisaged on top of the plateau and the lower reservoir is identified in the bottom within the alluvial plains.

The average elevation of the plateau where the Upper reservoir is proposed is about 485.0m and gradually declines towards the SE boundaries and reaches to elevation El 480.0m. Thus, the average

embankment height in the southern part becomes relatively higher and reaches to about 31m. The length of the Upper reservoir embankment in this alternative is 6384m. The proposed area occupies partially forest and mainly private lands.

The proposed Lower reservoir for this alternative in the alluvial plains having elevation variance from El 350.0m to El 325.0m. With the catchment area of 1.53 Km^2 the maximum height of the embankment reaches upto 26.5m. The proposed reservoir is completely located in forest area. A major Nallah flows in this alignment which will require diversion. Also, a local temple will be submerged if the lower reservoir is constructed at this location and will invite local issues.

The structures envisaged according to these proposed reservoirs are Upper embankment and upper intake, surface steel head race pipe, vertical pressure shaft, horizontal pressure tunnel, surface pit type powerhouse, tail race tunnel and lower embankment and lower intake (Figure 3).

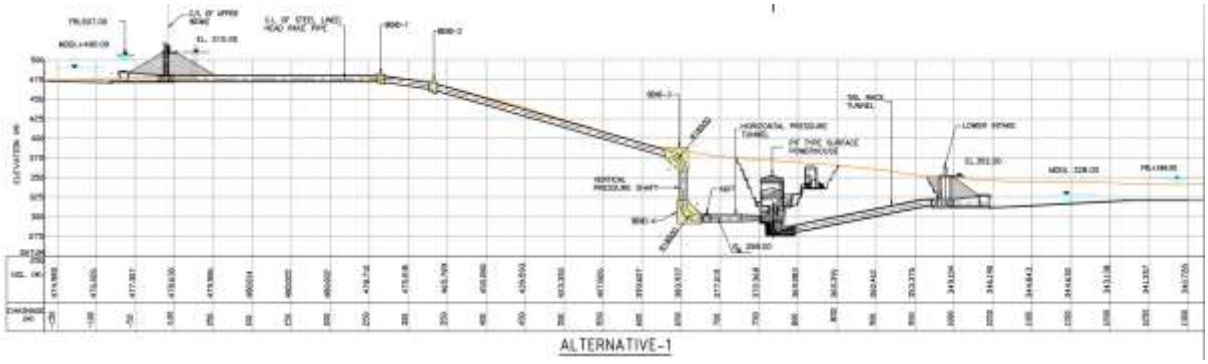

Figure 3: L-section along water conductor system for proposed Alternative-1.

Alternative 2

This alternative is envisaged just north of Alternative-1 with Upper reservoir located at around 3.5 kms from NH 76. The Upper reservoir of this proposal shares the southern boundary with the Upper reservoir of Alternative- 1. The upper reservoir is envisaged on top of the plateau and the lower reservoir is identified in the bottom within the alluvial plains.

The elevation of the plateau where the Upper reservoir is proposed varies from El 485.0m to El 495.0m with the higher elevations on the northern and western parts of the embankment. However, the change in elevations is very gradual and uniform all along the proposed reservoir boundary. Thus, the average embankment height reaches upto 24.5m. The length of the Upper reservoir embankment in this alternative is 5450m. The proposed area occupies partially forest and mainly private lands.

The proposed Lower reservoir for this alternative in the alluvial plains having elevation variance from El 350.0m to El 320.0m. With the catchment area of 1.27 km^2 the maximum height of the embankment reaches upto 26.5m. No major perennial drainage exists in the proposed reservoir area. The proposed reservoir is completely located in forest area.

The structures envisaged according to these proposed reservoirs are Upper embankment and upper intake, surface steel head race pipe, vertical pressure shaft, horizontal pressure tunnel, surface pit type powerhouse, tail race tunnel and lower embankment and lower intake (Figure 4).

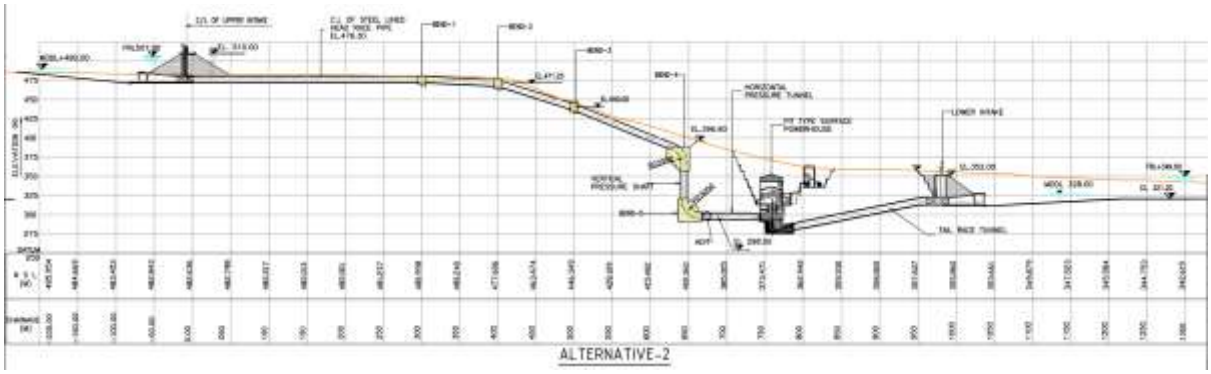

Figure 4: L-section along water conductor system for proposed Alternative-2.

Alternative 3

This alternative is envisaged about 1.7 km north of Alternative-2 near to the NH76 which is about 700m to 900m from Upper reservoir and Lower reservoir, respectively. Similar to the other alternatives, the upper reservoir is envisaged on top of the plateau and the lower reservoir is identified in the bottom within the alluvial plains.

The elevation of the plateau where the Upper reservoir is proposed varies from elevation El 480m to El 485m in most of its area. The average embankment height reaches to about 30m. The length of the Upper reservoir embankment in this alternative is 5453m. The proposed area is mostly in the forest land and very few in private lands.

The envisaged Lower reservoir for this alternative in the alluvial plains having elevation variance from El 350.0m to El 325.0m. With the catchment area of 1.27 Km^2 the maximum height of the embankment reaches upto 28m. The area for lower reservoir is mostly in the private land. The State Road of about 2km connecting the NH76 comes under submergence alongwith few village habitations along the roads. The rehabilitation of the nearby villages and the realignment of the State Road are mandatory to construct this reservoir.

The structures envisaged according to these proposed reservoirs are Upper embankment and upper intake, surface steel head race pipe, vertical pressure shaft, horizontal pressure tunnel, surface pit type powerhouse, tail race tunnel and lower embankment and lower intake (Figure 5).

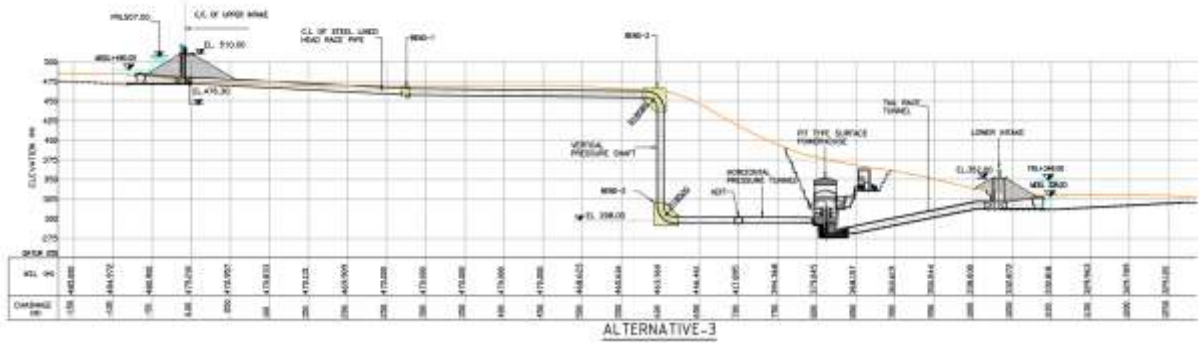

Figure 5: L-section along water conductor system for proposed Alternative-3.

The comparison of parameters for all the three alternative reservoir locations are given below in Table 1.

Table 1: Comparison of parameters of Reservoir Alternatives

#	Parameter	Unit	Alternative 1	Alternative 2	Alternative 3
1	Storage Capacity	MWh	10,800	10,800	10,800
2	Installed Capacity	MW	1800	1800	1800
3	FRL of Upper Reservoir	m	507	507	507
4	MDDL of Upper Reservoir	m	490	490	490
5	FRL of Lower Reservoir	m	349	349	349
6	MDDL of Lower Reservoir	m	328	328	328
7	Plan Area of Upper Reservoir at FRL	Sq km	1.762	1.762	1.762
8	Plan Area of Upper Reservoir at MDDL	Sq km	1.602	1.602	1.602
9	Plan Area of Lower Reservoir at FRL	Sq km	1.519	1.519	1.519
10	Plan Area of Lower Reservoir at MDDL	Sq km	1.269	1.269	1.269
11	Available Live Storage in Upper Reservoir	TMC	1.01	1.01	1.01
12	Available Live Storage in Upper Reservoir	TMC	1.00	1.00	1.00
13	Length of Upper Reservoir Embankment	m	6384	5450	5453
14	Length of Lower Reservoir Embankment	m	2901	2937	5177
15	Average Height of Upper Reservoir Embankment	m	31.0	24.5	30.0
16	Maximum Height of Lower Reservoir Embankment	m	26.5	26.5	28.0
17	Length of Water Conductor System	m	1083.4	1083.4	1194.3
18	L/H Ratio of Water Conductor System	m	7.0	7.0	7.7
19	Type of Land in Upper Reservoir		Partially Forest	Partially Forest	Mostly Forest
20	Natural Head between Reservoirs	m	154.73	154.73	154.73
21	Type of powerhouse (Surface/ Underground)		Surface	Surface	Surface
22	Type of Land in Lower Reservoir		Entirely Forest Land	Entirely Forest Land	Mostly Private Land

23	Land requirement				
i	Forest		438.1483	407.8227	413.1457
ii	Non forest		177.6702	216.3475	217.7494
24	Social Issues		Requires Relocation of Hindu Temple	-	Requires diversion of the State road and rehabilitation of village.
25	Diversion of Nallah		Requires Diversion of Nallah	Presence of minor Nallah. Diversion not required.	No Nalla along the Alignment
26	Length of Water Conductor for Initial Filling	m	450	500	2382

Conclusions

Based on the above studies carried out for various locations of reservoirs, the following has been concluded.

- The approach for all the studied reservoirs would be through the available road network (National Highway & State Road) with additional construction road to the reservoir locations for reasonable lengths.
- Topographically, the availability of the desired elevation with desired lengths are also not constraints for the selected reservoir locations. The Kuno river is also available for the initial filling at an reasonable distance, except that for the Alternative-3 with a required water conductor length of about 2.3km.
- Geological conditions will remain same for all the three alternatives with Upper reservoir resting on Sandstone and the Lower reservoir on Shale with intermittent bands of siltstone/ sandstone.
- For the development of Lower reservoirs complete forest land is available for Alternative-1 and Alternative-2, whereas, for Alternative-3, private land with village habitation and state road are coming in submergence which would lead to diversion of state road and village rehabilitation. Similarly, for the Upper reservoir, partial forest land is involved in Alternative-1 and Alternative-2, whereas mostly forest land is involved in Alternative-3. Social issue of relocation of existing Temple is involved in Lower reservoir of Alternative-2.
- Regarding the length of embankments, the Upper Reservoir embankment of all the 3 alternatives is reasonably same, whereas, for the Lower Reservoirs, the length of the embankment for Alternative-3 is almost double than the other alternatives.

- The envisaged civil components are mostly same consisting of Upper embankment and upper intake, surface steel head race pipe, vertical pressure shaft, horizontal pressure tunnel, surface pit type powerhouse, tail race tunnel and lower embankment and lower intake. The lengths of water conductor are varied with pit type surface powerhouse.

Based on above, the **Alternative-2** has been selected.

M/s Greenko Energies Private Limited

Authorization Signatory

Full title of the Project	:	Construction of Shahpur (1800 MW) Pumped Storage Project by M/s Greenko Energies Private Limited, in Hanumanthkhera, Mungawali villages, G.P-Subhdhara; Baint Village, G.P-Bichi; Sahjanpur, Ballarpur Villages, G.P-Kasba Nonera; Kaloni, Shahpur Villages, G.P-Mundiyar; Tehsil-Shahbad; Baran District, Rajasthan.
Proposal no	:	**FP/RJ/HYD/121439/2021**
Date of Proposal	:	03-02-2021
Diversion Area	:	407.8227 Ha

The proposed Shahpur (1800 MW) Pumped Storage Project (PSP) envisages project components like Upper & Lower Embankment/Reservoir, Powerhouse, Muck dumping, Construction camps and Colony etc. The total land required for the project is about 624.1702 Ha, out of total land requirement, 407.8227 Ha is forest land, which is proposed to be diverted for non-forest purposes from Mundiyar A, Nonera A, Santora Blocks of Shahbad Range, Baran Division in Baran District, Rajasthan. As per the FCA guidelines, Cost Benefit Analysis has to be prepared for project feasibility and calculation of the same is furnished below.

Details of calculation of Cost - Benefit analysis:

S.No	Description	Details
1	Project	Shahpur (1800 MW) Pumped Storage Project
2	Forest Land required (Ha)	407.8227

Component wise Breakup (Ha)-Shahpur-PSP				
S. No	**Component**	**Forest Land**	**Non-Forest**	**Total**
1	Road Upper Reservoir to NH-76	0.0000	8.2050	8.2050
2	Upper Reservoir	110.2062	159.6100	269.8162
3	Job Facilities Area	0.0000	15.0000	15.0000
4	Magazine (Explosive Storage Facility)	0.0000	0.1000	0.1000
5	Road From Upper Reservoir to Lower Reservoir	3.7775	0.0000	3.7775
6	WCS & Powerhouse	57.2250	0.0000	57.2250
7	Lower Reservoir	230.5140	0.0000	230.5140
8	Pumping Alignment	2.2800	0.0000	2.2800
9	Road from Lower Reservoir to BT Road	3.8200	2.7375	6.5575
10	Approach Road Lower Reservoir to Muck Disposal Are	0.0000	0.6950	0.6950
11	Proposed Muck Disposal Area	0.0000	30.0000	30.0000
Total		**407.8227**	**216.3475**	**624.1702**

Table-A: Category of proposals for which Cost Benefit Analysis are applicable

Sr. No.	Nature of Proposal	Applicable / Not applicable	Remarks
01	All categories of proposals involving forest land up to 20 hectares in plains and up to 5 hectares in hills	Not Applicable	NIL
02	Proposal for defense installation purposes and oil prospecting (prospecting only)	Not Applicable	NIL
03	Habitation, establishment of industrial units, tourist lodges / complex and other building constructions.	Not Applicable	NIL
04	All other proposals involving forest land more than 20 Ha in plain and more than 5 ha in hills including roads, transmission lines, minor medium and major irrigation projects, hydel projects, mining activities, Railway lines, location specific installation like Micro-wave station, auto repeater centre, TV towers, etc.	Applicable	These are cases where a Cost benefit analysis is necessary to determine when diverting the forest land to non-forest use is in the overall public interest.

Table B: Estimation of Cost of Forest Diversion:

S. No	Parameters	Cost in Rs. Lakhs	Remarks
1	Ecosystem services losses due to proposed forest diversion.	3906.941	Economic value of loss of eco-system services due to diversion of forests shall be the net present value (NPV) of the forest land being diverted (407.8227 Ha) as prescribed by the Central Government (MoEF & CC). * NPV is considered as 9.58 L/Ha
2	Loss of animal husbandry productivity including loss of fodder.	390.6941	Maximum of: 1. (a) Estimated Quantity of fodder / grasses in M.T = Average production fodder per grasses in M.T per Ha x Area Applied diversion. Based on the assumption that on closer an area can yield an average 2 to 4 MT of grass per ha. i.e. 3 x 407.8227 = 1223.47 MT. (Average fodder is 3 MT/Ha is considered) (b) Value or loss of fodder (Rs) =

S. No	Parameters	Cost in Rs. Lakhs	Remarks
			Estimated quantity x Market price = 1223.47 MT x Rs.5000/MT= Rs.61.17 Lakhs) 2. Considered 10% NPV which is maximum: Rs 3906.941 Lakhs x 0.1 (10%) = Rs. 390.6941 Lakhs Hence Rs 390.6941 Lakhs is considered as Loss of animal husbandry productivity including loss of fodder.
3	Cost of human resettlement.	Nil	--
4	Loss of public facilities and administrative infrastructure (Roads, building, schools, dispensaries, electric lines, railways etc) on forest land, which would require forest land if these facilities were diverted due to the project.	Nil	--
5	Possession value of forest land diverted.	3221.799	Maximum of i. 30% of environmental costs (NPV) due to loss of forests (3906.941x 0.30 = Rs 1172.082 lakhs) ii. Circle rate of adjoining area is taken as Rs. 7.90 Lakhs/Ha, accordingly (7.90 x 407.8227 Ha=Rs 3221.799 Lakhs) Hence Rs 3221.799 Lakhs is considered as possession value of forest land diverted.
6	Cost of suffering to Oustees.	Nil	Not applicable, there is no Displacement of people.
7	Habitat Fragmentation Cost.	1953.471	The cost due to fragmentation has been pegged at 50% of NPV applicable as thumb rule i.e. 3906.941x 0.50 = Rs. 1953.471 Lakhs
8	Compensatory afforestation and soil & moisture conservation cost.	9502.2689	Sum of i. Treatment cost for compensatory afforestation i.e. 407.8227 Ha @ 6 L/Ha = Rs 2446.936 Lakhs ii. Purchase Cost of Land for C.A = 407.8227 Ha @17.30/Ha = 7055.333 Lakhs.

S. No	Parameters	Cost in Rs. Lakhs	Remarks
			Hence, Rs 9502.2689 Lakhs has been considered towards Compensatory afforestation and soil & moisture conservation cost.
	Total	**18975.1746**	

Table C: Estimation of Benefits of Forest Diversion:

SNo	Parameters	Remarks	Benefits (in lakhs)
01	Increase in productivity attribute to the proposed project	The Shahpur (1800 MW) Pumped Storage Project would contribute planned peak power generation, there would be direct revenue to the State and the Nation. Further, the overall improvement of the infrastructure like Roads, Industries, Eco-tourism, Communication etc. would boost up the economy of the State and improve the standard of living of people. The project is proposed to generate Revenue of 1974 Cr/Year	7,81,700*
02	Benefits to economy due to the Project	Power/energy is one of the prime requirements for the overall development of a State and Nation. Since, Green power is the cleanest, cheapest and environmentally friendly source of energy; development of project will facilitate the emergence of industries, trade and commerce and would thereby bring more and more economic development in the State & Country. The establishment of more industries and production units due to improved power supply in the State will directly boost the overall economy of the State & the country at large.	--
03	No. of population Benefited due to the Project	Direct Employment during Construction-5800, Operation-200 The completion of project will directly and indirectly benefit the population residing in Baran District as well as State and the Country.	--
04	Economic benefits due to direct & indirect employment due to the Project	Benefits due to direct employment, during the construction phase, employment will be generated for skilled and unskilled manpower. About 3600 persons will be employed during the peak time of construction. The local people will also get the opportunity to carry out contract works subject to their work capability / expertise. After completion of the Project, during operation of the project about 300 people will be employed for routine operation and maintenance of roads and other structures.	--
05	Economic	Benefits from Compensatory Afforestation (CA) accruing over	--

SNo	Parameters	Remarks	Benefits (in lakhs)
	benefits due to Compensatory Afforestation	next 50 years and discounted to Present Value.	
		Total Benefits	**7,81,700.00**

* Total net benefit for 99 Years is Rs 7,81,700 Lakhs (7817 Cr) @ 4% net profit on gross revenue (197400*0.04*99)

Cost of the Economic benefits due to direct & indirect employment is not considered.

Calculation of Cost Benefit Ratio:

Total Benefits (As per Table C: Estimation of benefits of Forest Diversion) =Rs. 7,81,700 Lakhs
Total Cost (As per Table B: losses of forests) = Rs. 18975 Lakhs

Hence, Benefit/ Cost Ratio = 41.19

Thus, the project gives positive Benefit/ Cost Ratio. The monetary returns of the Project are positive over the environmental losses.

Date: 04.08.2023

Name: Gopi Krushna N

Gopi Krushna N
Deputy General Manager (DGM)
Authorised Signatory
Greenko Energies Private Limited

Place: Hyderabad

Authorized Signatory

Wildlife Conservation Plan
for
Schedule-I (IWPA 1972) Species

1. Leopard (*Panthera pardus*),
2. Sloth Bear (*Melursus ursinus*)
3. Common Pea fowl (*Pavo cristatus*)
4. Indian Monitor Lizard (*Varanus bengalensis*), and
5. Indian Rock Python (*Python molurus molurus*)

Prepared for:

SHAHPUR PUMPED STORAGE PROJECT

Greenko Energies Pvt. Ltd.
District Baran, Rajasthan

Prepared by:
R. S. Envirolink Technologies Pvt. Ltd.
NABET/EIA/2225/RA 0274
403, Bestech Chamber Commercial Plaza,
B-Block, Sushant Lok-I, Gurugram
Phone: +91-124-4295383: www.rstechnologies.co.in

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i. Greenko Group has been in the process of evaluating suitable locations and has identified suitable location for Pumped Storage Project (PSP) near Kaloni, Baint and Mungawali villages (Near Shahpur), Shahabad Tehsil, Baran District, Rajasthan for the proposed 1800 MW Shahpur Pumped Storage Project (PSP).

ii. The Shahpur Standalone Pumped Storage Project envisages construction of both upper reservoir and lower reservoir in Baran district of Rajasthan and involves construction of rockfill embankments. The water from the proposed lower reservoir will be pumped up and stored in the proposed upper Reservoir and will be utilized for power generation.

iii. Land requirement for proposed project has been worked out as 624.17 ha. Out of which 407.83 ha is forest land, 216.35 ha is Non-forest.

iv. The private land required for the project is proposed to be purchased through a voluntary sale with a willing buyer and seller process by following Section 2 and Part (a or क) of Sub-Section 3 of The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARR), 2013.

v. PH was held on 22nd February 2021 at Anganbadi School Grounds, Kaloni Village, Tehsil Shahabad, District Baran, Rajasthan.

vi. As per land use land cover map of the study area forests comprised of Deciduous forest and Scrub forest combinedly constitute a major part of the study area accounting for 46.87% of the area. Agricultural land constitutes 31.27%.

vii. For the operation of proposed project water will be lifted one time from the existing nearby Kuno river. The Kuno river is a tributary of the Chambal River. Kuno river is 180 km long, the catchment area of the Kuno river up to Mungawali village near the proposed lifting point is 963.59 sq km.

viii. The project area falls in Seismic Zone-I. No major earthquakes are reported/known from this area.

ix. The study area of the project lies in the Baran district, which experiences mostly hot summer and dry climate except in the monsoon season. The south-west monsoon rainfall occurs from June to September in the study area.

x. the predominant soils of the district have black soils of alluvial origin with clay loam to clay in texture and are generally non-calcareous.

xi. Most of the workers are dependent on agriculture practices and related activities for their livelihood. Irrigation of agriculture is mostly dependent on rainfall. Livestock's rearing is an important source of livelihood in the area.

xii. Villagers in the area also depend on forest resources for their day by day needs, mainly for fuelwood, fodder, timber, and medicinal purposes. Extraction of Tendu (*Diospyros melanoxylon*) leaves, from the forest area is one of the livelihood sources of the tribal population. Scrub forest and grassland in the area also used as grazing land for livestock's

xiii. A total of 113 plant species belongs to 43 families were recorded during field survey in the core zone of the project. plants including grasses were reported from the study area.

xiv. The detail inventory of 203 plant species reported from the study area (Core and Buffer Zone) has been prepared based on primary survey and same has been supplemented with available secondary data.

xv. *Tectona grandis* and *Diospyros melanoxylon* was found dominant in the Dry deciduous forest associated with *Anogeissus pendula, Madhuca longifolia, Terminalia tomentosa, Terminalia*

bellirica, Lannea coromandelica, Boswellia serrata, etc. *Acacia catechu* and *Ziziphus jujuba* were dominant in scrub forest.

xvi. According to the RED Data Book of Indian Plants and IUCN Red List of Threatened Species (Version 2022-1), none of the plant species found in the study area falls under any Threatened category.

xvii. Among the faunal species Mammals are represented by 19 species, 53 species of birds were recorded during survey. Herpetofauna (amphibians and reptiles) were represented by 14 species and 7 species of butterflies were recorded from the study area.

xviii. Common Leopard, Sloth Bear, Indian Peafowl, Indian Python and Bengal Monitor Lizard are the faunal species listed as Schedule I of IWPA (1972) reported from the study area.

xix. Proposed project is located within newly declared Shahabad Conservation Reserve. The other nearest Protected Area to the project is in Madhya Pradesh i.e Kuno National Park having aerial distance more than 40 km from project site.

xx. About 84.20% working population is engaged in agricultural activities, out of which 42.36% are Cultivators and 41.84% are Agricultural Labours in the study area.

xxi. Villagers in the district depend on forest resources for their day by day needs mainly for fuelwood, fodder, timber, and medicinal purposes. In the study area extraction of Tendu (*Diospyros melanoxylon*) leaves, from the forest area is one of the main livelihood sources of the tribal population. The main timber species in the forest area are *Tectona grandis*.

xxii. With other published literature Forest Working Plan of Baran Division has also been consulted for preparation of check list of plants and animals in the study area.

xxiii. The major irreversible impact of construction of proposed project is change in land use pattern as 407.82 ha of forest land will be diverted for the construction of the project components.

xxiv. If proper mitigation mad management measures have not been implemented during construction, then construction activities also have impact on ambient air Quality, Ambient Noise Quality, Water Quality, terrestrial ecology and on socio economic environment in the surrounding of proposed project.

xxv. During operation phase, no major impacts are envisaged on air, noise, water and terrestrial ecology.

xxvi. Construction and operation of proposed project provide employment and new livelihood sources to the local people and project also strengthen the basic infrastructure facilitiues in the area.

xxvii. To minimize the impact of construction activities various mitigation and management measures has been proposed under Environmental Management Plan viz, Control of Air, Noise and Water Pollution, Monitoring of Air, Noise and Water quality during construction, Muck Management Plan, Green Belt Development Plan, Public Health Delivery System, Energy Conservation Plan, Local Area Development Plan, Sanitation and Solid waste Management Plan, Labour Management Plan, etc.

xxviii. As the project area lies with Shahabad Conservation Reserve and there is presence of faunal species listed under Schedule-I of WPA 1972, Wildlife Conservation Plan has been formulated with financial provision following the guidelines issued by Office of Addl. Principal Conservator of Forest and Chief Wildlife Warden, Rajasthan, Jaipur issued by letter no. WCP/CWLW/2019/651-663 dated 24/05/2019.

xxix. The main objectives of wildlife conservation Plan are

- Conservation and management of natural habitat of faunal species in the area;
- Mitigation/ control of project induced biotic and/or abiotic pressures/ influences that may affect the natural habitats and
- Creating all round awareness regarding conservation by ensuring people's participation.

xxx. State Forest Department shall be the executing agency for implementation of the proposed mitigation measure under Wildlife Management Plan in the surrounding of proposed project site, therefore, a total amount of **Rs. 229.00 lakh** will be deposited with the State Forest Department for taking up proposed activities within core and buffer zone of the proposed project.

CHAPTER - 1

1.1. BRIEF NOTE ABOUT THE PROJECT AND ITS UTILITY

Pumped Storage Projects (PSP) presents an optimal, economically viable & scalable solution to supply Schedulable Power On-Demand (SPOD) with both base load and peak load capabilities to the Nation. Pumped-storage hydroelectricity allows energy from intermittent sources (such as solar, wind) and other renewables, or excess electricity from continuous base-load sources (such as coal or nuclear) to be saved for periods of higher demand. The reservoirs used with pumped storage are quite small when compared to conventional hydroelectric dams of similar power capacity, and generating periods are often less than half a day. Along with energy management, pumped storage systems are also helpful in controlling electrical network frequency and provide reserve energy.

Greenko Group has been in the process of evaluating suitable locations and has identified suitable location for Pumped Storage Project (PSP) near Kaloni, Baint and Mungawali villages (Near Shahpur), Shahabad Tehsil, Baran District, Rajasthan for the proposed Shahpur Pumped Storage Project (PSP) that can supply Schedulable Power on Demand (SPOD) which is Dispatchable & Schedulable Renewable Energy to consumers across India.

1.1.1 Project Location

Proposed Shahpur Pumped Storage Project (PSP) is located near Kaloni, Baint, Mungawali, Hanumatkhera, Balarpur, Shahpur villages, Baran District of Rajasthan. It envisages creation of upper reservoir & lower reservoir which are located away from all existing natural river systems and have negligible catchment areas. The project sites are accessible from NH-76 road close to Mahuri Khera from where Shahpur village road takes off; and is at a distance of approximately 6 Km. Nearest railhead is Baran Railway Station, about 77 kms from project site and nearest Airport is Gwalior Airport, about 200 km from project site The powerhouse is located near Shahpur village, which is in Shahabad Tehsil of Baran district. The Geographical co-ordinates of the proposed upper reservoir are at longitude 77° 10' 55.78"E and latitude is 25°11'25.21"N and that of proposed lower reservoir are 25°11'40.00"N and 77°11'50.00"E (**refer Figure 1**).

Scoping clearance of Shahpur Pumped Storage Project in district Baran, Rajasthan was accorded by Ministry of Environment Forests and Climate Change (MoEF&CC), Government of India vide letter no. J-12011/02/2020-IA-I, dated: 13.04.2020.

1.1.2 Project Description

The Shahpur Standalone Pumped Storage Project envisages construction of both upper reservoir and lower reservoir in Baran district of Rajasthan and involves construction of rockfill embankment with avg height of 24.5 m for the length of 5309 m for creation of Shahpur PSP upper reservoir with 1.21 TMC gross capacity and construction of rockfill embankment with avg height of 26.5 m for the length of 2937 m for creation of Shahpur PSP lower reservoir with 1.05 TMC gross capacity. This scheme envisages non-consumptive re-utilization of water by re-circulation. The water from the proposed lower reservoir will be

pumped up and stored in the proposed upper Reservoir and will be utilized for power generation. Total 6 numbers of Independent Head Race Pipe / Pressure Shaft with one pressure Tunnel bifurcating into two-unit pressure tunnel convey water between Lower and Upper reservoirs. Surface Power/Pump House will be located at about 830 m from the intake structure and shall be equipped with six vertical shaft reversible Francis type units composed each of a generator/motor and a turbine/pump having generating/pumping capacity of 300 & 150 MW/330 & 165MW. The Layout map of proposed project is given at **Figure 2**.

1.1.3 Land Requirement

For the development of Shahpur Pumped Storage Project (PSP), Both Private & Forest land would be acquired for construction of project components, reservoir area, muck dumping, construction camps and colony, etc. Based on the final project layout (**Figure 1 & 2**), land requirement has been worked out as **624.1702 ha** (**Table 1**). Out of which **407.8227 ha** is forest land, **216.3475 ha** is Non-forest.

Table 1: Land Requirement of Shahpur Pumped Storage Project

S. No	Component	Forest Land	Non-Forest	Total
1	Road Upper Reservoir to NH-76	0.00	8.205	8.205
2	Upper Reservoir	110.2062	159.6100	269.8162
3	Job Facilities Area	0	15.00	15.00
4	Magazine (Explosive Storage Facility)	0	0.10	0.10
5	Road From Upper Reservoir to Lower Reservoir	3.7775	0.00	3.7775
6	WCS & Powerhouse	57.2250	0.00	57.225
7	Lower Reservoir	230.514	0.00	230.514
8	Pumping Alignment	2.28	0.00	2.28
9	Road from Lower Reservoir to BT Road	3.82	2.7375	6.5575
10	Approach Road Lower Reservoir to Muck Disposal Area	0.00	0.6950	0.695
11	Proposed Muck Disposal Area	0.00	30.0	30.00
Total		**407.8227**	**216.3475**	**624.1702**

a. Land Acquisition

The forest land required for the project falls in Baran Forest Division. For diversion of 407.8227 ha of forest land, online application has been submitted to MoEF&CC vide proposal No.: FP/RJ/HYD/121439/2021.

The private land required for the project is proposed to be purchased through a voluntary sale with a willing buyer and seller process. With reference to the private land purchase through private negotiations and the applicability of the provisions relating to rehabilitation and resettlement for the above Project as per Section **2 and Part (a or क) of Sub-Section 3** of The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARR), 2013, the provisions of the Act shall apply in the cases, where:

(a) ***a private company purchases land, equal to or more than such limits in rural areas or urban areas, as may be prescribed by the appropriate Government,*** *through private negotiations with the owner of the land in accordance with the provisions of section 46;.*

In this context, it is to be noted that the total private land proposed to be purchased through private negotiations for the Shahpur Pumped Storage Project which falls in rural areas is about 216.35 ha only which is well within the prescribed limits as specified above.

b. Public Consultation

On completion of draft EIA report and its executive summary in English and vernacular language (Hindi), reports were submitted to Rajasthan State Pollution Control Board (RJSPCB) to initiate the process of Environmental Public Hearing (PH). PH was held on 22nd February 2021 at Anganbadi School Grounds, Kaloni Village, Tehsil Shahabad, District Baran, Rajasthan.

1.1.4 Project Benefits

Wind-Solar-Storage Hybrid Projects present a viable solution to the problem at hand and for future wherein large RE capacities are being planned to be added to National grid. Developing such integrated Wind-Solar projects along with Pumped Storage capacities independently, without impacting the existing natural water systems / irrigation systems is necessary to sustainably power the future needs of our country while maintaining grid stability.

With this in view, Greenko Group has undertaken feasibility studies to implement the 1800 MW Pumped Storage Energy which can act as a standalone power generator or act as an important component for Integrated Renewable Energy Projects (IREP).

Employment Generation

Typically, like all infrastructure projects, Shahpur PSP will generate employment opportunities during construction phase as well as operation phase. It is estimated that project would employ a workforce of about 3600 persons during the 3.0 years construction period and thereafter during project operation, permanent staff of about 300 persons will be employed.

In addition, the project would lead to creation of direct and indirect employment opportunities as new factories would come up in and around the project due to reliable power supply/availability, contract works for the locals during construction and operation phase, etc.

Local Area Development

An amount of **Rs. 15.00 crore** has been earmarked for local area development with a view to improve the quality of life of local residents in the project vicinity especially for those whose land will be acquired for the project construction. They will have opportunities for skill development, education, better medical and health care, improved local infrastructure, etc.

1.2. PROVISIONS OF ALL RELEVANT ACTS AND REGULATION

The Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India is the apex administrative body in the country for regulating and ensuring environmental protection and lays down the legal and regulatory framework for the same. The MoEF&CC and the pollution control boards Central Pollution Control Board and State Pollution Control

Boards) together form the regulatory and administrative core of the sector.

The main environmental laws, including under which various key environmental permits (or consents) are being issued in India, include the:

- The Electricity Act, 2003
- The Forest (Conservation) Act, 1980
- Air (Prevention and Control of Pollution) Act of 1977
- Environment (Protection) Act of 1986,
- Air (Prevention and Control of Pollution) Act of 1981
- Water (Prevention and Control) Act, of 1974
- Wildlife Protection Act, 1972
- Hazardous Wastes (Management and Handling) Amendments Rules, 2003
- National Environment Tribunal Act, 1995

1.2.1. The Electricity Act, 2003

The act seeks to create a framework for the power sector development by measures conducive to the industry. Electricity Act does not explicitly deal with the environmental implications of activities related to power transmission. The applicable legal provision under this act is: Section 68 (1) – sanctions from the Ministry of Power (MoP) is a mandatory requirement for taking up any new project.

1.2.2. The Forest (Conservation) Act, 1980

The Act provides for the conservation of forests and regulating diversion of forestlands for non-forestry purposes. When projects fall within forestlands, prior clearance is required from relevant authorities under the Forest (Conservation) Act, 1980. State government cannot de-reserve any forestland or authorize it use for any non-forest purposes without approval from the Central government.

1.2.3. The Environment (Protection) Act of 1986

The Environment (Protection) Act of 1986 was introduced as an umbrella legislation that provides a holistic framework for the protection and improvement to the environment.
In terms of responsibilities, the Act and the associated Rules requires for obtaining environmental clearance for specific types of new / expansion projects (addressed under Environmental Impact Assessment Notification, 1994, 2006 and amendments 2009) and for submission of an environmental statement to the State Pollution Control Board annually.

1.2.4. Air (Prevention and Control of Pollution) Act of 1981

The objective of the Act is to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carrying out the aforesaid purposes, of Boards, for confirming on and assigning to such Boards powers and functions relating thereto and matters connected therewith.

Decisions were taken at the United Nations Conference on the Human Environment held in Stockholm in June 1972, in which India participated, to take appropriate steps for the preservation of the natural resources of the earth which, among other things, includes the preservation of the quality of air and control of air pollution.

1.2.5. Water (Prevention and Control) Act, of 1974

The objectives of the Water (Prevention and Control) Act are to provide the Prevention and Control of Water pollution and the maintenance or restoration of the wholesomeness of water for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith.

1.2.6. Wildlife Protection Act, 1972

According to the Wildlife Protection Act, 1972 "wildlife" includes any animal, bees, butterflies, crustacean, fish and moths; and aquatic or land vegetation which form part of any habitat. In accordance with the Wildlife (Protection) Amendment Act, 2002 "no alteration of boundaries/National Park/ Sanctuary shall be made by the State government except on recommendation of the National Board for Wildlife (NBWL)".

Further, in terms of Supreme Court Order dated 13.11.2000 the State governments have to seek prior permission of Supreme Court before submitting the proposal for diversion of forest land in protected areas.

Whenever, any part of Wildlife Sanctuary/ National Park is getting affected by a hydro project the forest proposal in request of such project is entertained by MoEF&CC (earstwhile MoEF), GoI only after permission of de-reservation/ de-notification of Wildlife Sanctuary/ National Park has been accorded. After recommendation of Standing Committee of NBWL proposal for de-reservation/de-notification is ratified by Hon'ble Supreme Court.

1.2.7. Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016,

Hazardous Waste Management Rules are notified to ensure safe handling, generation, processing, treatment, package, storage, transportation, use reprocessing, collection, conversion, and offering for sale, destruction and disposal of Hazardous Waste. These Rules came into effect in the year 1989 and have been amended later in the years 2000, 2003, and with final notification of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 in supersession of former notification. The Rules lay down corresponding duties of various authorities such as MoEF&CC, CPCB, State/UT Govts., SPCBs/PCCs, while State Pollution Control Boards/ Pollution Control Committees have been designated with wider responsibilities touching across almost every aspect of Hazardous wastes generation, handing and their disposal.

1.2.8. Solid Waste Management Rules, 2016

The Union Ministry of Environment, Forests and Climate Change (MoEF&CC) notified the new Solid Waste Management Rules (SWM), 2016, which will replace the Municipal Solid Wastes (Management and Handling) Rules, 2000, which have been in place for the past 16 years.

These rules are the sixth category of waste management rules brought out by the ministry, as it has earlier notified plastic, e-waste, biomedical, hazardous and construction and

demolition waste management rules.

1.2.9. National Environment Tribunal Act, 1995

The Act provided strict liability for damages arising out of any accident occurring while handling any hazardous substance and for the establishment of a National Environment Tribunal for effective and expeditious disposal of cases arising from such accident, with a view to give relief and compensation for damages to persons, property and the environment and for the matters connected therewith or incidental thereto.

1.3. Villages and habitations within the area

For sustainable development, it is important to understand the social and economic conditions of the community in the area. The socio-economic profile of the project area is discussed in this section. The proposed Shahpur Pumped Storage Project is located in Shahbad tehsil of Baran district in the state of Rajasthan. The Baran district is situated at the south-eastern corner of the Rajasthan state and shares its boundaries with the Shivpuri, Shyopur, and Guna districts of Madhya Pradesh. The Baran district touches Kota district in the north-west and Jhalawar district in the south-west.

1.3.1. Socio-economic Profile of Villages in the Study Area

Socioeconomic profile of the study area is based upon Census of India, 2011 and Field Study/Survey. A major part of the study area of Shahpur PSP Project falls in Shahbad tehsil of Baran district in the state of Rajasthan whereas a very small part of the study area belongs to Guna and Bamori tehsils of Guna district in the state of Madhya Pradesh.

There is a total of 57 villages in the study area. Out of these, there are three project-affected villages namely **'Kaloni' ,'Mungawali' and 'Baint'** of Baran district**.** Out of the total 57 villages, one village namely **'**Musredi' is in Guna Tehsil and one village namely **'Vithalpur'** is in Bamori tehsil of Guna district in Madhya Pradesh state. (refer to **Table 2)**.

Table 2: List of Villages of the Study Area

S. No.	Village Name	S. No.	Village Name
Tehsil: Shahbad, District: Baran			
1	Hanotiya	29	Biharipura
2	Haryanagar	30	Khanda Sahrol
3	Sahrol Taleti	31	**Baint**
4	Shubh Dhara	32	Balharpur
5	Kushalpura	33	Sangeshwar
6	Birmani	34	Ganna Kheri
7	Kripalpur	35	Beelampur
8	Mahuri Khera	36	Mandi Barwali
9	Shahpur	37	Baman Gawan
10	Shahbad	38	Chiroli
11	**Mungawali**	39	Bhanpur
12	Suwans	40	Mandi Bhonra
13	Doondabar	41	Amkhoh
14	Gurjara	42	Nandiya
15	Gangan	43	Majhera

S. No.	Village Name	S. No.	Village Name
16	Beel Kheramal	44	Bichi
17	Pajantori	45	Balharpur
18	Bhoyal	46	Ghensuwa
19	Boodhi Bhoyal	47	Rampura Upreti
20	Tilgawan	48	Mohanpur
21	Budha Nonera	49	Suhan
22	Guwari	50	Mandi Sahjana
23	Majhari	51	Nukarra
24	Kasba Nonera	52	Tiparka
25	Sahjanpur	53	Munsredi
26	**Kaloni**	54	Pureni
27	Moondiyar	55	Tanda Kachhiyan
28	Mamoni		
District: Guna			
Tehsil: Guna		**Tehsil: Bamori**	
56	Musredi	57	Vithalpur

a) Demographic Profile of the Study Area

Socio-economic profile of the study area covering aspects like demography, occupational pattern, literacy rate, and other important socio-economic indicators of the villages. The baseline socio-economic profile is based on the Census of India 2011.

Total 7794 households with an average household size of 5 with a total population of 38465 out of which 19999 (51.99%) are male and 18466 (48.01%) are female in the study area. The sex ratio is 923 females per 1000 males. About 18.25% of the total population belongs to the 0-6 year age group, out of which 52.28% are boys and 47.72% are girl child of the same age group.

In the study area villages, about 36.37% population belongs to the Scheduled Tribes (ST) community whereas 20.19% population belongs to Scheduled Caste (SC) community. Among the ST community, 50.77% are males and 49.23% are females with a sex ratio of 970. However, among the SC community, 52.78% are males and 47.22% are females with a sex ratio of 895.

The literacy rate in the study area has been worked out to 59.13%, among males it is 74.18% while among females is 42.87% creating a gender gap of 31.31% (see **Table 3**).

Table 3: Demographic Profile of Study Area

Particulars	Number	%
Total No. of Households	**7794**	**-**
Average Household Size	**5**	**-**
Total Population	**38465**	**-**
Male	19999	51.99
Female	18466	48.01
Sex Ratio	**923**	
Population (0-6 age group)	**7020**	**18.25**
Male	3670	52.28
Female	3350	47.72
Child Sex Ratio	913	

Particulars	Number	%
Scheduled Caste (SC) Population	**7768**	**20.19**
Male	4100	52.78
Female	3668	47.22
Sex Ratio	**895**	
Scheduled Tribe (ST) Population	**13990**	**36.37**
Male	7103	50.77
Female	6887	49.23
Sex Ratio	**970**	
Total Literates	**18593**	**48.34**
Male	12113	65.15
Female	6480	34.85
Literacy Rate	-	**59.13**
Male Literacy Rate	-	74.18
Female Literacy Rate	-	42.87
Gender Gap in Literacy Rate	-	**31.31**

About 50.46% of the population in the study area is engaged in different kinds of works. Out of the total working population, 54.32% are male and 45.68% are female, creating a gender gap in the work participation rate of 8.64%.

Of the total working population, 62.80% are 'Main Workers' and 37.20% are 'Marginal Workers'. Among 'Main Workers' the gender gap of work participation is 24.58% while among Marginal Workers it 18.26% in favour of females, (refer **Table 4**).

About 84.20% working population is engaged in agricultural activities, out of which 42.36% are Cultivators and 41.84% are Agricultural Labours. A small percentage of the population is engaged as household industrial workers (2.05%) while about 13.75% are in miscellaneous services.

Table 4: Profile of Working Population in the Study Area

S. No.	Description	Number	% to Respective Total
1	Total Workers	19409	50.46 (w.r.t. total population)
	Male	10543	54.32
	Female	8866	45.68
	Gender Gap in Work Participation Rate	8.64	
2	Main Workers	12188	62.8
	Male	7592	62.29
	Female	4596	37.71
	Gender Gap in Work Participation Rate	24.58	
3	Marginal Workers	7221	37.2
	Male	2951	40.87
	Female	4270	59.13
	Gender Gap in Work Participation Rate	(-) 18.26	
4	Household Industrial Workers	398	2.05
	Male	161	40.45
	Female	237	59.55
5	Cultivators	8222	42.36
	Male	4929	59.95
	Female	3293	40.05
6	Agricultural Labour	8121	41.84
	Male	3540	43.59
	Female	4581	56.41
7	'Other Workers'	2668	13.75
	Male	1913	71.7
	Female	755	28.3

b) Basic Amenities & Infrastructure Available in the Study Area

The basic amenities like education, health, drinking water, electricity, approach road, transportation, and other facilities available in the study area are given in **Table 5**.

Table 5: Basic Amenities & Available Infrastructure in the Study Area

AMENITIES & INFRASTRUCTURE	Number of Institutions
Educational Institutions	
Pre-Primary School (Pvt.)	14
Primary School (Govt.)	27
Primary School (Pvt.)	14
Middle School (Govt.)	15
Middle School (Pvt.)	12
Secondary School (Govt.)	8
Secondary School (Pvt.)	2
Senior Secondary School (Govt.)	3
Senior Secondary School (Pvt.)	2
Health Facilities/Institutions	
Primary Health Centre	1
Primary Health Sub-centre	8
Dispensary	1
Family Welfare Centre	1
Maternity & Child Welfare Centre	2
Veterinary Hospital	1
ASHA	38
Anganwadi Centre	38
Drinking-Water	**Availability in Number of Villages**
Tap Water (Treated)	11
Tap Water (Un-treated)	7
Well (Covered)	13
Well (Un-covered)	15
Hand Pump	47
Tube wells/Borehole	15
River/Canal	6
Tank	6
Electricity Supply	
Power for Domestic Uses	39
Power for Agriculture Uses	29
Power for Commercial or Industrial Uses	16
Roads	
Black Topped (Paved/Pucca) Road	10
Gravel (Mud/Kuccha) Road	57
Footpath Road	57
Banking & Finance Institutions	
Commercial Bank	3
Co-operative Bank	3
Agricultural Credit Society	2
Self-Help Groups	1

Educational Institutions: Educational facilities play an important role in the overall development of an area. These facilities enhance economic growth and employment.

- There are 41 Pre-primary schools in the study area villages.
- There are 29 Primary Schools in the study area as per the Census 2011 record.
- There are 27 Middle Schools available in the study area.
- There are 10 Secondary Schools available in the study area.
- In the study area, there are 5 Senior Secondary Schools available (refer to **Table 5**).

Health Institutions: As per Census 2011, the available medical/health facilities/institutions in the study area are given in **Table 5.**

- There are only one Primary Health Centre and eight Primary Health Sub-centers in the study area.
- There is only one dispensary available for medical help in the area which is situated in Shahbad village.
- There is one Family Welfare Center and one Maternity & Child Welfare Center in Shahbad village, however, one Maternity & Child Welfare Center is in Baman Gawan village in the study area.
- One Veterinary Hospital is available in the Shahbad village.
- ASHA is available in 38 villages of the study area.

Drinking-Water: Hand pumps and Wells (covered & uncovered) are the major sources of drinking water. Apart from this, Tube wells/boreholes, River water, tank, and tap water is also using in some villages of the study area.

Electricity Supply: As per Census 2011, Electricity for domestic use is available in only 39 villages of the study area, while electricity for agricultural use is available in only 29 villages. However, for Commercial or Industrial uses it is available only in 16 villages of the study area.

Road Network: In the study area, only 10 villages are connected by the Black-topped roads, but all the 57 villages are facilitated with Gravel road and footpath in the study area.

Banking & Finance Institutions:

- There is 3 commercial, and 3 co-operative banks are located in villages Shubh Dhara, Kushalpura, and Shahbad.
- There are 2 Agricultural Credit Societies available in the area, out of which one is in Shahbad village and another one is in Baman Gawan village.
- Self-help groups are operational in only one village namely Musredi of the study area.

1.3.2. Demographic Profile of Project Affected Villages, i.e., Kaloni, Baint and Mungawali

Kaloni Village: As per Census 2011, the total population of the affected village Kaloni located in Shahbad Tehsil in Baran district is 1927 spread over 388 households. Out of this total population, 1000 are males and 927 are females. The sex ratio of the village is 927 females per 1,000 males. About 15.04% population belongs to the 0-6 age group. 57.65% of people in Kaloni village are literate. Out of these, 66.70% are male literates and that of females are 33.30%.

The 26.62% of the total population of the affected villages was represented by Scheduled Tribes population and Scheduled Caste population in this affected village is constitutes about 32.12% of the total population of the affected village.

Baint Village: As per Census 2011, the total population of the affected village Baint located in Shahbad Tehsil in Baran district is 312 spread over 57 households. Out of this total

population, 154 are males and 158 are females. The sex ratio of the village is 1026 females per 1,000 males.

About 22.44% population belongs to the 0-6 age group, of which 52.86% are boys and 47.14% are girl children of the same age group, as per Census 2011. In this affected village, 35.58% of people are literates. Out of these, 64.86% are male literates and that of females are 35.14%.

The total Scheduled Tribes population in the affected village Baint is 252 which represents 80.77% of the total population of the affected village. Out of this, 120 (47.62%) are males and 132 (52.38%) are females. The Scheduled Caste population in this affected village is only 42 which constitutes about 13.46% of the total population of the affected village. Out of this, 22 (52.38%) are males and 20 (47.62%) are females.

Mungawali Village: As per Census 2011, the total population of the affected village Mungawali located in Shahbad Tehsil in Baran district is 439 spreads over 87 households. Out of this total population, 228 are males and 211 are females. The sex ratio of the village is 925. About 15.26 % population belongs to the 0-6 age group, Literacy rate of Mungawali village was 63.44 % out of this 74.61 % are Male literates and that of Females are 51.40 %.

The Scheduled Caste population in this affected village is only 81 which constitutes about 18.45 % while Schedule Tribe (ST) were 10.93 % of the total population of the affected village.

1.3.3. Social Survey of Project Affected Village

Socio-economic survey was carried out by interacting with village heads, women's, youths and SC and ST community in the village in the affected villages. Discussions were carried out to understand the present socio-economic status of the village, socio-economic issues that need attention, their opinion/perception about the proposed project and expectations from the project, etc.

The project requires Land Acquisition of 624.17 Ha, out of which 407.82 ha of Forest Land and 216.35 ha of Private Land. Accordingly, the Rehabilitation & Resettlement (R&R) will be done following the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013". The details of affected land and families will be given in a separate section with Rehabilitation & Resettlement (R&R) Plan.

The key findings & observations made after the survey are enumerated below:

- It was observed that the people of the village mainly speak the Hindi language.

➢ **Scheduled Tribe Community in the Village:**

- The ST population belongs to the 'Sariya' ST community.
- The ST are mainly work as agricultural labors activities for livelihood and use forest wood for cooking.
- They are facing water scarcity for irrigation purposes.
- The community has shown its desire for better education facilities in the village for them.
- They get support from some special schemes/facilities like a Housing scheme, Land for

Landless households, etc.

- **Education Facilities:**

- In the affected village, there is one Primary School, one Middle School, and one Secondary school.
- Higher Secondary Schools are not available in the village and for this, students have to go around 3 km outside the village where the facilities are available.
- For the college-level education and Technical Training, students of the village usually travel around 13 km each side where the college and training Institutes are available.

- **Drinking-Water Facilities:**

- Tube well and Wells are the main source of drinking water for the villagers.
- Tap water is also available through the government Bore well.
- Hand Pumps are also available for drinking water in the villages but in some cases, the hand pumps are not functioning due to Ground Water Level issues.

- **Health & Sanitation Facilities:**

- There is no Primary Health Centre (PHC) or Sub-centre in the village. The nearest CHC is available at a distance of 13 km from the affected village.
- The Allopathic Hospital is not available in the village, but for any such medical issue, villagers are bounded to move approx. 75 km far from the village.
- Trained ASHA Workers are available in the village.
- In the village, houses are facilitated with the In-door and out-door toilet facility. But, due to a lack of water for domestic uses, people prefer to use the outdoor toilet.

- **Electricity/Power Supply**

- Electricity is available in the village for domestic, agricultural well as commercial or industrial uses.
- The village is connected with paved road which is in a good condition. Also, there are mud and footpath roads available in the village.
- The village has no banking institutions. People usually travel about 13 km to avail of this facility.
- Agriculture and Dairy are the main occupations & sources of income for the villagers.
- For Irrigation purposes, villagers using bore wells and hand pumps which is inadequate.
- The main crops grown in the village are Wheat, Mustard, Gram, Soybean, Orange, Guava, Ajwain, white Muesli, etc.
- In the village, an agricultural society which provides supports to the farmers for seeds & fertilizers.
- For marketing & trading purpose, farmers/villagers visit Baran and Samariya villages.
- There is a Fair Price shop available in the village.
- During the survey, the villagers told that available facilities in the village are not adequate and there is ample scope for further development, especially Irrigation and drainage facilities which need improvement.
- During the village survey, the villagers showed keen interest in the project and expecting employment opportunities from proposed project the local people.
- Farmers/landowners are expecting respectful and judicious compensation in case of any loss (land/agriculture) due to the proposed project.

1.3.4. Main Agricultural Crops Grown in the Area

Agriculture is the important occupation in the study area. According to Agro-Ecological Sub Region (ICAR) classification, the study area falls under Central Highlands (Malwa), and the Kathiawar Peninsula, Semi-Arid Eco-Region (5.2) and according to Agro Climatic Zone (NARP), it falls in the Humid South Eastern Plain Zone (RJ-9).

Most of the workers are dependent on agriculture practices and related activities for their livelihood. Irrigation of agriculture is mostly dependent on rainfall. The major crops grown in the district in the Kharif season (July – Oct) are Jowar, maize, pulses, groundnut, and soybean. Rabi (Nov – Mar) crops are grown as wheat barley, gram, linseed, mustard, garlic, and coriander. Coriander and Soybean are the main crops of the district. The district is also rich in horticulture products like Guava, Lime, Amla, Chilly, Tomato, etc.

1.3.5. Livestock's

Livestock's/ cattle's rearing is common practice in the area. Livestock's rearing is an important source of livelihood as villagers the area depend on dairy based industry and supply milk and milk based products in nearby towns like, Shahabad and Shivpuri. Animals like cow, buffalo, goats, sheep, camel, etc are common in the area.

1.3.6. Dependency on Forest Resources

Villagers in the district depend on forest resources for their day by day needs. Plants are mainly used for fuelwood, fodder, timber, and medicinal purposes. The main timber species in the forest area are *Tectona grandis*. Other commonly used tree species in the area for timber are *Haldina cordifolia*, *Terminalia tomentosa*, *Toona ciliata*, *Anogeissus latifolia,* etc. In the study area extraction of Tendu (*Diospyros melanoxylon*) leaves, from the forest area is one of the main livelihood sources of the tribal population. It is the main resource for making '*bidis'*. Other minor forest products of commercial importance such as Bamboo, Behda (*Terminalia bellirica*)*,* Chironji (*Buchanania cochinchinensis*), Amla (*Phyllanthus emblica*), etc. are collected from the forest by the villagers. Scrub forest and grassland in the area also used as grazing land for livestock's.

1.3.7. Historical, Religious and Archaeological Importance Places

No site of national importance was notified by the Archaeological survey of India in the project area. Shahbad fort in Shahbad town is the historical site in the study area. Among the religious places there are temples in every village.

1.4. Physical Environment

1.4.1. Physiography

To understand the topography of the study are, Digital Elevation Map, a Relief map, and a slope map were prepared from the Digital Elevation Model (DEM) of Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM) Version 2 data was downloaded from https://earthexplorer.usgs.gov/ from which mask of the study was extracted to prepare above mentioned thematic maps. These maps are given in **Figures 4, 5, & 6.**

Accordingly, Digital Elevation Model (DEM) was generated from SRTM data and the same is

given in **Figure 4** and according to it, the study area lies between 283 m and 551 m elevation. From the DEM, then relief map of the study area was prepared and according to it, about 44% of the project study area lies in 300m to 350 m elevation band (refer **Figure 5** and **Table 6**) and about 43% of the project components are restricted to 450m to 500m elevation band.

Table 6: Area under different elevation categories

S. No.	Elevation Band (m)	Area (Sq km)	Area (%)
1	Up to 300	8.14	1.74
2	300 – 350	208.06	44.39
3	350 – 400	21.57	4.60
4	400 – 450	26.62	5.68
5	450 – 500	203.42	43.40
	500 – 551	0.91	0.19
	Total	**468.71**	**100.00**

A slope map of the study area and data are given in **Figure 6** and **Table 7** it shows that most of the area is almost gently to moderately sloping except a few areas which are hilly tracts with a slope varying from 8 to 30 degrees.

Table 7: Area under different slope categories

S. No.	Slope Category (Degrees)	Area (Sq km)	Area (%)
1	Gently Sloping (0 – 2)	235.55	50.26
2	Moderately Sloping (2 – 8)	203.11	43.33
3	Strongly Sloping (8 – 15)	15.86	3.38
4	Moderately Steep (15 – 30)	14.06	3.00
5	Steep (30 – 45)	0.13	0.03
	Total	**468.71**	**100.00**

1.4.2. Drainage

The Shahpur PSP is an off-stream pumped storage project, which will comprise two reservoirs that are to be constructed newly. Water will be lifted one time from the existing nearby Kuno river to the proposed Shahpur PSP lower reservoir. The Kuno river is a tributary of the Chambal River, passing through districts like, Guna, Shivpuri, Baran, Sheopur and drains into the Chambal River in Morena at MP-Rajasthan border. Kuno river is 180 km long, the catchment area of the Kuno river up to Mungawali village near the proposed lifting point is 963.59 sq km.

1.4.3. Geology

Understanding geology is of prime importance for any environmental or natural hazard protection and for minimizing/managing the adverse impacts of the project. The Stability of the engineering structures depends on the basement rocks and active geological processes of the region where the project is being developed. The description of Geology is based upon PFR prepared by the project proponent. The description of Geology is based upon Pre-Feasibility studies of the project proponent. The brief of the geological aspects is detailed below in the following paragraphs.

a. Brief Regional Geology of the Project Area

i. Upper Reservoir, Intake, and Penstock Area:

The upper reservoir area is a hillock dominantly constituted of sandstone as a bedrock (**Photo 1**). Sandstone is well exposed along the periphery of the hillock proposed for the upper reservoir (**Photo 2**). Bedrock is light purple, strong, hard, compact, and un-weathered. Intake is proposed on exposed sandstone bedrock (**Photo 3**). Nature of overburden within the upper reservoir varies between clayey sand (in the vegetated area) – brown clay (active agricultural land) (**Photo 4**). The thickness of the overburden varies between 0.00m (along the hillock periphery) and 2.00m (approx. within the core area of the proposed upper reservoir rim). The actual depth of overburden in the core area will be assessed upon exploratory drilling.

Photo 1: Upper Reservoir Hillock

Photo 2: Exposed Sandstone Bedrock in Upper Reservoir Hillock

Photo 3: Area for Intake and Penstock Alignment

Photo 4: Soil Cover on Underlying Sandstone Bedrock in Core Area – Reservoir

Primary bedding observed on the bedrock is tentatively having a strike in the East-West direction is revealed from distant periphery exposures (**Photo 5**). Apart from primary bedding, two other bedding planes were also observed. High spacing, open aperture, and long persistence of these two other beddings along with primary bedding followed by weathering effect resulting in the overturning of the exposed bedrock slab along the hill periphery.

Except for the hill periphery, bedrock within the proposed upper reservoir rim is overlain by soil cover therefore, wide, and open joints, which are observed along the periphery are unseen in the core area.

Photo 5: Bedding Plane in Bedrock

ii. Lower Reservoir, Powerhouse, and Pressure Shaft Area

Good sections of local litho-stratigraphic succession have been observed along the River Kuno (left and right bank) just beyond the downstream (northern limit) of the lower reservoir. These locations are detailed as below:

S. No.	Litho-Succession	Thickness (approx. "m")	Top
1	Brown Clayey Soil	1 – 1.5	↑
2	Pebbles & Cobbles intermixed in silty, clayey sand	6 - 8	
3	Limonitic layer	0.05	
4	Greenish-grey Shale	0.3	
5	Purple Shale	Exposed – sub-surface	Bottom

- **River Kuno Road Bridge Downstream (Left Bank):** Area out of Project Location (N 25012'56.16"/ E 77012'59.31"). Litho-stratigraphic succession at this location observed as shown (**Photo 6**):

  Structural features are observed as follows:
  Primary Bedding: $N070^0/ 3^0 - 5^0$ (Dip Direction/ Dip amount)
  Other Bedding: $N332^0/ 78^0 - 80^0$
  Other Bedding: $N221^0/ 78^0 - 80^0$

Photo 6: Litho-Stratigraphic Succession Upstream of the Bridge on River Kuno – Left Bank

- **River Kuno Upstream of Road Bridge (Right Bank**): Light bank reveals the alternate bedding sequence of sandstone and shale. The thickness of sandstone varies between 8cm – 15cm whereas shale (grey & purple), lies in the range of 5cm – 6cm (**Photo 7**).

Photo 7: Alternate Shale & Sandstone Sequence along River Kuno - Right Bank

- **Start of Northern Limit of Lower Reservoir** (N25^{0}12'15.75"/ E77^{0}12'14.03") - an area covered with sandy clayey silt (**Photo 8**).

Photo 8: Surrounding in Lower Reservoir

- **Shale Exposure along Nala Section within Lower Reservoir** (N 25^{0}12'10.08"/ E 77^{0}12'10.07"): Natural Nala section at this co-ordinate reveals the existence of litho-succession of overburden material (pebble, cobbles intermixed in sandy clay matrix) followed by variegated shale (**Photo 9a & 9b**). Natural nala bed is synformal at places resulting in the creation of natural small pondage with water. This reveals that the existing shale, which forms the base for the lower reservoir, is tight and firm in-situ and will act as a water seal to hold the reservoir water upon filling. The final assessment of reservoir tightness may assess based on proposed exploratory drill holes. The typical natural succession in Nala is as below:

S. No.	Litho-Succession	Thickness (approx. 'm')	Top
1	Pebble, Cobbles intermixed in Sandy Clay matrix (including surrounding)	6 - 8	↑
2	Purple Shale	0.5	
3	Greenish-grey Shale	0.10	
4	Purple Shale	Sub-surface	Bottom

Photo 9a: Typical Natural Litho-stratigraphy within Lower Reservoir

Photo 9b: Typical Nala Section Front View – Left Bank

- **Lower Reservoir Intake Area (N 25^{0}11'39.67"/ E 77^{0}11'48.87"):** Area is nearly flat with minor undulations. Entire area is covered with clayey sand (**Photo 10a & 10b**). Tentative soil/ overburden cover may vary in the range of 0.50m – 5.00m. A natural drain exists adjacent to the proposed lower intake in the NE-SW direction with a negligible flow. The width of the drain is about 2.00m. No bedrock exposure was available in the vicinity. Based upon the type of vegetation and its density, it is to infer that shale may exist as a bedrock in the area.

Photo 10a: Lower Intake Area with minor Undulations & Overburden Cover

Photo 10b: Natural Drain Adjacent to Proposed Lower Intake

- **Powerhouse Area and Pressure Shaft Alignment (N 25^{0}11'32.66"/ E 77^{0}11'20.79"):** Powerhouse axis is aligned in N-S direction and falls on the foothill slope and No bedrock exposure observed in the vicinity, which may be due to thick overburden cover and dense vegetation on the hill slope (**Photo 11a**). The thickness of the overburden varies between 8.00m – 10.00m and consists of gravels, pebbles, cobbles, and boulders of sandstone with clayey sandy matrix (**Photo 11b**). Nature of scree material spread in the area of proposed powerhouse and pressure shaft alignment reveals that litho-contact of sandstone (exposed in the upper reservoir area and along the penstock alignment) and variegated shale (exposed in dominance within the lower reservoir and its intake) may exist within the stretch of the powerhouse and proposed vertical pressure shaft alignment.

Photo 11a: Proposed Powerhouse Area on the Foothill Slope

Photo 11b: Overburden Material In & Around the Powerhouse and Pressure Shaft Alignment

b. Seismicity of the Project Area

Although no major earthquakes are reported/known from this area. As the project area falls in Seismic Zone-I (refer to **Figure 7**), therefore, appropriate coefficients together with suitable safety factors would be used in the design of the major project components.

1.4.4. Land use/Landcover

The land use/landcover classes were followed as per the NRSC classification. The land use/ land cover map of the study area is shown in **Figure 8**. Forests comprised of Deciduous forest and Scrub forest combinedly constitute a major part of the study area accounting for 46.87% of the area. Agricultural land constitutes 31.27%, Fallow land constitutes 10.40%. Scrub land in the study area comprises of 6.71%. Rest of the class constitutes 4.75% (**see Figure 8 & Table 8**).

Table 8: Area under different land use/ landcover classes

S. No.	Land use/ Landcover	Area (Sq km)	Area (%)
1	Deciduous Forest	124.97	26.66
2	Scrub Forest	94.73	20.21
3	Scrub Land	31.44	6.71
4	Grassland	11.86	2.53
5	Gullied	0.70	0.15
6	Agricultural Land	146.56	31.27
7	Fallow Land	48.74	10.40
8	Settlement	2.09	0.45
9	Waterbodies	7.62	1.63
	Total	**468.71**	**100**

1.4.5. Meteorology

The study area of the project lies in the Baran district, which experiences mostly hot summer and dry climate except in the monsoon season. The south-west monsoon rainfall occurs from June to September in the study area with maximum rainfall occurring between these months. The temperature in the command area starts rising in February and attains its maximum value in May and then decreases. May and January are the hottest and coldest months of the year, respectively. In summer, though day temperature remains high, nights are colder and pleasant. A brief account of different meteorological attributes is given in the succeeding paragraphs.

i. Temperature

The temperature of the study area recorded monthly data for the year from 2011 to 2020. In the study area, the average maximum temperature of 41.3°C was recorded during May. The average minimum temperature of 11.0°C was recorded during January (the reference year 2011-2020).

ii. Relative Humidity

The relative humidity is generally low throughout the year, except during monsoon months when the average humidity in the study area is close to 75% in August. The summer months are generally the dry months of the year with average humidity as low as 17% in the study area (the reference year 2011-2020).

iii. Rainfall

The area receives maximum rainfall during the south-west monsoon i.e. between June and September when about 89.0% of the annual average rainfall is received and 11% of the annual average rainfall occurs between October and November post-monsoon or retreating monsoon season. The mean annual average rainfall of Shahabad tehsil of Baran district was recorded as 604.05 mm. Maximum Rainfall in the area was recorded in 2019 with an annual rainfall of 1788.7 mm with 122 rainy days. Minimum annual rainfall was recorded in the year 2015 with an annual average of 294.99 mm.

iv. Wind Speed

The wind speed is higher during the monsoon period as compared to the post-monsoon period. The average maximum wind speed of 5.1 kmph is observed during June.

1.4.6. Soil

In general, the predominant soils of the district have black soils of alluvial origin with clay loam to clay in texture and are generally non-calcareous. Its colour varies from dark brown to black. This type of soil generally occurs in plains. Red gravelly loam hilly soils are found in the southern and eastern parts of the district.

Soil Taxonomic Classification

The soil taxonomic classification map of the study area was prepared from the map of Rajasthan published by the National Bureau of Soil Survey & Land Use Planning (NBSS&LUP) i.e. Soils of Rajasthan for Optimising Land Use, NBSS Publ.51b, 1995. For interpreting soil data Soil Taxonomic Classification System published by USDA, Washington DC (1999) was followed.

The soil map prepared from this data is given in **Figure 9**. As seen from **Figure 9 and Table 9,** the majority of the study area including the area around the lower reservoir and water conductor system fall under Soil unit 351 (78.47%) characterized as deep, moderately well-drained, fine soils on a very gently sloping plateau with the clayey surface, slight erosion; associated with: Deep, well-drained, fine soils, moderately eroded. 17.62% of the study area falls under Soil unit 340, characterized by rock-outcrops.

Table 9: Soil Taxonomic groups in the Study Area

Unit	Description	Taxonomic Classification	Area (sq km)	Area (%)
340	Rock-outcrops; associated with: Shallow, well-drained, loamy-skeletal soil, on very gently sloping foot slopes, severely eroded.	• Rock-outcrops Lithic Ustochrepts	82.58	17.62
351	Deep, moderately well-drained, fine soils on a very gently sloping plateau with a clayey surface, slight erosion; associated with: Deep, well-drained, fine soils, moderately eroded.	• Typic Chromusterts Typic Chromusterts	367.81	78.47
427	Very shallow, somewhat excessively drained, loamy soils on moderately steep sloping hills with escarpments with very severe erosion and moderately stony; *associated with*: Slightly deep, somewhat excessively drained, loamy soils on moderately sloping with severe erosion and slightly stony.	• Loamy, Kaolinitic, hyperthermic, Lithic Ustorthents Fine-loamy, Kaolinitic, hyperthermic, Typic Ustochrepts	10.84	2.31

Unit	Description	Taxonomic Classification	Area (sq km)	Area (%)
453	Shallow, well-drained, loamy-skeletal soils on a moderately sloping undulating plateau (slightly dissected) with severe erosion and moderately stony; associated with: Very shallow, well-drained, loamy-skeletal soils on gently sloping with severe erosion and strongly stony.	• Loamy-skeletal, Kaolinitic, hyperthermic, Typic Ustochrepts Loamy-skeletal, Kaolinitic, hyperthermic, Lithic Ustorthents	4.93	1.05
482	Deep, moderately well-drained, calcareous, clayey soils on gently sloping flood plain (Ravenous, moderately dissected) with moderate erosion; associated with: Deep, moderately well-drained, clayey soils on very gently sloping with moderate erosion.	• Fine, mixed, (Cal.), hyperthermic, Udic Ustochrepts Fine, mixed, (Cal.), hyperthermic, Udic Haplusterts	2.55	0.54
TOTAL			**468.71**	**100**

1.5. Details of Linear Structure in Project Area

As seen from the Study area map shown below in figure 222. There is no linear structure like road, railway line, canal, water ways and other development structure in the project area. Hence no impact on any linear structure due to construction and operation of proposed project.

1.6. Description of Flora and Fauna of the Project Area

1.6.1. Floristic Diversity

i. Plant Species Recorded in the core zone and surrounding villages

As per data collected during field surveys, a list of 113 plant species belongs to 43 families is prepared and shown in **Table 10**. The list includes 39 tree species, 24 Shrub, 35 species of herbs, 7 species of grass/bamboo and 7 species of climbers.

Table 10: List of Plant Species recorded during field survey

S. No.	Botanical Name	Habit
	Acanthaceae	
1	*Achyranthes aspera*	Herb
2	*Achyranthes bidentata*	Herb
3	*Justicia adhatoda*	Shrub
4	*Barleria prionitis*	Shrub
5	*Rungia repens*	Herb
	Acoraceae	
6	*Acorus calamus*	Herb
	Anacardiaceae	
7	*Mangifera indica*	Tree
8	*Spondias pinnata*	Tree
9	*Lannea coromandelica*	Tree
	Apocynaceae	
10	*Calotropis gigantea*	Shrub
11	*Carissa spinarum*	Shrub
	Arecaceae	
12	*Phoenix acaulis*	Herb
13	*Phoenix sylvestris*	Tree
	Asparagaceae	
14	*Drimia indica*	Herb
15	*Asparagus racemosus*	Shrub
	Asteraceae	
16	*Artemisia annua*	Herb
17	*Bidens biternata*	Herb
18	*Bidens pilosa*	Herb
19	*Erigeron canadensis*	Herb
20	*Parthenium hysterophorus*	Herb
21	*Sonchus asper*	Herb
22	*Tridax procumbens*	Herb
23	*Xanthium strumarium*	Shrub
	Boraginaceae	

S. No.	Botanical Name	Habit
24	*Cordia dichotoma*	Tree
	Cactaceae	
25	*Opuntia stricta*	Herb
	Cannabaceae	
26	*Trema politoria*	Shrub
	Capparaceae	
27	*Capparis zeylanica*	Herb
28	*Capparis sepiaria*	Shrub
	Combretaceae	
29	*Terminalia bellirica*	Tree
30	*Anogeissus latifolia*	Tree
31	*Tephrosia purpurea*	Herb
32	*Terminalia chebula*	Tree
33	*Terminalia tomentosa*	Tree
	Convolvulaceae	
34	*Cuscuta reflexa*	Herb
35	*Ipomoea carnea*	Shrub
36	*Ipomoea pes-tigridis*	Herb
	Cyperaceae	
37	*Cyperus compressus*	Grass
	Dioscoreaceae	
38	*Dioscorea hispida*	Climber
	Euphorbiaceae	
39	*Mallotus philippinensis*	Tree
40	*Euphorbia hirta*	Herb
41	*Ricinus communis*	Shrub
	Fabaceae	
42	*Abrus precatorius*	Climber
43	*Bauhinia racemosa*	Tree
44	*Bauhinia vahlii*	Climber
45	*Butea monosperma*	Tree
46	*Butea superba*	Climber
47	*Crotalaria medicaginea*	Herb
48	*Dalbergia paniculata*	Tree
49	*Desmodium oojeinense*	Tree
50	*Erythrina suberosa*	Tree
51	*Mimosa pudica*	Shrub
52	*Pterocarpus marsupium*	Tree
53	*Senegalia catechu*	Tree
54	*Senegalia pennata*	Climber
55	*Senna obtusifolia*	Shrub
56	*Senna siamea*	Tree
57	*Senna tora*	Herb
58	*Tamarindus indica*	Tree

S. No.	Botanical Name	Habit
59	*Vachellia nilotica*	Tree
	Lamiaceae	
60	*Ocimum basilicum*	Herb
61	*Ocimum sanctum*	Herb
62	*Tectona grandis*	Tree
	Liliaceae	
63	*Gloriosa superba*	Climber
	Lythraceae	
64	*Woodfordia fruticosa*	Shrub
	Malvaceae	
65	*Abutilon indicum*	Shrub
66	*Corchorus aestuans*	Herb
67	*Grewia hirsuta*	Shrub
68	*Grewia tiliifolia*	Tree
69	*Helicteres isora*	Shrub
70	*Sterculia urens*	Tree
71	*Thespesia lampas*	Shrub
	Meliaceae	
72	*Azadirachta indica*	Tree
73	*Melia azedarach*	Tree
	Moraceae	
74	*Ficus benghalensis*	Tree
75	*Ficus racemosa*	Tree
76	*Ficus religiosa*	Tree
	Myrtaceae	
77	*Syzygium cumini*	Tree
	Nyctaginaceae	
78	*Boerhavia diffusa*	Herb
	Papaveraceae	
79	*Argemone mexicana*	Herb
	Phyllanthaceae	
80	*Phyllanthus emblica*	Tree
81	*Phyllanthus reticulatus*	Shrub
	Plantaginaceae	
82	*Lindenbergia indica*	Herb
	Poaceae	
83	*Aristida setacea*	Grass
84	*Chrysopogon fulvus*	Grass
85	*Cymbopogon martini*	Grass
86	*Dendrocalamus strictus*	Grass
87	*Dichanthium annulatum*	Grass
88	*Eragrostis tenella*	Grass
89	*Heteropogon contortus*	Grass
90	*Saccharum munja*	Grass
	Primulaceae	
91	*Embelia robusta*	Shrub
	Rhamnaceae	
92	*Ziziphus nummularia*	Herb

S. No.	Botanical Name	Habit
93	*Ziziphus jujuba*	Tree
94	*Ziziphus xylopyrus*	Shrub
	Rubiaceae	
95	*Mitragyna parviflora*	Tree
96	*Gardenia latifolia*	Tree
97	*Haldina cordifolia*	Tree
	Rutaceae	
98	*Aegle marmelos*	Tree
99	*Chloroxylon swietenia*	Tree
100	*Murraya paniculata*	Shrub
	Salicaceae	
101	*Flacourtia indica*	Shrub
102	*Flacourtia indica*	Shrub
	Sapindaceae	
103	*Dodonaea viscosa*	Herb
104	*Schleichera oleosa*	Tree

S. No.	Botanical Name	Habit
105	*Smilax macrophylla*	Climber
	Solanaceae	
106	*Datura metel*	Herb
107	*Solanum virginianum*	Herb
	Symplocaceae	
108	*Symplocos racemosa*	Herb
	Ulmaceae	
109	*Holoptelea integrifolia*	Tree
	Verbenaceae	
110	*Gmelina arborea*	Tree
111	*Lantana camara*	Shrub
	Vitaceae	
112	*Leea macrophylla*	Herb
	Zygophyllaceae	
113	*Tribulus terrestris*	Herb

ii. Plant Species Reported from the Study Area (Core and Buffer Zone)

The detail inventory of Plant species reported from the study area has been prepared based on primary survey and same has been supplemented with available secondary data. An inventory of 203 species of plants belonging to angiosperms was compiled which includes plant species found in forested areas, scrub land, near agricultural fields and settlements, abandoned land, etc. List of plant species recorded from the area is given in **Annexure I.** This list includes 62 species of trees, 55 species of shrubs, 86 herbaceous plants including grasses and climbers. Most of the vegetation is found mainly in the forest area. Dominant families in the area are Fabaceae and Poaceae followed by Apocynaceae, Malvaceae, and Asteraceae.

iii. Rare, Endangered and Threatened (RET) Species

None of the plant species found in the study area falls under Threatened category of RED Data Book of Indian Plants. As per IUCN Red List of Threatened Species Version 2022-2, Majority of the species have not been evaluated or assessed yet by IUCN (2022-2). The majority of the species have not been assessed yet by IUCN, while out of 58 species that have been assessed, 57 species falls under the 'Least Concern' category (LC) and one species under the 'Data Deficient' category (DD) (see **Table 11** below).

Table 11: Conservation Status of Plant Species

S. No.	Family/ Scientific Name	Conservation Status IUCN 2022-2
	Acoraceae	
1	*Acorus calamus*	LC
	Anacardiaceae	
2	*Mangifera indica*	DD
	Annonaceae	
3	*Annona squamosa*	LC
	Anthericaceae	
4	*Chlorophytum tuberosum*	LC
	Apocynaceae	

S. No.	Family/ Scientific Name	Conservation Status IUCN 2022-2
5	*Carissa spinarum*	LC
6	*Holarrhena pubescens*	LC
7	*Nerium oleander*	LC
8	*Wrightia tinctoria*	LC
	Araceae	
9	*Colocasia esculenta*	LC
	Asparagaceae	
10	*Asparagus racemosus*	LC
	Boraginaceae	

S. No.	Family/ Scientific Name	Conservation Status IUCN 2022-2
11	*Cordia dichotoma*	LC
	Cactaceae	
12	*Opuntia elatior*	LC
13	*Opuntia stricta*	LC
	Capparaceae	
14	*Capparis sepiaria*	LC
	Colchicaceae	
15	*Gloriosa superba*	LC
	Cornaceae	
16	*Alangium salviifolium*	LC
	Cucurbitaceae	
17	*Mukia maderaspatana*	LC
	Cyperaceae	
18	*Cyperus rotundus*	LC
	Euphorbiaceae	
19	*Jatropha curcas*	LC
	Fabaceae	
20	*Acacia nilotica*	LC
21	*Acacia pennata*	LC
22	*Albizia lebbeck*	LC
23	*Albizia procera*	LC
24	*Bauhinia variegata*	LC
25	*Butea monosperma*	LC
26	*Caesalpinia decapetala*	LC
27	*Cassia fistula*	LC
28	*Dalbergia sissoo*	LC
29	*Delonix regia*	LC
30	*Hardwickia binata*	LC
31	*Mimosa pudica*	LC
32	*Parkinsonia aculeata*	LC
33	*Pithecellobium dulce*	LC
34	*Pongamia pinnata*	LC
35	*Tamarindus indica*	LC
36	*Tephrosia purpurea*	LC

S. No.	Family/ Scientific Name	Conservation Status IUCN 2022-2
	Lamiaceae	
37	*Vitex negundo*	LC
	Lythraceae	
38	*Woodfordia fruticosa*	LC
	Malvaceae	
39	*Bombax ceiba*	LC
40	*Grewia tenax*	LC
41	*Kydia calycina*	LC
	Meliaceae	
42	*Azadirachta indica*	LC
43	*Melia azedarach*	LC
	Moraceae	
44	*Ficus hispida*	LC
45	*Ficus racemosa*	LC
	Myrtaceae	
46	*Corymbia citriodora*	LC
47	*Syzygium cumini*	LC
	Phyllanthaceae	
48	*Bridelia retusa*	LC
49	*Phyllanthus emblica*	LC
50	*Phyllanthus reticulatus*	LC
	Plantaginaceae	
51	*Lindenbergia indica*	LC
	Poaceae	
52	*Brachiaria eruciformis*	LC
53	*Cynodon dactylon*	LC
54	*Echinochloa colona*	LC
55	*Saccharum spontaneum*	LC
	Rhamnaceae	
56	*Ziziphus jujuba*	LC
	Rubiaceae	
57	*Gardenia gummifera*	LC
	Rutaceae	
58	*Aegle marmelo*	LC

1.6.2. Faunal Diversity

a) Mammals

A list of 19 species of mammals with their conservation status reportedly found in the study area was compiled and the same is given in **Table 12**.

Table 12: List of Mammalian Species Reported in the Study Area

S. No.	Order/ Family	Common Name	Scientific Name	Conservation Status	
				IUCN 2022-2	WPA 1972
	CARNIVORA				
1	Canidae	Fox	*Vulpes bengalensis*	LC	II
2	Canidae	Jackal	*Canis aureus*	LC	II
3	Felidae	Common Leopard	*Panthera Pardus*	VU	I
4	Herpestidae	Mongoose	*Herpestes edwardsii*	LC	II
5	Ursidae	Sloth Bear	*Melursus ursinus*	VU	I
6	Hyaenidae	Striped Hyena	*Hyaena hyaena*	NT	I
7	Viverridae	Small Indian Civet	*Viverricula indica*	LC	II

S. No.	Order/ Family	Common Name	Scientific Name	Conservation Status	
				IUCN 2022-2	WPA 1972
8	Herpestidae	Indian Grey Mongoose	*Herpestes edwardsii*	LC	II
	CETARTIODACTYLA				
9	Bovidae	Nilgai/Blue Bull	*Boselaphus tragocamelus*	LC	III
10	Cervidae	Sambar	*Rusa unicolor*	VU	III
11	Cervidae	Chital	*Axis axis*	LC	III
12	Suidae	Wild Boar	*Sus scrofa*	LC	III
	LAGOMORPHA				
13	Leporidae	Common Hare	*Lepus nigricollis*	LC	IV
	PRIMATES				
14	Cercopithecidae	Rhesus macaque	*Macaca mulatta*	LC	II
15	Cercopithecidae	Common Langur	*Semnopithecus entellus*	LC	II
	RODENTIA				
16	Hystricidae	Porcupine	*Hystrix indica*	LC	IV
17	Sciuridae	Five-striped Palm Squirrel	*Funambulus pennantii*	LC	IV
	Chiroptera				
18	Pteropodidae	Bat	*Rousettus leschenaulti*	LC	IV
	Eulipotyphla				
19	Soricidae	House Shrew	*Suncus murinus*	LC	-

IUCN Ver.2022-2- *International Union for Conservation of Nature; LC - Least Concern; VU: Vulnerable; WPA – Wildlife (Protection) Act, 1972*

b) Avifauna

Birds sighted during the survey were identified using the field guide of birds by Ali & Ripley (1983), Grimmett *et al.* (1998, 2011), Inskipp *et al.* (1999), and Kazmierczak (2000). The classification and nomenclature of bird species are as per https://avibase.bsc-eoc.org. During the field surveys, 53 species of birds belonging to 12 Orders were recorded from the study area. A list of bird species composition and their conservation status has been described in **Table 13.**

Table 13: List of birds reported from the study area with their conservation status

S. No.	Family	Common Name	Scientific name	Residential Status	Conservation Status	
					IUCN (2022-2)	WPA, 1972
	Order: Anseriformes					
1	Anatidae	Indian Spot-billed Duck	*Anas poecilorhyncha*	R	LC	IV
	Order: Bucerotiformes					
2	Upupidae	Common Hoopoe	*Upupa epops*	R	LC	IV
	Order: Charadriiformes					
3	Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	R	LC	IV
4	Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*	R	LC	IV
5	Scolopacidae	Wood Sandpiper	*Tringa glareola*	WV	LC	IV
	Order: Apodiformes					
6	Apodidae	Little Swift	*Apus affinis*	R	LC	IV
	Order: Columbiformes					
7	Columbidae	Laughing Dove	*Streptopelia senegalensis*	R	LC	IV
8	Columbidae	Spotted Dove	*Spilopelia suratensis*	R	LC	IV
9	Columbidae	Eurasian Collard-Dove	*Streptopelia decaocto*	R	LC	IV
10	Columbidae	Rock Dove	*Columba livia*	R	LC	IV

S. No.	Family	Common Name	Scientific name	Residential Status	Conservation Status	
					IUCN (2022-2)	WPA, 1972
	Order: Coraciiformes					
11	Alcedinidae	Common Kingfisher	*Alcedo atthis*	R	LC	IV
12	Alcedinidae	Pied Kingfisher	*Ceryle rudis*	R	LC	IV
13	Alcedinidae	White-throated Kingfisher	*Halcyon gularis*	R	LC	IV
14	Coraciidae	Indian Roller	*Coracias benghalensis*	R	LC	IV
15	Meropidae	Asian Green Bee-eater	*Merops orientalis*	R	LC	IV
	Order: Cuculiformes					
16	Cuculidae	Western Koel	*Eudynamys scolopaceus*	R	LC	IV
17	Cuculidae	Greater Coucal	*Centropus sinensis*	R	LC	IV
	Order: Passeriformes					
18	Alaudidae	Rufous-tailed Lark	*Ammomanes phoenicura*	R	LC	IV
19	Cisticolidae	Common tailorbird	*Orthotomus sutorius*	R	LC	IV
20	Cisticolidae	Rofous-Fronted Prinia	*Prinia buchanani*	R	LC	IV
21	Cisticolidae	Graceful Prinia	*Prinia gracilis*	R	LC	IV
22	Cisticolidae	Grey-breasted Prinia	*Prinia hodgsonii*	R	LC	IV
23	Cisticolidae	Ashy Prinia	*Prinia socialis*	R	LC	IV
24	Corvidae	Large-billed Crow	*Corvus macrorhynchos*	R	LC	IV
25	Corvidae	House Crow	*Corvus splendens*	R	LC	V
26	Corvidae	Rufous Treepie	*Dendrocitta vagabunda*	R	LC	IV
27	Dicruridae	Black Drongo	*Dicrurus macrocercus*	R	LC	IV
28	Estrildidae	Scaly-breasted Munia	*Lonchura punctulata*	R	LC	IV
29	Hirundinidae	Wire-tailed Swallow	*Hirundo smithii*	R	LC	IV
30	Laniidae	Long-tailed Shrike	*Lanius schach*	R	LC	IV
31	Leiothrichidae	Jungle Babbler	*Turdoides striata*	R	LC	IV
32	Motacillidae	White Wagtail	*Motacilla alba*	WV	LC	IV
33	Motacillidae	Western Yellow Wagtail	*Motacilla flava*	WV	LC	IV
34	Muscicapidae	Brown Rock Chat	*Oenanthe fusca*	R	LC	IV
35	Muscicapidae	Oriental Magpie-Robin	*Copsychus saularis*	R	LC	IV
36	Muscicapidae	Indian Robin	*Saxicoloides fulicatus*	R	LC	IV
37	Passeridae	House Sparrow	*Passer domesticus*	R	LC	IV
38	Ploceidae	Baya Weaver	*Ploceus philippinus*	R	LC	IV
39	Pycnonotidae	Red-vented Bulbul	*Pycnonotus cafer*	R	LC	IV
40	Sturnidae	Common Myna	*Acridotheres tristis*	R	LC	IV
41	Sturnidae	Asian Pied Starling	*Gracupica contra*	R	LC	IV
42	Sturnidae	Brahminy Starling	*Sturnia pagodarum*	R	LC	IV
	Order: Pelecaniformes					
43	Ardeidae	Grey Heron	*Ardea cinerea*	R/WV	LC	IV
44	Ardeidae	Indian Pond-Heron	*Ardeola grayii*	R	LC	IV
45	Ardeidae	Cattle Egret	*Bubulcus ibis*	R	LC	IV
46	Ardeidae	Little Egret	*Egretta garzetta*	R	LC	IV
	Order: Piciformes					
47	Ramphastidae	Coppersmith Barbet	*Psilopogon haemacephalus*	R	LC	IV
	Order: Psittaciformes					
48	Psittaculidae	Rose-ringed Parakeet	*Psittacula krameri*	R	LC	IV
	Order: Suliformes					
49	Phalacrocoracidae	Little Cormorant	*Microcarbo niger*	R	LC	IV
	Order: Gruiformes					
50	Rallidae	Common Moorhen	*Gallinula chloropus*	R	LC	IV

S. No.	Family	Common Name	Scientific name	Residential Status	Conservation Status	
					IUCN (2022-2)	WPA, 1972
51	Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*	R	LC	IV
	Order: Galliformes					
52	Phasianidae	*Pavo cristatus*	Indian Peafowl	LC	I	RR
	Order: Strigiformes					
53	Strigidae	Eurasian Eagle-owl	*Bubo bubo*	R	LC	IV

IUCN Red List of Threatened Species. Version 2022-2.; LC - Least Concern; IWPA – Wildlife (Protection) Act, 1972, LC: Least Concern; R: Resident; WV Winter Visitor

c) Herpetofauna

During the surveys, 2 reptiles viz; Northern House Gecko and Garden lizard were sighted in the study area. Based on the sighting and information available in the Forest Working Plan a list of herpetofauna is given below in **Table 14.**

Table 14: List of Herpetofauna Reported from the Study Area

S. No.	Family	Scientific name	Common name	Conservation Status	
				IUCN (2022-2)	WPA, 1972
CLASS: AMPHIBIA					
	Order Anura				
1	Dicroglossidae	*Duttaphrynus stomaticus*	Marbled Toad	LC	-
2	Dicroglossidae	*Duttaphrynus melanostictus*	Common Indian Toad	LC	-
3	Dicroglossidae	*Hoplobatrachus tigerinus*	Indian Bull Frog	LC	IV
4	Dicroglossidae	*Sphaerotheca breviceps*	Indian Burrowing Frog	LC	IV
CLASS: REPTILIA					
	Order: Squamata				
5	Boidae	*Eryx johnii*	Indian sand Boa	NT	IV
6	Colubridae	*Ptyas mucosa*	Rat snake	LC	II
7	Elapidae	*Bungarus caeruleus*	Krait	LC	IV
8	Elapidae	*Naja naja*	Indian Cobra	LC	II
9	Pythonidae	*Python molurus*	Python	NT	I
10	Viperidae	*Vipera russelli*	Russell's Viper	LC	II
11	Agamidae	*Calotes versicolor*	Indian Garden Lizard	LC	-
12	Chamaeleonidae	*Chamaeleo zeylanicus*	Indian Chameleon	LC	II
13	Varanidae	*Varanus bengalensis*	Indian Monitor Lizard	NT	I
14	Gekkonidae	*Hemidactylus flaviviridis*	Northern House Gecko	LC	-

(*The list has been compiled based on description given in the Forest Working Plan of Baran Forest Division and information collected during the public consultation and about the study area*).

d) Butterflies

During the field survey, only 7 species of butterfly were recorded from the study area (**Table 15**). These butterflies belong to the families Nymphalidae, and Pieridae. These are frequently observed along the river, scrub forest, and borewells/ handpumps near settlements.

Table 15: Butterflies recorded from Study Area

S. No.	Family	Common Name	Scientific name	Conservation Status	
				IUCN (2022-2)	WPA, 1972
1	Nymphalidae	Plain Tiger	*Danaus chrysippus*	LC	-
2	Nymphalidae	Common leopard	*Phalanta Phalantha*	LC	-
3	Nymphalidae	Blue Pansy	*Junonia orithya*	LC	-

S. No.	Family	Common Name	Scientific name	Conservation Status	
				IUCN (2022-2)	WPA, 1972
4	Nymphalidae	Lemon Pansy	*Junonia lemonias*	-	-
5	Nymphalidae	Danaid Eggfly	*Hypolimnas misippus*	LC	II
6	Pieridae	Common Emigrant	*Catopsilia pomona*	-	-
7	Pieridae	Cabbage White	*Pieris brassicae*	LC	-

e) Conservation Status of Fauna

Different faunal species like mammals and birds were assessed for their conservation status according to IUCN Red List categories (Ver. 2022-2) accessed in April 2022 and WPA (1972) Schedules. Common Leopard, Sloth Bear, Indian Peafowl, Indian Python and Bengal Monitor Lizard are the faunal species listed as Schedule I of IWPA (1972) reported from the study area. Among the bird sighted during the field survey, none of the avifaunal species is under any category of the IUCN Red List of Threatened Species version 2022-2. As per the Wildlife (Protection) Act 1972 Indian Peafowl in listed as Schedule-I species, rest of the species are Schedule IV and Schedule V.

1.7. Description of Forest and Habitat Condition

The project area falls in the Baran Forest Division under Kota Circle, Forest Department, Government of Rajasthan. As seen from the land use map of the study area, a large part of the vegetation is comprised of forests especially in the surrounding of proposed project components. These forests in the study area can be classified following the 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968) fall under Group 5: Dry Tropical Dry Deciduous (**Table 16**)**.**

Table 16: Forest types found in the Study Area

Group	Sub-Group	Forest Type
Group 5. Tropical Dry Deciduous Forests	5B-Northern Tropical Dry Deciduous Forests	5B/C2 Northern dry mixed deciduous forest
		5E1/DS1 *Anogeissus pendula* scrub forest

1.7.1. Vegetation Profile of the Study Area

The project study area falls under the Baran Forest Division, Government of Rajasthan. The area is characterized by undulating terrain dominant with forest and Scrubland. Forest in the study area comprises of Northern dry mixed deciduous forest on slopes of hillocks, along the drainages and scrub vegetation around the habitation and degraded/ fallow land.

In the study area Northern dry mixed deciduous forests occurs on the slopes of hillocks comprises of tree species like *Tectona grandis, Anogeissus pendula, Diospyros melanoxylon, Madhuca longifolia, Terminalia tomentosa, Terminalia bellirica, Lannea coromandelica, Boswellia serrata, Albizia lebbeck, Butea monosperma, Syzygium cumini, Desmodium oojeinense, Bombax ceiba,* etc.

Vegetation on Scrub forest and scrub land in the study area *was* represented by species like *Acacia nilotica, Aegle marmelos, Cassia fistula, Bauhinia racemosa, Grewia tiliifolia, Phyllanthus emblica, Bridelia retusa* and *Ziziphus jujuba*.

Among the trees, *Azadirachta indica*, *Madhuca longifolia, Mangifera indica, Cassia fistula, Dalbergia sissoo, Aegle marmelos*, *Syzygium cumini*, *Morus alba*, *Desmodium oogeinense*, *Acacia nilotica, Albizia lebbeck, Phyllanthus emblica,* and *Ziziphus* species are the most common tree species found growing near the settlements. *Tectona grandis* (Teak) was observed as a plantation along the road and the bunds of agricultural fields.

The bushes are comprised of shrubs like *Asparagus racemosus, Butea superba, Justicia adhatoda, Lantana camara, Murraya koenigii, Phyllanthus reticulatus, Trema politoria* and *Woodfordia fruticosa* are commonly found on margins of forest. The species like *Abutilon indicum, Datura stramonium, Helicteres isora, Murraya koenigii, Senna obtusifolia, Woodfordia fruticosa, Xanthium strumarium,* and *Ziziphus xylopyrus* are found in scrub forest and scrub land. Commonly found herbaceous species are *Ajuga integrifolia, Andrographis paniculata, Argemone mexicana, Bidens pilosa, Boerhavia diffusa, Capparis zeylanica, Flemingia chappar, Galium aparine, Lindenbergia indica, Rumex hastatus, Rungia repens, Senna tora, Tribulus terrestris, Solanum americanum* and *Sonchus asper* and are found around Scrubland and open/ scrub forest.

Grasses in the study area are represented by species like *Apluda mutica, Aristida adscensionis, Brachiaria eruciformis, Cenchrus ciliaris, Dichanthium aristatum, Digitaria ciliaris, Heteropogon contortus, Saccharum spontaneum, Themeda quadrivalvis,* and *Vetiveria zizanioides.*

1.7.2. Faunal Species Sighted During Survey

a) Mammals

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

In addition, the presence of *Panthera pardus* (Leopard), Sloth Bear (*Melursus ursinus*), *Axis axis* (Spotted deer), *Vulpes bengalensis* (Fox) and *Canis aureus* (Jackal), were also confirmed by villagers. The Forest Working Plan of Baran Forest Division has reported the presence of mammals like Leopard (*Panthera Pardus*), Sloth Bear (*Melursus ursinus*), Common Wolf (*Canis lupus*), Spotted Dear (*Axis axis*), Sambar Deer (*Rusa unicolor*), and Chinkara (*Gazella gazella*), etc., in their jurisdiction. However, during the field surveys, none of these mammalian species were sighted in the study area. Locals also did not confirm the probable presence or sighting of Common Wolf, Sloth bear, Sambar Deer and Chinkara in the study area.

b) Avifauna

During the field surveys, 53 species of birds belonging to 12 Orders were recorded from the study area. Birds like House sparrow, White-Throated Kingfisher, Dove, Common Myna, House crow, Red-wattled Lapwing, Red-vented bulbul, Indian Peafowl, Rock Pigeon, Black Drongo, and Cattle Egret were most frequently sighted bird species in the study area. Most of the birds recorded are resident in nature. Bird species like Wood Sandpiper, White Wagtail and Western Yellow Wagtail are winter visitor in the area.

c) Herpetofauna

The sampling for herpetofauna was carried along the bunds of the proposed reservoir area, around the periphery of the reservoir, and ponds and area along the existing and proposed water conductor system. Sampling was repeated during evening time also. Visual Encounter Survey (VES) search was followed for recording herpetofauna (amphibians and reptiles). During the surveys, 2 reptiles viz; Northern House Gecko and Garden lizard were sighted in the study area.

d) Butterflies

During the field survey, only 7 species of butterfly were recorded from the study area. These butterflies belong to the families Nymphalidae, and Pieridae. Plain Tiger (*Danaus chrysippus*), Blue Pansy (*Junonia orithya*), Lemon Pansy (*Junonia lemonias*), Common Emigrant (*Catopsilia Pomona*), Cabbage White (*Pieris brassicae*) are frequently observed along the river, scrub forest, and borewells/ handpumps near settlements.

MAMMALS SIGHTED DURING FIELD SURVEY

		
Common langur	**Rhesus macaque**	**Blue Bull**
		
Five-striped Palm Squirrel	**Jackal**	**Mongoose**

Some of the bird species sighted during the surveys

		
Little Egret	**Laughing Dove**	**White-throated Kingfisher**

		
Large-billed Crow	**Sparrow**	**Long-tailed Shrike**
		
Little Cormorant	**Red-vented Bulbul**	**Indian Robin**
		
Asian Pied Starling	**Red-wattled Lapwing**	**White-breasted Waterhen**
		
Pond Heron	**Common Myna**	**Spotted Dove**
		
Brahminy Starling	**Common Wood-pigeon**	**Indian Roller**
		
Jungle Babbler	**Black Drongo**	**Oriental Magpie-Robin**

1.7.3. Protected Areas

Proposed project is located within newly declared Shahabad Conservation Reserve. Scoping Clearance for Shahpur Pumped Storage was accorded by MoEF&CC on April 2020, while the Shahabad Conservation Reserve was notified by Govt. of Rajasthan on 28th October 2021. Map showing location of components with respect to Shahabad Conservation Reserve is shown in **Figure 10**.

The other nearest Protected Areas to the project components are in Madhya Pradesh i.e. Madhav National Park and Kuno National Park having aerial distance more than 40 km from the project site. Map showing location of components Madhav National Park and Kuno National Park is shown in **Figure 11**.

As per the WPA, 1972 (subsequent amendments) Conservation reserve do not enjoy the same level of protection status as compared to National Parks and Sanctuaries. Further, as per the MoEF & CC guidelines dated 06.05.2022, projects falling in Conservation Reserve does not attract Wildlife Clearance. However, considering the presence of Conservation Reserve, a detailed Wildlife Conservation Plan has been prepared and incorporated in the EIA/EMP report.

1.8. Wildlife Movement in the Area

The proposed project is being constructed in the jurisdiction of Rajasthan Forest Department. The forest land in the area is comprised of dry Deciduous and Scrub Forest lies in Shahabad Conservation Reserve. Although the project area is in Shahabad conservation Reserves, however the project site is surrounded by habitation.

Sighting of mammals like *Semnopithecus entellus* (Common Langur)*, Macaca mulatta* (Rhesus macaque), *Sus scrofa* (Wild Boar) and *Lepus nigricollis* (Common Hare), *Herpestes edwardsii* (Indian Grey Mongoose), *Canis aureus* (Jackal), and *Funambulus pennantii* (Five-striped Palm Squirrel) were common in the area. In addition to these villagers also confirmed the presence of *Panthera pardus* (Leopard), *Axis axis* (Spotted deer), and *Vulpes bengalensis* (Fox), in the area.

1.9. Man-Animal Conflict and Depredation Caused By The Wild Animals

Proposed project is surrounded by forest, although there is agriculture field and human settlement also. Deforestation, growing human settlements, expansion of agricultural land and fragmentation of natural habitat and grazing ground of species like Wild Boar, Nilgai/Blue Bull, Sloth bear and habitat other wild animals are the causes behind rising of human wildlife conflict. In the study area human-wildlife conflict in terms of crop damage is perhaps more common and causes huge loss to the farmers.

Also, the expansion of agriculturally used land, encroachment of humans and their livestock into forest areas are main factors contributing to habitat loss and decrease of wild prey. As a result, animals like Leopard, Sloth Bear Jackal and Fox approach human settlements, where they are tempted to prey on domestic livestock like cattle, dogs, and goats, which constitutes an important part of their diet if they live on the periphery of human habitations. In retaliation for attacks on livestock, wild animals are trapped in brutal snares.

During the survey villages revealed that the human wildlife conflict is common, but villagers doesn't report the cases to avoid the dispute over the land boundary with forest department.

1.10. Indicative Plans of the Present Projects

Institutional arrangement for planning and implementing various mitigation and management measures along with environment monitoring are given at **Table 17.**

Table 17: Environmental Management Plan for Proposed Project Area

S. No.	Activities	Implementing Agency	Monitoring/ Supervising/ Approving Agency
1	Compensatory Afforestation Programme	Forest Department	Forest Department
2	Biodiversity Conservation and Wildlife Management Plan	State Forest Department	State Forest Department
3	Muck Management	Contractor	Greenko Energies Pvt. Ltd./ SPCB
4	Sanitation and Solid Waste Management	Contractor	Greenko Energies Pvt. Ltd./ SPCB
5	Public Health Delivery System	Contractor	Greenko Energies Pvt. Ltd./ District Administration (Health Department)
6	Energy Conservation Measures	Contractor	Greenko Energies Pvt. Ltd./ SPCB/ Forest Department
7	Control of Air, Noise and Water Pollution	Contractor	Greenko Energies Pvt. Ltd./ SPCB
8	Rehabilitation and Resettlement Plan	Greenko Energies Pvt. Ltd.	District Administration
9	Disaster Management	Greenko Energies Pvt. Ltd.	District Administration
10	Local Area Development Plan	Greenko Energies Pvt. Ltd.	District Administration
11	Environmental Monitoring	Greenko Energies Pvt. Ltd.	SPCB
12	Submission of half yearly compliance report on 1st June and 1st December of each calendar year	Greenko Energies Pvt. Ltd.	MoEF&CC

1.11. The List of Experts Involved And Sampling Procedures Adopted

Ecology and Biodiversity experts of R S Envirolink Technologies Pvt. Ltd. (RSET), a QCI-NABET accredited consulting organisation visited the Project site for Ground-truthing. The study was carried out in direct influence zone of the proposed project i.e. the main project components like Powerhouse, proposed upper and lower reservoirs and approach roads, etc. and area with in 10.0km radius of the proposed project components. The field surveys for the collection of primary data commenced from March 2020 and were completed in December 2020 covering pre-monsoon/summer, monsoon, and winter seasons to collect data/ information on terrestrial ecology and physical environment parameters.

The main objectives of the floristic studies is to prepare an inventory of plants species distributed around the project area as well as with 10.0km radius of proposed project components. The study has been conducted covering the locations of proposed project components. Vegetation survey was done to cover different land use/ land cover categories like Forest area (open and Scrub Forest), Scrubland near agricultural fields, fallow/ abandoned land, and vegetation along the bank of water bodies, etc. Florestic surveys of the vegetation were conducted at 6 sampling locations. The selection of sampling sites for vegetation analysis was based on the land use pattern in the study area. A list of sampling locations is given in **Table 18.**

Table 18: Sampling Locations for Floristic and Faunal Survey

Site Code	Sampling Location	Land use	Latitude	Longitude
V1/ Tr1	Near Shahabad	Open Forest	25°13'1.30"N	77° 8'15.74"E
V2/ Tr2	Near Pindasal Village	Scrub Land	25°13'25.27"N	77°11'19.79"E
V3/ Tr3	Proposed Lower Reservoir Area	Open Forest	25°11'25.74"N	77°11'44.85"E
V4/ Tr4	Proposed Upper Reservoir Area	Scrub Land	25°11'55.89"N	77° 9'54.44"E
V5/ Tr5	Khanda Sahrol Village	Scrub Land	25° 9'43.30"N	77° 9'16.23"E
V6/ Tr6	Majhari Village	Fallow Land	25°11'38.42"N	77°14'4.07" E

The faunal survey was carried out for the species of Mammals, Birds, Herpetofauna, and butterflies. For the preparation of the checklist of animals, the Forest Working Plan of the Baran Forest Division was consulted. In addition, data was compiled from published literature like Prater (1998) for mammals, Daniel (2002) for reptiles, and Ali & Ripley (1983) for birds.

Sampling Methodology & Constraints

A systematic field visit was carried out in the study area during day hours. The survey of wild animals was conducted by using 10x50 prismatic field binocular and handheld GPS 72 in different locations. The presence of wildlife was also confirmed by the local inhabitants depending on the animal sightings and the frequency of their visits in the catchment and study area. In addition to these, secondary sources mainly literature was also referred to for preparing checklists and other analysis in the study of animals and wildlife in the region. The sampling locations of transects for faunal surveys are given in **Table 18**.

1.12. Brief Note About Literature Reviewed

i. Impact on Flora and fauna

Impacts of construction and operation of proposed project in surrounding environment is discussed in Chapter 2.

ii. Relevant Research on WCP area.

- Ali, S. and Ripley, S.D. (1983). Handbook of the birds of India and Pakistan. Oxford (Delhi and New York).
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- The soil map of the study area was prepared using maps published by the National Bureau of Soil Survey & Land Use Planning (NBSS &LUP), Nagpur i.e. "Soils of Rajasthan for Optimising Land Use, NBSS Publ.51b, 1995" and "Soils of Madhya Pradesh for Optimising Land Use, NBSS Publ. 59b, 1996".
- The data on meteorology on parameters like Temperature, Relative Humidity, Rainfall, Wind Speed, and Wind Direction were downloaded from https://www.worldweather online.com.
- For Land use/ landcover, thematic maps prepared by the National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO) of Dept. of Space with State Remote Sensing Applications Centre, Dept. of S&T, Govt. of Rajasthan and Remote Sensing Applications Centre, MP Council of S&T, Govt. of MP as partners for the period 2016-17 were downloaded from their web portal http://bhuvan.nrsc.gov.in/gis/thematic/index.php.
- For the generation of FCC, Landsat 8 satellite data of Path 146 Row 42 dated 28.04.2019.
- The description of the Geology of the area was sourced from Pre-Feasibility Studies of the proposed project prepared by the project proponent.
- For describing the socio-economic profile of the study area and available infrastructure in the area data were collected during field survey and supplemented by Village and Town Directory, District Census Handbook, Baran, Series -09, Part-XIIA and Village and Town wise Primary Census Abstracts (PCA) Directory, District Census Handbook, Baran, Series -09, Part-XIIB published by Census of India Demographic profile of the study area from Census of India 2011, Directorate of Census Operations, Rajasthan were consulted.

1.13. Relevant Geographical Maps

All geographical map indicating various information of the Study area is given in in Chapter-7 of the report.

CHAPTER 2

2.1. Details Of Investigated Environmental Impacts

All the likely impacts have been considered for various aspects of environment, including physico-chemical, ecological and socio-economic aspects. Invariably there are two types of impacts that occur due to construction and operation of projects viz. permanent which generally lead to loss of plant species, change of land-use, etc. which can be compensated/managed and temporary which can be minimized and mitigated.

Based on the project details and the baseline environmental status, potential impacts as a result of the construction and operation of the proposed Shahpur Pumped Storage Project have been identified. Wherever possible, the impacts have been quantified and otherwise, qualitative assessment has been undertaken. Environmental protection measures can be best enforced through inclusion of relevant clauses in the contract not only for the main contractors but also for sub-contractors as most of activities are undertaken through various contractors.

2.1.1. Impacts on Air Quality

A. Construction Phase Impacts

The sources and activities that might affect air quality in the project area are vehicular traffic, dust arising from unpaved village roads and domestic fuel burning. The air environment around project site is free from any significant pollution source. Therefore, ambient air quality is quite good in and around the project area.

Increased vehicular movement for transportation of man and material and use of construction equipment will impact air quality at the construction site through emissions from the engines and equipment, fugitive emissions due to material handling, etc. Additionally, construction activities including operation of crushers, concrete batch plants, construction work and movement of vehicles along unpaved road will generate dust & gaseous emission and impact air quality. The burning of waste will also affect air quality and therefore, need to be controlled. In absence of proper fuel, construction workers at the project site may use wood for fuel burning.

a. Pollution due to fuel combustion in various equipment

The operation of various construction equipment requires combustion of fuel. Normally, diesel is used in such equipment. Diesel exhaust contains various types of organic and inorganic pollutants, whose concentration depends upon fuel quality and engine running conditions. NOx, hydrocarbons and CO are major pollutants; SO_2 is not significant due to low Sulphur diesel. Depending upon the fuel quality and quantity and rating of DG sets and other equipment, it is important to provide adequate stack height for emission to be dispersed in the atmosphere to have minimum increase in Ground Level Concentrations (GLCs).

b. Emissions from various crushers and other construction plants

The operation of the crusher and other construction plants during the construction phase generates dust and fugitive emissions, which can impact plant area and surrounding area as well, depending on wind direction. Crushing process generates dust consisting of PM, PM_{10} and $PM_{2.5}$; substantial part of the emissions is in the form of coarse dust which settles in immediate surrounding. Finer particles ($PM_{2.5}$) gets carried to larger distances and have likely impacts on local residents depending upon wind direction. Preventive and Protective measures are required to be implemented by contractors at site to control such emissions and further reduce their impacts on workers and locals. CPCB's and State Pollution Control Board's guidelines need to be followed to minimize the impact.

c. Fugitive Emissions from material handling and transportation

During construction phase, there will be increased vehicular movement. Lot of construction material like sand, fine aggregate is stored at various sites, during the project construction phase. Normally, due to blowing of winds, especially when the environment is dry, some of the stored material can get entrained in the atmosphere. Although it is very difficult to completely eliminate such an impact, it is possible to reduce its intensity by implementing mitigation measures discussed in ensuing text.

B. Operation Phase Impacts

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

2.1.2. Impact on Noise Environment

Sources of noise will be increased vehicular traffic due to project construction on approach roads and at construction sites. Due to construction activity in the area, noise levels will increase during the period of construction, however, they will remain limited to the work area mainly where large-scale construction activity will progress. Other sources of noise and vibration will be the use of explosives for blasting purposes for construction activities.

I. Construction Phase Impacts

a) Noise due to Construction Equipment

The noise levels due to operation of the different construction equipment are given in **Table 19**.

Table 19: Equivalent Noise Levels due to Operation of Construction Equipment

Equipment	Noise level dB(A)	Equipment	Noise level dB(A)
Earth Moving		**Material Handling**	
Compactors	70-72	Concrete mixers	75-85
Front loaders	72-82	Movable cranes	82-84
Backhoes	70-92		
Tractors	76-90		
Scrappers, graders	82-90		
Truck	84-90		
Others			
Vibrators	69-81	Saws	74-81

Noise level of about 80 dB(A) at 1m from the source will reduce significantly with distance

and can be calculated with the following formula at any location:

$$N2 = N1\text{-}20 \log_{10}(r2/r1) - A_f \quad dBA$$

Where, N2 = Sound level at any location at a distance r2 from the source
N1 = Sound level at any location at a distance r1 from the source

The decrease in sound level of 80 dB(A) (at 1m from the source) at a distance of 100 m from the source is 40 dB(A) even in the absence of external attenuation factor. Decrease in sound levels (measured at 1 m from the source) at various distances are given at **Table 20**. In the absence of details of attenuation factors, they have assumed zero, whereas in actual practice attenuation factors such as vegetation, barricades, etc. will reduce the sound level significantly. Noise levels get reduced by 6 dB(A) with every doubling of distance.

Table 20: Decrease in Sound Levels with Distance from Source*

Distance from Source (m)	Corresponding Sound levels dB(A)
100	40.0
200	34.0
500	26.0
1000	20.0
1500	16.5
2000	14.0
2500	12.0
3000	10.5

* Source sound is 80 dB(A) at a distance of 1m

Walls of houses attenuates at least 30 dB(A) of noise. In addition, there is attenuation due to air absorption, atmospheric in homogeneities, vegetal cover, etc. Thus, no increase in noise levels is anticipated beyond 100m from source during the project construction phase. However, it can be a cause of concern from workers working in proximity to machines generating noise.

b) Noise due to increased vehicular movement

During construction phase, there will be increase in vehicular movement for transportation of construction material in and around the project sites. During construction phase, the increase in vehicular movement is expected to be at least 5-6 trucks/hour during peak construction period. The impact on noise level due to increased vehicular movement cannot be quantified as it will depend upon various factors such as vehicle condition, vehicle speed, road condition, idling time, traffic condition, etc. Project site will be connected from NH76 by a new proposed road directly to upper reservoir site and through BT road to lower reservoir site. NH76 and BT road have adequate traffic capacity to handle increased traffic. The proposed new roads are away from habitation; nearest village, Shahpur is more than 2 Km away. Therefore, noise impact due to increase of traffic in area is not significant.

c) Noise Generated due to Blasting

Noise generated by blasting is instantaneous in nature. Noise generated due to blasting is site specific and depends on type, quantity of explosives, dimension of drill hole, degree of compaction of explosives in the hole and rock. Noise levels generated due to blasting at

various sites recorded in other projects are given in **Table 21**.

Table 21: Noise generated due to blasting

No. of holes	Total charge (kg)	Maximum charge/delay (kg)	Distance (m)	Noise level dB(A)
15	1500	100	250	76-85
17	1700	100	250	76-86
18	1800	100	250	74-85
19	1900	100	400	70-75
20	2000	100	100	76-80

It can be observed from **Table 21** that noise level due to blasting operations are expected to be of the order of 75-85 dB(A) at a distance of about 250m; which will be reduced to 35-45 dB(A) in another 100m. External attenuation factor will reduce it further. As the blasting is likely to last for 4 to 5 seconds depending on the charge, noise levels over this time would be instantaneous and short in duration. Considering attenuation due to various sources, even the instantaneous increase in noise level is not expected to be significant especially during daytime. Hence, noise level due to blasting is not expected to cause any significant adverse impact.

e) Impacts due to Ground Vibrations

The explosive energy generated during blasting sets up a seismic wave within the surface, which may affect the structures and cause discomfort to human population. When an explosive charge is fired in a hole, stress waves traverse in various directions, causing the rock particles to oscillate. Blasting also generates ground vibrations and instantaneous noise. Various measures have been recommended to minimize the adverse impacts due to blasting:

- Proper design of blast hole to be developed.
- Use of noiseless trunk delays to minimize the noise due to air blast.
- Use of non-electric system of blasting for true bottom-hole initiation.
- Use of muffling mats to arrest the dust and fly rock.

Noise in and around the construction site have the potential to affect the wildlife and residents in the nearby areas. Typically, wildlife in the area will likely move away from the noise and eventually return to the area when the blasting is over. However, there is no major wildlife observed in and around the construction site and hence this may not be a significant issue.

f) Impacts on Labour

The effect of high noise levels on the operating personnel has to be considered as this may be particularly harmful. It is known that continuous exposures to high noise levels above 90 dB(A) affects the hearing ability of the workers/operators and hence, should be avoided. To prevent these effects, it has been recommended by Occupational Safety and Health Administration (OSHA) that the exposure period of affected persons be limited as in **Table 22**.

Table 22: Maximum Exposure Periods Specified by OSHA

Maximum equivalent continuous noise level dB(A)	Unprotected exposure period per day for 8 hrs/day and 5 days/week
90	8
95	4
100	2
110	½
120	¼

II. Operation Phase Impacts

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

2.1.3. Water Environment

Various sources of water pollution in the project area during the construction phase include disposal of effluents with high turbidity from crushers commissioned at various sites, sewage disposal from labour camp, blasting and other land clearing activities, washing of oil, grease and other chemicals from diesel generator sets, vehicles and other machinery etc.

I. Impacts of water pollution

Water pollution is harmful and is considered to be a serious health hazard. It has far-reaching consequences and effects on human beings and animals also. The effect can be felt not only in the surface water bodies but also the ground water source in the area. The affect may be of temporary or permanent nature. The major impacts of water pollution are given as under:

- The civil and hydro-mechanical work at site will lead to stockpiling and excavation activity on site, thereby exposing the base soil to erosion. The run-off from this site and also from muck disposal sites may contain a high quantity of Suspended Solids which shall add to the inorganic load of water bodies and drainages in the area. However, the impact of runoff may not be very significant except during rainy season.
- During construction phase, wastewater, sewage etc., shall be generated from the labour camp and workshops. If disposed untreated, this would substantially deteriorate the surface and ground water quality in the area.
- The oil and grease released from the project related activities may also change the physico-chemical characteristics of water.

II. Construction Phase Impacts

The major sources of water pollution during project construction phase are as follows:

- Sewage from Construction work camps/colonies
- Effluent from Construction Plants and Workshops
- Disposal of muck

Sewage from Construction worker Camps

The domestic water requirement for the construction worker and the technical staff migrating into the project area is of the order of 360 cum/day @ 100 lpcd. Adding other requirement from fluctuating population, it can go up to 380 cum/day. With 80% of this quantum to be generated as wastewater, the quantity of 305 cum/day is considered significant and require planned disposal otherwise it will lead to water pollution, resulting in increase in coliforms and other pathogens, which can lead to incidence of water borne

diseases. Therefore, project authorities would be taking appropriate measures to check such disposal into the natural water bodies. In order to avoid any deterioration in water quality due to disposal of untreated wastewater from labour camps, appropriate sewage treatment facilities will be commissioned in the labour camps and only treated wastewater will be discharged following "General Discharge Standards".

Effluent from Construction Plants and Workshops

As discussed earlier, construction plants viz. aggregate processing and concrete mixing and workshops will be established. Water is used in these construction plants and wastewater generated with high suspended solids. Similarly from workshops, major pollutant will be oil and grease. Discharge of untreated wastewater will adversely affect the surface and ground water quality. To minimize the impact, such effluent needs to be treated in-site before discharge to any water body or for land application.

Disposal of Muck

The major impact on the water quality arises when the muck is disposed along the water bodies and natural drainage system. The unsorted waste going into the channels/ water bodies will greatly contribute to the turbidity of water continuously for long time periods. The high turbidity is known to reduce the photosynthetic efficiency of primary producers in the water bodies and as a result, the biological productivity will be greatly reduced. Therefore, the prolonged turbid conditions would have negative impact on the water quality. Therefore, muck disposal has to be done in line with the Muck Disposal Plan, as proposed under Environment Management Plan to avoid any negative impact.

III. Operation Phase Impacts

During the operation phase, due to absence of any large-scale construction activity, the cause and source of water pollution will be much different. Since, only a small number of O&M staff will reside in the area in a well-designed colony with sewage treatment plant and other infrastructural facilities, the problems of water pollution due to disposal of sewage are not anticipated. The treated sewage will be reused for gardening and green belt around the colony.

2.1.4. Land Environment

I. Construction Phase Impacts

For the development of Shahpur Pumped Storage Project (PSP), Both Forest and Non- Forest land would be acquired for construction of project components, reservoir area, muck dumping, construction camps and colony, etc. Based on the project layout, land requirement has been worked out as 624.17 ha, out of which 407.82 ha is forest land, 216.35 ha is Non-Forest.

A) Impact due to change in land-use

Major impact of land acquisition is permanent change of land use, which is unavoidable. Land acquisition has impacts on local population by way of loss of their agriculture land and hence livelihood. Land acquisition also lead to loss of flora and fauna by way of loss of forest land and clearing of vegetation on acquired land. These impacts can be mitigated to a large

extent by providing adequate compensation to private landowners and by compensatory afforestation in lieu of loss of forest land.

B) Impacts Due to Muck Generation

It is proposed to dispose off the unused muck, i.e 0.87 Mcum Muck disposal in dead storage part of Upper and Lower Reservoirs and 5.61 Mcum at a one pre-identified muck disposal site. The site will be fully rehabilitated and restored on completion of muck dumping. Muck, if not securely transported and dumped at pre-designated site, can have serious environmental impacts, such as:

- Can be washed away into the natural water bodies which can cause negative impacts on surface and ground water quality.
- In many of the sites, muck is stacked without adequate stabilisation measures. In such a scenario, the muck moves along with runoff and creates soil erosion like situations.
- Normally muck disposal is done at low lying areas, which get filled up due to stacking of muck. This can sometimes affect the natural drainage pattern of the area leading to accumulation of water or partial flooding of some area which can provide ideal breeding habitat for mosquitoes.

Muck disposal needs to be carefully planned else it becomes a major impact from construction of project.

C) Impacts Due to Waste Generation

The construction of the proposed Pumped Storage Project will involve different categories of manpower like labour, technical, other officials and service providers. These people will be living in temporary and permanent colonies/ settlements. The main sources of waste generation can be categorized as:

- Municipal waste (includes commercial and residential wastes generated in either solid or semi-solid form excluding industrial hazardous wastes and bio-medical wastes)
- Construction and demolition debris (C&D waste)
- Bio-medical waste
- Hazardous waste (generated from construction machinery and equipment)
- e-Waste (computer parts, Printer cartridges, electronic parts, etc.,).

Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management to dispose off, as warranted under the Solid Wastes Management Rules (SWM) 2016. The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed as per the SPCB guidelines. It's proposed to provide adequate septic tanks with soak pits for treatment and disposal of sewage.

2.1.5. Impacts on Forests and Forest Land

About 407.82 ha of forest land will be diverted for the construction of the project components. This shall lead to loss of some of the plant species used for various economic purposes. This impact is partially mitigated by implementation of Compensatory Afforestation Plan as well as Biodiversity Management Plan.

2.1.6. Flora and Fauna

I. Construction Phase

A) Impact on Terrestrial Flora

Proposed project is located with the recently notified Shahabad Conservation Reserve. The change in land use pattern of the area will result as loss of 407.82 ha forest area of Shahabad Conservation Reserve. However, by implementing, the compensatory afforestation plan along with green belt development plan and biodiversity conservation and wildlife management plan the impact on forest cover will be minimized.

The direct impact of construction activity is generally limited in the vicinity of the construction sites only. As mentioned earlier, a large population of people are likely to congregate in the area during peak project construction phase. The workers and other population groups residing in the area may use fuel wood, if no alternate fuel is provided. Hence, to minimize such impacts, it is proposed to provide alternate fuel for cooking e.g. LPG/kerosene to the construction workers. The other alternative is to provide community kitchens on a cooperative basis by the contractor.

B) Impact on Terrestrial Fauna

Forest cover in the vicinity of proposed project working sites and their immediate vicinity is comprised of deciduous forest with agriculture as next pre-dominant land use type. 19 species of mammals and 53 species of avifauna have been compiled from the study area. The acquisition of forest land within the Shahabad Conservation Reserve will cause disturbance to wildlife habitat.

In addition, during construction period, large number of machinery and construction workers shall be mobilized, which may create disturbance to wildlife population in the vicinity of project area. The operation of various equipment will generate significant noise; noise and vibration will also increase during blasting which will have adverse impact on fauna of the area. The noise may scare the fauna and force them to migrate to other areas. Likewise siting of construction plants, workshops, stores, labour camps etc. could also lead to adverse impact on fauna of the area. During the construction phase, accessibility to area will lead to influx of workers and the people associated with the allied activities from outside will also increase. Increase in human interference will have an impact on terrestrial ecosystem.

Therefore, adequate measures will be required during the construction phase not to cause any adverse impact on terrestrial and avifaunal population. Impact of blasting and other construction activities needs to be mitigated by adopting controlled blasting and strict surveillance regime and the same is proposed to be used in the project. This will reduce the noise level and vibrations due to blasting to a great extent.

II. Operation Phase Impacts

On completion of the construction of the project, the land used for construction activities will be restored. Construction workers who have resided in that area will move to another project site. By ensuring all the mitigation and management measures, as planned for this

project, are implemented to minimize the impact of construction phase, large part of the area will go back to its original form. Operation phase impacts on flora and fauna will be positive due to green belt development, restoration of construction areas, restoration of muck disposal area. Increase of greenery in the area and creation of reservoir, will have positive impact on avifauna.

2.1.7. Impacts on Socio-economic Environment

A project of this magnitude is likely to entail both positive as well as negative impacts on the socio-cultural fabric of area.

a) Positive Impacts on Socio-Economic Environment

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

i) A number of marginal activities and jobs would be available to the locals during construction phase.
ii) Developer bringing large scale investment to the area will also invest in local area development and benefit will be reaped by locals. Education, medical, transportation, road network and other infrastructure will improve.
iii) The availability of alternative resources provided by developer in the rural areas will reduce the dependence of the locals on natural resources such as forest.

b) Negative Impacts on Socio-Economic Environment

Such projects, in addition, to positive impact on socio-economic environment may also bring certain negative impact due to influx of outside population. Workforce for construction activities will reside in that area for around three years and also there will be influx of drivers and other workers on temporary basis.

Villagers in the area also depend on forest resources for their day by day needs, other than fodder and fuel, villagers also collected NTFP like *Tendu* leaves from the forest area. Scrub forest in the area also used as grazing land for livestock's. Loss of forest and grazing land have impact on social environment of the area. These impacts can be mitigated by implementing biodiversity conservation and wildlife management plan along with green belt development plan. Loss of natural habitat will also lead to human wildlife conflict by means of damage of agriculture crops.

This influx of people in otherwise isolated area may lead to various social and cultural conflicts during the construction stage. Developer need to take help of local leaders, Panchayat and NGOs to ensure minimum impact on this count.

c) Increased incidence of Diseases

Large scale activity in the area due to the proposed project may become a cause of spread different types of diseases in the project area due to following reasons:

- Project requires long-term input of labour from outside the area.

- Project requires that significant numbers of project employees be separated from their families for long periods of time.
- Project involves the creation of large, temporary construction camp(s).
- Increases mobility of people in and out of the area (job seekers, formal and informal service providers).
- Requires participation/ resettlement of the local population.

2.2. Measures For Minimizing/Offsetting Adverse Impacts

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 during construction activities as discussed in later section under the head, "Mitigation Measures".

Impacts of projects such as muck generation, worker's health and safety, waste generation from labour colonies, impact on workers' health, impact of tree cutting for fuel, impact on physical environment due to material handling and operation of construction machinery, etc. will be minimized by implementing various management plans. Environmental Management Plans viz. Compensatory Afforestation Plan, Green Belt Development Plan, Landscaping & Restoration Plan, Muck Management Plan, Dam Break Modeling & Disaster Management Plan, Public Health Delivery Plan, Sanitation and Solid Waste Management Plan, Energy Conservation Measures and Biodiversity Management & Wildlife Conservation Plan have been prepared to address these specific impacts with a view to minimize adverse impacts.

2.3. Irreversible And Irretrievable Commitments Of Environmental Components

The proposed Scheme will involve construction of both upper reservoir and lower reservoir in Baran district of Rajasthan and involves construction of rockfill embankment with avg height of 24.5 m for the length of 5309 m for creation of Shahpur PSP upper reservoir of 1.21 TMC gross capacity and construction of rockfill embankment with avg height of 26.5m for the length of 2937 m for creation of Shahpur PSP lower reservoir with 1.06 TMC gross capacity. Total 6 numbers of independent Head Race Pipe / Pressure Shaft with one pressure Tunnel bifurcating into two-unit pressure tunnel convey water between Lower and Upper reservoirs. Surface Power/Pump House will be located at about 830 m from the intake structure and shall be equipped six vertical shaft reversible Francis type units composed each of a generator/motor and a turbine/pump having generating/pumping capacity of 300 & 150 MW/330 & 165MW.

Irreversible environment components or resources are those, whose use limit the future use options and Irretrievable components are those whose use eliminate the future use options. Typically, in the context of infrastructure project, Irreversible and Irretrievable commitments of environmental components are due to use of non-renewable resources in project construction and operation.

During the construction stage of the project, raw material will be consumed as resources, which are in abundant supply. No impact is identified on any of the flora or fauna species which will make them extinct by the project. Land required for the project will undergo permanent change of land use. Forest land will be compensated by compensatory

afforestation and private land will be compensated as per the law. No displacement of population is involved. During the project operation, water will be the main raw material for power generation. About, 1.26 TMC of water is required for project operation, which will be sourced from Kuno river as one-time storage/filling, out of which 1.01 TMC shall be utilized for power generation by recirculation. Only evaporation losses will be added on annual basis. Therefore, project does not have any significant irreversible and irretrievable impacts on environmental components.

2.4. Assessment Of Significance Of Impacts

Impacts, as discussed above, along with the mitigation measures have been summarized in the form of matrix and subjected to categorization in the form of magnitude, significance and duration of impact. Categorization is largely judgement based as assessed by experts who were involved in carrying out the study. Impact assessment matrix is given at **Table 23**.

Table 23: Impact Assessment Matrix

S. No.	Environmental attribute	Potential impacts	Nature of impact	Phase	Magnitude of impacts			Significance		Long Term/Short Term	
					Low	Medium	High	Significant	Insignificant	Permanent	Temporary
A.	**Physical Resources**										
1.	Land use and Topography	Change in the surface features and present aesthetics due to the construction of the project Muck disposal	Direct/Local/ irreversible	Before construction phase			X	X		X	
B.	**Environmental Resources**										
1.	Air Quality	Project will have impact on air quality during the construction period due to increase in the dust emission, fuel combustion in various equipment, crushers and other construction plants & Emissions from material handling and transportation	Direct/Local/ reversible	During construction activity		X		X			X
2.	Noise	Noise due to general construction activities and equipment, increased vehicular traffic, blasting etc.	Direct/Local/ reversible	During construction activity		X		X			X
3.	Surface and Ground Water quality	Waste from construction labor camps, effluent from construction plants and workshops Runoff from the construction site and its disposal	Direct/Local/ reversible	During construction activity		X		X			X

S. No.	Environmental attribute	Potential impacts	Nature of impact	Phase	Magnitude of impacts			Significance		Long Term/Short Term	
					Low	Medium	High	Significant	Insignificant	Permanent	Temporary
		Domestic wastewater from construction sites	Direct/Local/ reversible	During construction and operation	X				X		X
4.	Soils	Soil erosion due to excavation, muck generation, construction activities and clearing of vegetation and access roads. Muck disposal	Direct/Local/ reversible	During and after the construction activity			X	X		X	
C.	**Ecological Resources**										
1.	Terrestrial Flora	Loss of vegetation	Direct/ Local/ irreversible	Before and during the construction phase			X	X		X	
2.	Terrestrial Fauna	Disturbance to the local fauna during construction	Direct/ Local/ reversible	Before, and during construction phase		X		X			X
3.	Aquatic Ecology	Disturbance to the aquatic fauna after construction	Direct/ Local/ reversible	During construction	X				X		X
D.	**Human Environment**										
1.	Health and Safety	Increased incidence of Diseases Fires, explosion and other accidents at construction sites	Direct/ Local/ Continuous	During and after the construction phase.	X			X			
2.	Agriculture	Impact envisaged as there is private land involved	Direct/ Local/ reversible	Before the construction		X		X		X	
3.	Socio-economics	Positive and negative impacts on socio-economic environment Job opportunities	Direct/ Regional/ Continuous	During operational phase		X		X			

S. No.	Environmental attribute	Potential impacts	Nature of impact	Phase	Magnitude of impacts			Significance		Long Term/Short Term	
					Low	Medium	High	Significant	Insignificant	Permanent	Temporary
		during construction phase.									
4.	Private land acquisition	Impact envisaged as there is private land involved without displacement	Direct/ Local/ reversible	Before the construction		X		X			X
5.	Historical and archaeological sites	No archaeological, historical or cultural important sites are affected by the construction.	Direct/ Local/ reversible		X				X		X
6.	Traffic and Transportation	Traffic congestion on BT road due to movement of construction vehicles	Direct/ Local/ reversible	During construction phase		X		X			X
7.	Solid Waste Generation	Probability of Surface and ground water pollution	Indirect/ Local/ reversible	During construction and operation phase	X				X		X

2.5. Study technique adopted and observations of the experts in the field

The methodology and techniques for collection of data were discussed in Section 1.1 of Chapter 1. QCI-NABET accredited experts of various sectors from RS Envirolink Technologies Pvt. Ltd. (RSET), a consulting organisation visited the Project site and surrounding area. After interpretation of primary and secondary baseline information/ data and keeping in view the nature of project the impact of the project on biological, physical and social environment has been accessed.

There is no direct sighting of Schedule-I species from the project area. However as per the information collected from field survey and data available with forest department, Schedule-I species under Wildlife Protection Act 1972 reported from the area are:

1. Leopard (*Panthera pardus*),
2. Sloth Bear (*Melursus ursinus*),
3. Common Pea fowl (*Pavo cristatus*)
4. Indian Monitor Lizard (*Varanus bengalensis*), and
5. Indian Rock Python (*Python molurus molurus*)

In addition to these Shahabad Conservation Reserve provide habitat to many other mammals, birds, herpetofauna, butterflies and other faunal species. Same has been discussed in Section 1.7 of Chapter 1.

CHAPTER 3

3.1. OBJECTIVE OF WILDLIFE CONSERVATION PLAN

Keeping in view of the anticipated impacts as per the foregoing chapters, the management objectives can be described as:

i. Maintenance of ecological balance through preservation and restoration, wherever it has been disturbed due to project developmental activities,
ii. Conservation and preservation of natural habitats in project surrounding
iii. Mitigation and control of project induced biotic and/or abiotic pressures/ influences that may affect the natural habitats,
iv. Habitat enhancement in project area by taking up afforestation and soil conservation measures,
v. Creating all round awareness regarding conservation and ensuring people's participation in the conservation efforts and minimizing human wildlife conflict.

3.2. MITIGATION MEASURES

Institutional arrangement for planning and implementing various mitigation and management measures along with carrying out environment monitoring are given at **Table 24**. Table given below also give view of the implementing and monitoring agency for proposed mitigation and management measures.

Table 24: Mitigation and management measures

S. No.	Activities	Implementing Agency	Monitoring/ Supervising/ Approving Agency
1	Compensatory Afforestation Programme	Forest Department	Forest Department
2	Biodiversity Conservation and Wildlife Management Plan	Forest Department	Forest Department
3	Muck Management	Greenko Energies Pvt. Ltd	Greenko Energies Pvt. Ltd./ SPCB
4	Sanitation and Solid Waste Management	Greenko Energies Pvt. Ltd	Greenko Energies Pvt. Ltd./ SPCB
5	Public Health Delivery System	Greenko Energies Pvt. Ltd	Greenko Energies Pvt. Ltd./ District Administration (Health Department)
6	Energy Conservation Measures	Greenko Energies Pvt. Ltd	Greenko Energies Pvt. Ltd./ SPCB/ Forest Department
7	Control of Air, Noise and Water Pollution	Greenko Energies Pvt. Ltd	Greenko Energies Pvt. Ltd./ SPCB
8	Rehabilitation and Resettlement Plan	Greenko Energies Pvt. Ltd.	District Administration
9	Disaster Management	Greenko Energies Pvt. Ltd.	District Administration
10	Local Area Development Plan	Greenko Energies Pvt. Ltd.	District Administration
11	Environmental Monitoring	Greenko Energies Pvt. Ltd.	SPCB*

*SPCB: State Pollution Control Board

In addition to above given mitigation and management measures following management strategies proposed under Wildlife Conservation Plan shall be implemented by forest department in the impact area of proposed project.

i. Habitat Improvement of Schedule-I species through conservation and preservation of natural habitats in project surrounding
ii. Infra-structure development
iii. Anti-Poaching measures
iv. Training Programme for Techniques of faunal species Rescue
v. Prevention of Forest Fire
vi. Creating all round awareness regarding conservation and ensuring people's participation in the conservation efforts and minimizing human wildlife conflict.

CHAPTER 4

4.1. Proposed Management Strategies Within The Project Site

4.1.1 Mitigation Measures

Mitigation of construction-related impacts would be the responsibility of the project proponent (through its contractors). Air and water are two major environmental factors that are directly affected by any kind of construction activity. Transportation of material, storage and handling of material and construction operations lead to air and noise pollution. During construction period generation and release of effluents from construction site, workshops, sewage disposal from labour camp, blasting and other land clearing activities, washing of oil, grease and other chemical from diesel generator sets, vehicles and other machinery etc. cause water pollution and affect the quality of surface as well ground water.

The major air pollutants, which could be generally, released during various construction activities and vehicular movements are Particulate Matter (PM), SOx and NO_X. In addition to these construction activities also generate noise due to the use of heavy machinery, heavy vehicles, blasting, etc. which has serious impacts on humans as well as the wildlife of the area.

I. Control of Air Pollution

For the control of air pollution during construction phase of the project, it is suggested that it should be made mandatory for the contractor/s engaged in the construction works to ensure the following conditions:

- The crushers should be provided with air pollution control devices as per the rules laid down by pollution control board, so as to minimize the release of PM into the atmosphere.
- The chimneys of the Diesel Generator Sets should be kept at appreciable height (as per the CPCB guidelines). The DG sets should be properly maintained and with valid certificates of Type Approval and also valid certificates of Conformity of Production.
- Regular water sprays at the crushing sites, dumping sites as well as on roads should be ensured. Necessary clause shall be incorporated in the contractor's agreement.
- Masks should be provided to the workers and staff.
- Proper ventilation facilities shall be provided inside the tunnel and at all the residential complexes of the staff and labour.
- Ambient Air quality shall be monitored seasonally during the construction phase at different locations with the help of NABL accredited lab.
- Controlled blasting during construction activities will be ensured.

II. Control of Noise Pollution

Since continuous exposure to noise is detrimental to health, it is essential to control the noise pollution. Various measures for control of noise pollution in the project area are suggested below:

- Diesel Generator sets should have acoustic enclosures to reduce the noise as per the CPCB guidelines.

- Ear protection aids such as ear plugs, earmuffs, must be provided to the workers who have to continuously work in the high noise area.
- Proper and regular maintenance/lubrication of machines should be done.
- Noise producing still machines (such as crushers, aggregate processing plants, etc.) should be provided with sound barriers, if close to habitation.
- Quieter machines and vehicles with high quality silencers should be used.
- Afforestation around the residential colonies and office complexes should be done as proposed under the Green Belt Development Plan.
- Ambient noise should be monitored periodically at different locations as outlined in Environment Monitoring Program.

III. Control of water pollution

To avoid deterioration of water quality of the receiving water body following measures are suggested:

- During Construction phase provision of Portal STP/septic tank/ soak pit etc., of adequate capacity for labour camp so that it can function properly for the entire duration of construction phase
- Construction of settling tank to settle the suspended impurities from various sources i.e. HMP/ crushers, labour camps, etc. before discharging into the main stream
- During Operation, Commission of suitable treatment facilities to treat the sewage generated from the colony
- Provision of sedimentation cum grease traps at the outer mouth of drains located along workshops, fuel filling stations, diesel generator rooms etc. so as to prevent entry of contaminants to the water bodies.
- Oil interceptors shall be provided for refueling areas, vehicle parking, washing areas etc. All spills and collected petroleum products will be disposed off in accordance with SPCB guidelines.

4.1.2 Management Measures

I. Muck Management Plan

The construction activities would generate muck from excavation for various project structures. The total quantity of muck generated from soil and rock excavation is about **13.31 Mcum.** Of the total muck generated, about **12.16 Mcum** is expected to be utilized for as aggregate for construction. Total quantity of muck proposed to be disposed in designated muck disposal area, after considering 40% swelling factor would be **6.48 Mcum**. For the disposal of 5.61 M Cum of muck an area of 30 Ha has been identified and 0.87 MCum of muck disposal in dear storage part of Lower & Upper reservoirs. Map showing location of Muck dumping site is given at **Figure 12.** The Rehabilitation plan of muck dumping site includes following engineering and biological measures.

A. Engineering Measures

i) Retaining Wall
ii) Compaction
iii) Fencing

B. Biological Measures

i) Soil treatment
ii) Plantation

II. Landscaping and Restoration of Construction Sites

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

III. Sanitation and Solid Waste Management

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

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

The waste generated from the project area will be collected, segregated and disposed off in line with the provisions laid down in Solid Waste Management Rules, 2016.

IV. Public Health Delivery System

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

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

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

- Ambulance: 2 no. with all the basic Medicare facilities and small DG set, etc. to cater for villages in the project area.
- Budget for running the ambulances including driver, fuel and maintenance for 3 years.
- First aid posts including sheds, furniture and basic equipment.
- Budget for running the first aid post including cost of medico, para-medico/Nurses and attendant, consumables, etc. for 3 years.
- Budget for strengthening existing medical facilities.

- Budget for Health Awareness/ Vaccination Camps for 3 years.
- Mitigation measures to avoid spread of pandemic like COVID19 among workforce

V. 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.

VI. 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.

VII. Green Belt Development Plan

Green belt development will comprise of plantations at various places like periphery of reservoir, roads, powerhouse area and at different project offices and colonies etc. The green belt helps to provide habitat for faunal species and capture the fugitive emission and to attenuate the noise generated apart from improving the aesthetics environment in the area.

VIII. Disaster Management Plan

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

4.2. Locations of the Proposed Interventions

The proposed mitigation and management measure has been implemented within the project area near Kaloni, Baint and Mungawali villages (Near Shahpur), Shahabad Tehsil, Baran District, Rajasthan. The key locations for implementation of proposed plan are:

- Periphery of the proposed upper and lower reservoir area
- Project colony area
- Job facility Area
- Along the proposed project road
- Temporary construction sites
- Muck dumping sites

4.3. Environment Management Plan overlapping in Nature

The section 3.2 of Chapter 3 (**refer Table 24**) provides details of mitigation measures and management plan along with details of executing and monitoring agencies proposed under Environmental Management Plan.

4.4. Plan period

Construction of Shahpur PSP is planned to be completed in a period of three (3) years, therefore, the proposed mitigation measures and management plans shall be executed within the construction period.

CHAPTER 5

5.1. Proposed Management Strategies Within The Buffer Area (10.0km Radius Of Proposed Project Components)

The proposed Biodiversity Conservation and Management Plan shall be implemented within the buffer zone of the proposed project.

5.2. Wildlife Management Plan

5.2.1. Propose of Report

In reference to additional conditions of Terms of Reference (ToR) issued by Ministry of Environment, Forest, and Climate Change (MoEF&CC), Government of India vide letter no. J-12011/02/2020-IA-I, dated: 13.04.2020, directed to submit Conservation plan for the Scheduled I species reported from the study area. In pursuant to the condition of ToR, the Conservation Measures of Schedule-I species is prepared. It is Pertinent to mention that none of the Schedule-I species were reported in the primary survey during EIA/EMP studies. However, Common Leopard (*Panthera pardus*), Sloth Bear (*Melursus ursinus*), Indian Monitor Lizard (*Varanus bengalensis*), Indian Peafowl (*Pavo cristatus*), and Indian Rock Python (*Python molurus molurus*) are the Schedule-I species reported from the study area.

5.2.2. Threats to Biodiversity & Wildlife

The fragmentation of forested landscape in the area is likely to happen due to acquisition of forest land thereby change in land use, degradation of adjoining forested landscape due to various project construction activities. Therefore, land use change and construction activities will affect biodiversity in the study area. Such activities might lead to increased disturbance to wildlife in the area, man-animal conflict, introduction of exotic weedy plant species into the adjacent forested area. Major threats to biodiversity and wildlife in the project area are as follows.

a) Diversion of Forest land for Project

The proposed project is being constructed in the jurisdiction of Rajasthan Forest Department. For the development of Sukhpura PSP, the total land requirement has been worked out as 624.17 ha, out of which 407.8227 ha is forest land lies in Shahabad Conservation Reserve. The forest land in the area is comprised of dry Deciduous and Scrub Forest. The diversion of forest land for project i.e., land use change will immediately put wildlife present in those forest patches under stress leading to landscape fragmentation. Increased access to nearby forests by construction of new roads will result in disturbance to wildlife by degradation as well as loss of habitats thereby affecting wildlife populations in the area.

A large population around 3500 persons from other areas, including technical staff, workers, and other groups of people is likely to congregate in the area during the peak project construction phase. It can be assumed that the technical staff will be of higher economic status and will live in a more urbanized habitat, and will not use wood as fuel if adequate alternate sources of fuel are provided. However, workers and other population groups

residing in the area may use fuel wood, if no alternate fuel is provided. The workers may also cut trees to meet their requirements for the construction of houses, furniture. Normally in such situations, a lot of indiscriminate use or wastage of wood is also observed, especially in remote or inaccessible areas.

During the construction period, a large number of machinery and construction workers shall be mobilized, which may create disturbance to the wildlife population in the vicinity of the project area. The operation of various equipment will generate significant noise, especially during blasting which will affect the fauna of the area. The noise may scare the fauna and force them to migrate to other areas. Likewise, siting of construction plants, workshops, stores, labour camps, etc. could also lead to adverse impacts on the fauna of the area. During the construction phase, accessibility to the area will lead to an influx of workers and the people associated with the allied activities from outside will also increase. An increase in human interference could have an impact on the terrestrial ecosystem.

Thus, it is necessary to formulate a conservation and management plan to mitigate the adverse impacts on terrestrial flora during the project construction phase.

b) Operation Phase Impacts

On completion of the construction of the project, the land used for construction activities will be restored. Construction workers who have resided in that area will move to another project site**.** By ensuring all the mitigation and management measures, as planned for this project, are implemented to minimize the impact of the construction phase, a large part of the area will return to more or less its original form. Operation phase impacts on flora and fauna will be positive due to green belt development, restoration of construction areas, restoration of the muck disposal area and implantation of biodiversity management and Wildlife Conservation Plan. An increase of greenery in the area and the creation of the reservoir will have a positive impact on wildlife habitat and avifaunal diversity.

c) Human Wildlife Conflict:

Deforestation, growing human settlements, expansion of agricultural land and fragmentation of natural habitat and grazing ground of species like Wild Boar are the causes behind rising of human wildlife conflict. In the study area human-wildlife conflict in terms of crop damage is perhaps more common and causes huge loss to the farmers.

d) Hunting and poaching:

Damage of crops by species like Monkey, Langur, Wild Boar, etc. and loss of livestock's results as hunting and killing of these wild animals by means of poisoning or with the help of hunters.

e) Illegal cutting of trees:

The stakeholders from the study area depends upon forest for their day to day need of fodder, fuelwood, and other non-Timber Forest products (NTFP) as well as timber wood needs. This results in tremendous pressure on the forests.

f) Grazing pressure:

The scrub forest in the area is under heavy grazing pressure by the livestock and is susceptible to damage by livestock.

5.2.3. Objectives of Management

Keeping in view of the anticipated impacts as per the foregoing chapters, the management objectives can be described as:

i. Maintenance of ecological balance through preservation and restoration, wherever it has been disturbed due to project developmental activities,
ii. Conservation and preservation of natural habitats
iii. Mitigation and control of project induced biotic and/or abiotic pressures/ influences that may affect the natural habitats,
iv. Habitat enhancement in project area by taking up afforestation and soil conservation measures,
v. Creating all round awareness regarding conservation and ensuring people's participation in the conservation efforts and minimizing human wildlife conflict.

5.2.4. Mitigation Measures

The following management strategies including shall be implemented by forest department in the impact area of proposed project.

i. Habitat Improvement of Schedule-I species through conservation and preservation of natural habitats in project surrounding
ii. Infra-structure development
iii. Anti-Poaching measures
iv. Training Programme for Techniques of faunal species Rescue
v. Prevention of Forest Fire
vi. Creating all round awareness regarding conservation and ensuring people's participation in the conservation efforts and minimizing human wildlife conflict.

5.3. Conservation and Management Measures

Wildlife conservation is the preservation and protection of animals, plants, and their habitats. The most effective way of biodiversity management and wildlife conservation in the area are habitat management through habitat enhancement, preservation and improvement, conducting conservation programmes and creation of environmental awareness involving local people, and strict enforcement of wildlife protection laws.

5.3.1. Wildlife Habitat Preservation & Improvement

i. Afforestation and Enrichment plantation

Afforestation and enrichment plantation will be carried out in the area. The area under forest and tree cover will be expanded through systematic planning and implementation of afforestation and rehabilitation programs in available community lands. Afforestation programme in the degraded Forest Compartments is also proposed to be carried out in the surrounding of the project area. The sites and species to be planted will be finalized by the state Forest Department as the program will be implemented by them.

The plantation site will be trench fenced and brushwood fence, for the protected from cattle

grazing. With the improvement in the habitat of wildlife, the incidences of human-wildlife conflict will accordingly reduce. The enrichment plantation will be carried along the periphery of the proposed reservoirs in the adjoining forest area. As such, no additional forest land will be diverted for this purpose.

ii. Farm Forestry

The project area harbours several economically important plants like *Diospyros melanoxylon, Tectona grandis, Buchanania cochinchinensis, Phyllanthus emblica, Terminalia bellirica, etc*. These valuable resources will be directly useful to the people of the area which can form the basis of economic upliftment.

To reduce dependence on the natural forests for biomass and other Non-Timber Forest Products (NTFPs) or Minor Forest Products (MFPs) alternate resources need to be building up. NTFPs/MFPs plantations will be carried out on the community land, degraded land, fallow lands which help in sustainable land management and a tool for reclamation. An area of about **5 ha** will be developed.

Decentralized nurseries will be created with the help of the forest department. Species to be raised are primarily to cater to fuel, fodder, and small timber needs. Besides, seedlings of economically important plant species like Amla (*Phyllanthus emblica*), Behda (*Terminalia bellirica*), Bamboo, etc., will be distributed every year to villagers at a nominal rate. The distribution will be facilitated through the Forest Range office in the area. The Forest department may take up a prior survey with the help of local administrative bodies/ panchayats to assess the required plants.

iii. Development of Grassland

Grassland/ and Scrubland in the area provide habitat to faunal species like, Wild Pig, Spotted Dear, Sambhar and other small faunal species that play important role in food chain. The grazing pressure of livestock from the surrounding villages on the grassland and scrubland leads to habitat destruction and cause human wildlife conflict. Also, the over grazing cause soil erosion and affect the seed germination.

In order to prevent habitat destruction, soil erosion and to avoid such conflict and habitat destruction it is necessary to conserve the natural maintain grassland. To ensure uniform growth of grasses, seed pellets of grasses will be sown at regular intervals. Pellets are made by mixing powdered clay and farmyard manure into which grass seeds are mixed. The mixture is then made into balls and sun dried in summer to be sown before monsoon. This will also help in arresting erosion to a great extent. Also, fencing at the vulnerable sites that attract conflict between wild and domestic animals will be preferred.

iv. Awareness Programme

The success of any conservation plan of this magnitude is entirely hinged on the active support and wholehearted co-operation of all stakeholders with the members of the public playing a major role. For this purpose, meetings and workshops will be organized from village to village on regular basis. Functions like Van Mahotsav, Wildlife Week, World Forestry Day, and World Environment Day will be organized in a befitting manner to which village heads, members of

public representatives' system at Gram Panchayat level, local leaders, and members of NGO will be involved. The topics should include deterioration of biodiversity, habitat loss, human-wildlife conflicts, fire damage control, and how best the vegetation can be revamped, etc. Members of the public will be encouraged to speak. The student community should also be sensitized to various conservation issues.

Considering that the wildlife populations will be impacted by project construction activities and due to the influx of migrant labour force, mitigation measures should also be taken for the larger area. The following measures are proposed:

- Control on hunting and poaching.
- Awareness campaigns are aimed at creating awareness towards respecting habitat protection in general and the protection of wildlife species.

General awareness of the Wildlife Protection Act and its rules would be spread among the locals through communication and extension services. The wildlife populations in this area are likely to be affected by project construction activities and also due to the influx of migrant labour force, awareness among them and contractors would be inculcated.

Under this programme, various activities viz. training, publishing of pamphlets, brochures, hoardings, etc. shall be carried out during the construction phase of the project. The following activities are planned under this programme:

Observance of Wildlife Week: The wildlife week will be celebrated every year in March to assess all the tasks set aside for wildlife management. Under this programme, seminars, art competitions, and awareness campaigns will be held.

Nature Club: Nature clubs will be introduced at the Higher Secondary and High school level in the project area. They will be imparted education using audio-visual aids to sensitize them about the importance of wildlife conservation.

Involvement of Village Panchayats and NGOs: The Panchayats of affected villages and active NGOs in the project area would be involved to disseminate the knowledge about the benefits of the proposed project and ensuring greater participation in the conservation efforts and safeguard the environment of the area.

5.4. CONSERVATION AND MANAGEMENT OF SCHEDULE-I SPECIES

The development activities often present a threat to biodiversity in the area like habitat destruction, degradation, fragmentation through overexploitation, poaching, hunting, pollution, etc. Therefore, developmental projects are required to maintain ecological integrity to ensure biodiversity conservation and sustainable development together. The impacts need be mitigated or minimized substantially through well drafted conservation management plan. The Indian Wildlife (Protection) Act, 1972 mandates protection of plants and animal species by way of listing them under different schedules to provide them varying degrees of protection. Schedule I and part II of Schedule II provide absolute protection and offences under these are prescribed the highest penalties. Key strategies required for any management plan are *in situ* strategy, *ex situ* strategy, reduction of anthropogenic pressure and rehabilitation of endangered species.

5.4.1. Schedule-I Species Reported from the Area

According to Indian Wildlife (Protection) Act, 1972, 5 faunal species viz. Common Leopard (*Panthera pardus*), Sloth Bear (*Melursus ursinus*), Indian Peafowl (*Pavo cristatus*), Indian Monitor lizard (*Varanus bengalensis*) and Indian Rock Python (*Python molurus molurus*) are the Schedule-I species reported from the study area.

5.4.2. Conversation Measures for Schedule-I Species

5.4.3.1. Leopard (Panthera pardus)

The Indian leopard (*Panthera pardus*) is one of the five big cats found in India, apart from Asiatic lion, Bengal tiger, Snow leopard and Clouded leopard. The Indian leopard (*Panthera pardus*) is widely distributed in the Indian subcontinent.

a) Habitat

The species has a wide geographical range. On the Indian subcontinent, topographical barriers to the dispersal of this subspecies are the Indus River in the west, and the Himalayas in the north. In the east, the lower course of the Brahmaputra and the Ganges Delta form natural barriers to the distribution of the Indochinese leopard. Indian leopards are distributed all over India, in Nepal, Bhutan, Bangladesh and parts of Pakistan. They inhabit tropical rain forests, dry deciduous forests, temperate forests and northern coniferous forests.

The Leopard is classified as Vulnerable (VU) on the IUCN Red List of Threatened Species Ver. 2020-3 (https://www.iucnredlist.org/species/15954/163991139) and species is listed as the Schedule-I under Indian Wildlife Protection Act, 1972. *Panthera pardus* is listed in CITES Appendix I.

b) Threats

i. **Habitat Threats**: Loss of natural habitat is a major threat to leopard. Habitat fragmentation, reduced prey base and conflict with livestock and game farming have reduced Leopard populations throughout most of their range (https://www.iucnredlist.org/species/15954/163991139). Habitat degradation outside the parks, caused by overgrazing, overharvest of forest products, expansion of agricultural areas, and mining of minerals also possess threats to the habitat of species.

ii. **Human - Leopard Conflicts**: Expansion of agriculturally used land, encroachment of humans and their livestock into protected areas are main factors contributing to habitat loss and decrease of wild prey. As a result, leopards approach human settlements, where they are tempted to prey on domestic livestock like cattle's, dogs, and goats, which constitutes an important part of their diet, if they live on the periphery of human habitations. Human-leopard conflict situations ensue and have increased in recent years. In retaliation for attacks on livestock, leopards are shot, poisoned and trapped in brutal snares. Leopard-human conflict is a serious problem in India and the subcontinent and is another cause of significant mortality of Leopards. India's Forest Department is entitled to set up traps only in cases of a leopard having attacked humans.

v. Poaching: A significant immediate threat to wild leopard populations is the illegal trade in poached skins and body parts. Illegal trade in Leopard body parts (skin, bones, and claws) continues to threaten the survival of the species in the wild.

d) Management and Conservation Measures

i. Habitat improvement: Leopards live in a variety of dry and wet forests, and also in some grasslands, where boulders and scattered shrubs and trees provide shelter. The leopard has the widest habitat tolerance than any big cat in India. Habitat of the species will be improved by planting suitable species in surrounding areas. The prey species preferred by leopard will be conserved to ensure sufficient prey availability, which will also reduce the conflict with humans. The prey species preferred by leopard will be conserved to ensure sufficient prey availability which will also reduce the conflicts with humans.

ii. Biological Fences: Conflicts generally arises when leopard enters in croplands and human settlements, which indirectly reflect the condition of adjacent forested areas, i.e. its ability to support leopard. Protective Fencing to Protect Livestock: Biological fences will be used to protect the livestock from the leopard attack.

iii. Strict Protection Measures: The Wildlife (Protection) Act of 1972 provides us with the statutory framework for wildlife conservation, and Poaching is a crime against wildlife. During interview and discussion with local people it was noted that study area is not prone to poaching or any other wildlife violence related to leopard. But, precaution will be always taken while dealing with wildlife. The contact information of concern wildlife and forest department will be provided to every worker or at the field office. If any kind of poaching or other offense is noticed; it will be immediately clued-up to the concern Forest and Wildlife Officials. More importantly, worker will make aware of wildlife crime and subsequent penalties and punishment.

iv. Public Awareness Programme: Involvement of local people in conservation activities will be ensured by organizing meetings and seminars from village to village on regular basis to carry the people along with implementation. Moreover, workers will be trained and educated about the importance of leopard for ecology and ultimately for humans; an internal attraction towards the species will be tried to develop.

The support of village heads and other members of gram panchayat, local leaders and members of regional NGO would be solicited to execute the proposed awareness and habitat improvement programmes. Functions like wildlife week, world forestry day, *Van Mahotsav* and world environment day will be organized. The discussion may evolve around habitat loss, human- wildlife conflicts and how best the vegetation can be revamped etc.

Moreover, a training workshop for all workers will be conducted in starting of any project. It will include the formal training on the importance of biodiversity and also to make available the information of the flora and fauna of high conservation value present in the area. Information on Wildlife policies and Government regulation and penalties will be

provided to workers. Similar kind of activities will be done time to time to enhance the interest of mine workers in the conservation.

5.4.3.2. Sloth Bear (Melursus ursinus)

The Sloth Bear (*Melursus ursinus*) distribution includes a large portion of India, Bangladesh, and Sri Lanka, as well as the southern lowlands of Nepal. At least 90% of the present Sloth Bear range occurs in India (https://www.iucnredlist.org/species/13143/166519315). Sloth Bears occupy a wide range of habitats on the Indian mainland including wet and dry tropical forests, savannahs, scrublands, and grasslands. Sloth Bears subsist primarily on termites, ants, and fruits. Sloth Bears are the only species of bear adapted specifically for myrmecophagy (ant and termite-eating; Garshelis et al. 1999, Sacco and Van Valkenburgh 2004).

Sloth Bears typically breed May through July, and females give birth, usually to one or two cubs, from November to January (Gopal 1991, Joshi et al. 1999, Chauhan et al. 2003).

The Sloth Bear is classified as Vulnerable (VU) on the IUCN Red List of Threatened Species Ver. 2022-1 (https://www.iucnredlist.org/species/15954/163991139). Sloth Bear (*Melursus ursinus*) is listed in CITES Appendix I.

5.4.3.3. Threats

i. **Habitat Threats**: Major threats to this species are habitat loss or degradation (often related to human population growth), retaliation from human–bear conflicts, and poaching (Johnsingh 2003, Chauhan 2006, Bargali and Sharma 2013). Habitat has been lost, degraded, and fragmented by overharvest of forest products (timber, fuelwood, fodder, fruits, honey), establishment of monoculture plantations (e.g. Teak, Eucalyptus), over-grazing, extraction of minerals, quarrying, and expansion of agricultural areas, human settlements, and roads.

ii. **Human Wildlife Conflict:** The encounters between people and Sloth Bears have led to numerous serious human injuries and many deaths (Rajpurohit and Krausman 2000, Bargali et al. 2005, Ratnayeke et al. 2014). Such incidents occur where people frequently use bear habitat for fuelwood and fodder collection, and where the habitat has become severely degraded, prompting bears to seek food and water in closer proximity to humans.

iii. **Habitat Conflict with Other Animals:** Leopards (*Panthera pardus*) are the only natural (non-human) threats to Sloth Bears. The threat of Tiger predation may account for the aggressive nature of Sloth Bears (Joshi et al. 1999). Sloth Bears have been observed fending off Tigers, but they are also occasionally killed by Tigers (Gopal 1991).

iv. **Poaching**: A significant immediate threat to Sloth Bear populations is the illegal trade in poached skins and body parts. Illegal trade in Sloth Bear parts (skin, bones, and claws) continues to threaten the survival of the species in the wild.

5.4.3.4. Management and Conservation Measures

Habitat improvement: Like Leopards, Sloth Bear live in a variety of dry and wet forests, and in some grasslands, where scattered shrubs and trees provide shelter. The Sloth Bear has the restricted habitat. Habitat of the species will be improved by restricting the encroachment in their habitat and provide suitable species in surrounding areas which will also reduce the conflicts with humans.

In addition to conservation of Sloth Bear habitat, restoration of habitat through community-based forestry activities needs to be implemented. Community-based forestry programs could significantly expand habitat for sloth bears. The benefits of this community-based approach to maintaining ecosystem integrity thus extends well beyond sloth Bear.

Biological Fences: Conflicts generally arises when leopard or Sloth Bear enters in human settlements, which indirectly reflect the condition of adjacent forested areas, i.e. its ability to support Leopard and Sloth Bear habitat. Protective Fencing to Protect Livestock: Biological fences will be used to protect the livestock from the leopard attack.

Strict Protection Measures: The Wildlife (Protection) Act of 1972 provides us with the statutory framework for wildlife conservation, and Poaching is a crime against wildlife. During interview and discussion with local people it was noted that study area is not prone to poaching or any other wildlife violence related to leopard. But, precaution will be always taken while dealing with wildlife. The contact information of concern wildlife and forest department will be provided to every worker or at the field office. If any kind of poaching or other offense is noticed; it will be immediately clued-up to the concern Forest and Wildlife Officials. More importantly, worker will make aware of wildlife crime and subsequent penalties and punishment.

5.4.3.5. Indian Peafowl (Pavo cristatus)

The Indian Peafowl (Pavo cristatus) is the national bird of India, and is common and widely distributed in the Indian Subcontinent (Ali & Ripley 1987). Peafowl do not migrate or travel widely. They are most common in deciduous open forest habitats.

a) Habitat

In general Peafowl prefer human dominated and associated surrounding habitats like agricultural fields, fellow and scrub land. During day time that temporally move towards the surrounding areas like agricultural fields or water bodies for feeding while during night time roosts on the trees in open forest or on the trees in scrub forest in the vicinity of the human settlement.

Peafowls are omnivorous; they consume insects, worms, lizards, frogs and other arthropods, reptiles and amphibians. They also feed on plant parts, flower petals, seed heads, grains, grasses and bamboo shoots. In the study area tree canopy, scrub forest, agricultural farms and grasslands supports good insect diversity which is very common food for peafowls.

An Indian Peafowl or Peacock (*Pavo Cristatus*) is a large pheasant declared as the National Bird of India in 1963. In India, it is given the utmost protection by inclusion in Schedule I of

Indian Wildlife Act, 1972. Being a wide spread species, apart from the various urban habitats, it is also found in agriculture field, along stream with good vegetation and close to human habitation in semi-feral conditions.

b) Threats

Threats to the peacocks in the area are:

1) Habitat loss, especially the shortage of tall trees in and around the villages for roosting and for providing shade during hot summer months,
2) Shortage of drinking water for the birds during the hot summer days,
3) Casualties caused by eating chemically treated agricultural crop seeds, and
4) Illegal hunting.

c) Conservation Measures

Habitat Improvement Action Plan: Conservation Measures Direct and indirect approach is required to provide effective conservation, which is recommended as under:

i. Peafowl prefers tall trees with dense foliage or thorny trees for roosting and prefer open scrub vegetation for foraging. Therefore, increasing the tree cover in the area for shelter and roosting of pea fowls is necessary. This will be achieved by planting of tree groves. Species like *Azadirachta indica* (Neem), *Madhuca longifolia* (Mahuwa), *Mangifera indica* (Aam), *Albizia sp.* (Siris), *Cassia fistula* (Amaltash), *Dalbergia sissoo* (Shesham), *Butea monosperma* (Dhak), *Acacia catechu* (Khair), *Acacia nilotica* (Babool), *Prosopis juliflora* (Kikar), trees etc. will be planted.
ii. By conducting awareness programmes (community and school level) for conservation of peacocks in the area during "Wildlife Week" and "Van Mahotsave" celebrations.
iii. Water hole will be constructed at the area where "Peacocks" generally (nearby habitat). Location of water holes will be suggested by the forest department. Water will be supplied during summer seasons through tankers in the village to fill the ponds or water holes.
iv. Some provision of rewards to informers for the control of poaching and illegal trade in wildlife.
v. Provision of veterinary care and cages for injured or sick deformed birds.

Further suggestion/recommendation:

- Restricted uses of pollutants in their habitat.
- Stopping the increased vehicle pollution, wildlife road fatalities and damaged to habitat by people to start movement towards these areas.
- Participation of villagers in conservation and habitat improvement efforts.
- To carry out census to population status of the species and know the potential threats.

5.4.3.6. Indian Rock Python (Python molurus molurus)

There are two recognized subspecies of *Python molurus* which are separated by geographic range and certain physical characteristics. *Python molurus bivitatus* (the Burmese python), is typically thought to range from Myanmar eastward across southern Asia through China and Indonesia. *Python molurus molurus* (Indian rock python) is native to India, Pakistan, Sri Lanka, and Nepal. Indian rock python (*Python molurus molurus)* is the largest snake species

found in tropical and sub-tropical areas of Southern Asia. Python is a solitary species. Mating is the only time that snakes are commonly found in pairs. Indian pythons will generally move only when food is scare or when threatened.

a. Habitat

Pythons inhabit a wide range of habitats including wetlands, open forest, scrublands, harsh desert, rainforests, woodlands, grassy marshes, river valleys, rocky slopes, and savanna. They live in hollows of trees, mangrove thickets, mammal burrows and dense water reeds, in caves and unattended ruins of old buildings with clumps of vegetation around and is reluctant to move away from its established territory. It is adept at both swimming and climbing trees.

Python is carnivorous. Its diet consists of live prey like rodents and other mammals. As like other pythons, it kills prey which are mainly small mammals by the process of constriction and suffocation.

Python preys upon many types of rodents and vertebrates. It has an important and crucial role as a limiting factor for the populations of its prey species. Due to its decisive place, it is important in maintaining its ecological habitat. It helps in maintaining the exceeding populations of rodents which inflict heavy grain losses in the crops. In this way, its ecological association is extremely important for humans.

b. Threats

The specie is facing many potential threats like loss of habitat due to change in land use pattern for various development activities. Due to lack of awareness the highest killings were due to fear from snakes. Over hunting and illegal trade for its beautiful skin of these animals has greatly reduced their number. The use of pesticides and agrochemicals and unexpected floods are also increasing the intensity of potential treat.

c. Management and Conservation Measures

i. Implement and monitor the strong rules and regulations to stop python habitat degradation, killings and illegal trade.
ii. To create awareness in people about Indian rock python role in maintaining the natural ecosystem seminars, training workshops should be organized at the community level.
iii. The human-python conflict could be overcome through better management programs and compensation schemes for the affected community.
iv. Species and habitat management must be initiated and improved to protect the wildlife in their natural habitat. This will increase the natural prey population for python, minimizing the livestock depredation and human- python conflicts.

5.4.3.7. Indian Monitor Lizard (Varanus bengalensis)

Indian Monitor Lizard also known as Bengal monitor is found in a variety of habitats, from desert areas to floodplains, scrubland to forests, at moderate elevations (https://www.iucnredlist.org/species/164579/5909661). It can also inhabit agricultural areas. In the wild, Bengal monitors are almost completely solitary. Much of the daytime is spent in constant movement, searching for food. Bengal monitor are more likely to interact

with one another during the peak breading season. There are no noted negative impacts of *Varanus bengalensis* on humans. Bengal monitors are not large enough to attack any livestock nor do they eat any human cultivated crops.

a) Habitat

This species has a wide range across south central and Southeast Asia and it inhabits a variety of habitats. This species is found in a variety of habitats, from desert areas to floodplains, scrubland to forests, at moderate elevations. It can also inhabit agricultural areas (https://www.iucnredlist.org/species/164579/5909661).

The diet of Bengal monitors is almost strictly carnivorous. They consume almost anything that is smaller than themselves. They are known to scavenge carcasses of previously felled animals. Common prey includes insects, amphibians, smaller reptiles, birds, small mammals, and eggs.

As per the Wildlife (Protection) Act, 1972 Indian Monitor Lizard (*Varanus bengalensis*) is a Schedule-I species. According to the IUCN Red List of Threatened Species ver. 2020-3, *Varanus bengalensis* is a species under 'Least Concern' category.

b) Threats

This species is possibly threatened by habitat destruction, however, as it can utilize a wide range of habitat types this is not considered a major threat at this time. This species is indirectly affected by pesticides which reduce the food resource availability in agricultural areas. However, perhaps the greatest threat to this species is hunting as it is hunted commercially for its skin. The fat of this species is also used in traditional medicine.

c) Management and Conservation Measures

i. Small earthen material lined water tanks will be created in the identifies habitat area as well as to make sure availability of drinking water.
ii. Awareness program: Gardeners and farmers would be encouraged to use natural manure such as cow dung and vermicompost (compost prepared by earthworms which convert organic waste into manure) instead of chemical fertilizers and pesticides that mostly kill insects (food of monitor lizard) which limit food supply. Insects are an important prey-item during the incubation period and for juvenile's growth.
iii. Awareness generation between farmers and local villagers about the nature and ecological importance of the species.
iv. Litter burning will be discouraged strictly. Litter burning practices destruct habitat and destroy feeding material and removes the cover and nesting materials necessary for shelter and protection from predators.

5.5. Management Measures

In view of the above, various Management and Conservation measures like Habitat improvement, development of Biological Fences using suitable plant species, enforcement of Strict Protection Measures, Public Awareness Programme involving villagers and forest officials for protection and conservation of various species, Anti-Poaching measures, Construction and filling of water holes and check dams/Ponds, tube wells etc.,

Support/Provision of veterinary care, cages, rescue centers, etc., Infra-structure development (Surveillance Equipment's like Cameras, Wireless Sets, GPS etc)., Training Programme for Rescue Techniques of faunal species, Prevention of Forest Fire activities like Training and Infrastructure facilities etc., have been proposed.

5.5.1. Veterinary care

Following provision has been made for ensure the veterinary care of wildlife in the protected area.

i. Creation of veterinary facilities and rescue centres for healthcare of wild animals and for disease control. For this purpose, it is essential to maintain medical facilities in the veterinary centres.
ii. Provision of 01 mobile-rescue-cum-rehabilitation-van.
iii. For Maintenance of mobile-rescue-cum-rehabilitation-van and medical budgetary provision has been made under this plan.

5.5.2. Training to Local Youth

In addition to activities like management and conservation of habitat and provision of veterinary care for faunal species in the area, training programme for interested local youths and officials of forest department about the rescue techniques of faunal species with the help of recognized organizations, wildlife professionals and NGO's.

5.5.3. Prevention of Forest Fire

Incidences of fire in Semi-evergreen forests are rare except in areas. In the forest area having dry grass lands or bushy vegetation, fire incidences are common. Main reason for fire is Rab burning in the agriculture land and for inducing fresh flush of grass. It has a damaging effect on the soil and affects growth of naturally regenerated seedlings. Burning of leaf litter also makes the soil prone to erosion in the incoming rains. Incident of forest fire will be minimized through forming a fire line around the forest area. The following measures are therefore proposed to be taken to prevent forest fire:

i. **Fire Fighting Equipments:** These Fire watchers will also be equipped with certain Fire Fighting Equipments such as Fire resistance dress, Water bottle, Axe, Shoes etc. to attend to emergencies. Therefore, financial provision has been made for fire-fighting equipments.
ii. **Clearing of Fire Line:** Fireline will be cleared over a vulnerable area.
iii. **Training & Awareness:** Financial provision to organise firefighting training for forest officials and villagers residing around project area has been made under this Plan.

5.5.4. Construction and Maintenance of Water Holes/ Ponds in Wildlife Habitat.

For easy accessibility of drinking water for wildlife within the forest area provision of water holes/ artificial ponds has been made. Fund has been allocated for construction of new waterholes/ ponds and maintenance of existing waterholes/ ponds in the forest area. In addition to the cost of construction and maintenance, financial provision of has been made for water supply and filling of dry ponds during dry season.

5.5.5. Training and Capacity building

In addition to activities like management and conservation of habitat provision of training programme for interested local youths and officials of forest department about veterinary care and the rescue techniques of faunal species with the help of recognized organizations, wildlife professionals and NGO's has been made under this plan Training.

5.6. Safeguards during construction phase

During the construction phase, various adverse impacts on the forest and wildlife are anticipated in the surrounding areas of the proposed project in terms of increased noise levels, release of air and water pollutants, etc. To avoid and minimize the negative impacts of these activities, project authorities are advised to prepare strict guidelines as suggested below:

(i) Minimum levels of noise during construction activities will be maintained and ambient noise should be monitored periodically at different locations as outlined in Environment Monitoring Program.
(ii) Strict restrictions shall be imposed on the workers at project sites to ensure that they do not harvest any species/produce from the forests and cause any danger or harm to the animals and birds in the wild.
(iii) The provision made for community kitchen and ensure the supply of the kitchen fuel from the nearest depots to avoid forest degradation and destruction of forest and wildlife habitats.
(iv) The interference of human population would be kept to a minimum in the adjacent forested areas and it would be ensured that the contractors do not set up labour colonies in the vicinity of forests and wilderness areas.

5.7. Strengthening of Infrastructural Facilities of Forest Department

Under this plan, the Project Authority would assist the State Forest Department in strengthening the infrastructure facilities, which are poorly developed in the area. Various activities that are necessary for the forest protection plan are described in the following paragraphs.

i) For improvement of vigilance and measures to check illegal tree falling, extraction of Minor forest products, and poaching, check posts and watchtowers will be needed. To strengthen the working capacity, the workforce of the State Forest/Wildlife Department must be provided with necessary equipment such as a camera, wireless, binoculars GPS, searchlights, health kits, etc. that would increase their capability and efficiency of monitoring.
ii) The construction of inspection paths and watchtowers for more effective and meaningful patrolling by the department.
iii) Creation of veterinary facilities and rescue camps for the healthcare of wild animals and disease control. For this purpose, it is essential to maintain a stock of medicines in addition to setting up a *mobile-rescue-cum-publicity-van*.

CHAPTER 6

6.1. Budgetary Provisions

As per instructions for processing of Wildlife Conservation Plan for Projects issued by Office of Addl. Principal Conservator of Forest and Chief Wildlife Warden, Rajasthan, provisions for the proposed Wildlife Conservation and Management Plan has been made and given in table below.

S. No.	Particulars	Provisions	Cost in Rs.
1	**407.8227 ha** of Forest land to be diverted for Proposed Shahpur PSP	Rs 0.50 lakh per ha for 407.8227 ha	20391135.00
2	**5 No. of Schedule- I species** reported from the project area.	Rs. 5.00 lakh for each Schedule-I species	2500000.00
Total Cost			**2,28,91,135.00**

The total budget allocated for Wildlife Conservation and Management Plan including conservation and management measures for Schedule-I species is **Rs 22891135.00 (say 229.00 lakh)**. The Break-up of the budget is given in **Table 25**.

State Forest Department shall be the executing agency for implementation of the proposed mitigation measure under Wildlife Management Plan in the surrounding of proposed project site, therefore, a total amount of **Rs. 229.00 lakh** will be deposited with the Rajasthan State Forest Department for taking up proposed activities within the area.

6.2. Breakup of the Budget

As per guidelines issued by Office of Addl. Principal Conservator of Forest and Chief Wildlife Warden, Rajasthan, Jaipur issued by letter no. WCP/CWLW/2019/651-663 dated 24/05/2019, budget allocated under various categories is given below in **Table 25**.

Table 25: Break-up for Biodiversity Conservation and Wildlife Management Plan

S. No.	Item	% of Total Outlay of Plan (Rs. in lakh)
1	Habitat improvement & mitigative measures and measures to reduce/ minimize the human- animal conflicts (50% of the total cost)	**114.50**
2	Awareness and Extension (10% of the total cost)	**22.90**
3	Support to Forest Department for monitoring, rescue & rehabilitation of Wildlife (10% of the total cost)	**22.90**
4	Contribution towards conservation of Wildlife in PA's (10% of the total cost)	**22.90**
5	Administrative Cost for processing inspections etc. (10% of the total cost)	**22.90**
6	Miscellaneous including Eco- development (10% of the total cost)	**22.90**
	Total	**229.00**

CHAPTER 7

7.1. RELEVANT MAPS

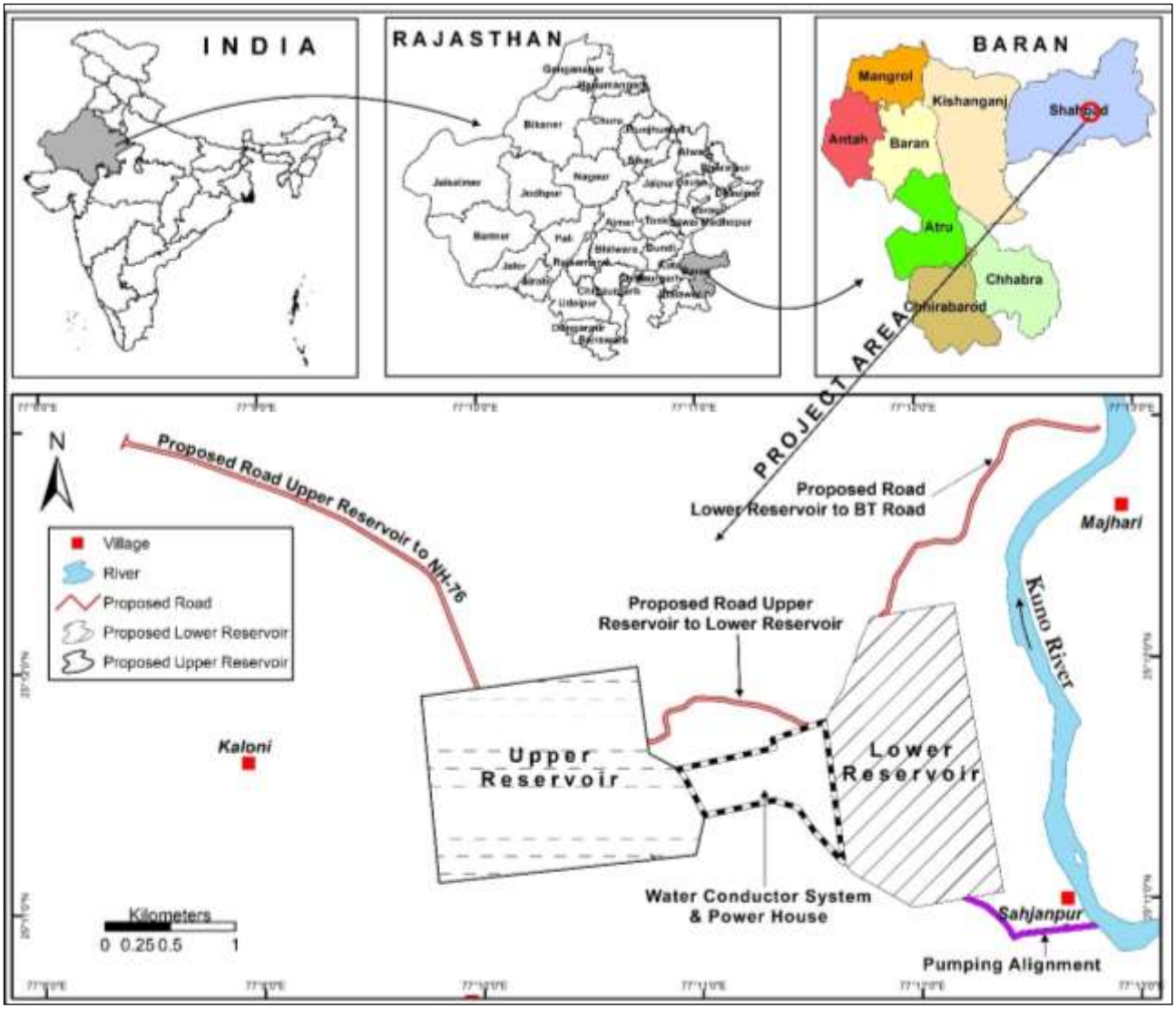

Figure 1: Project Location Map

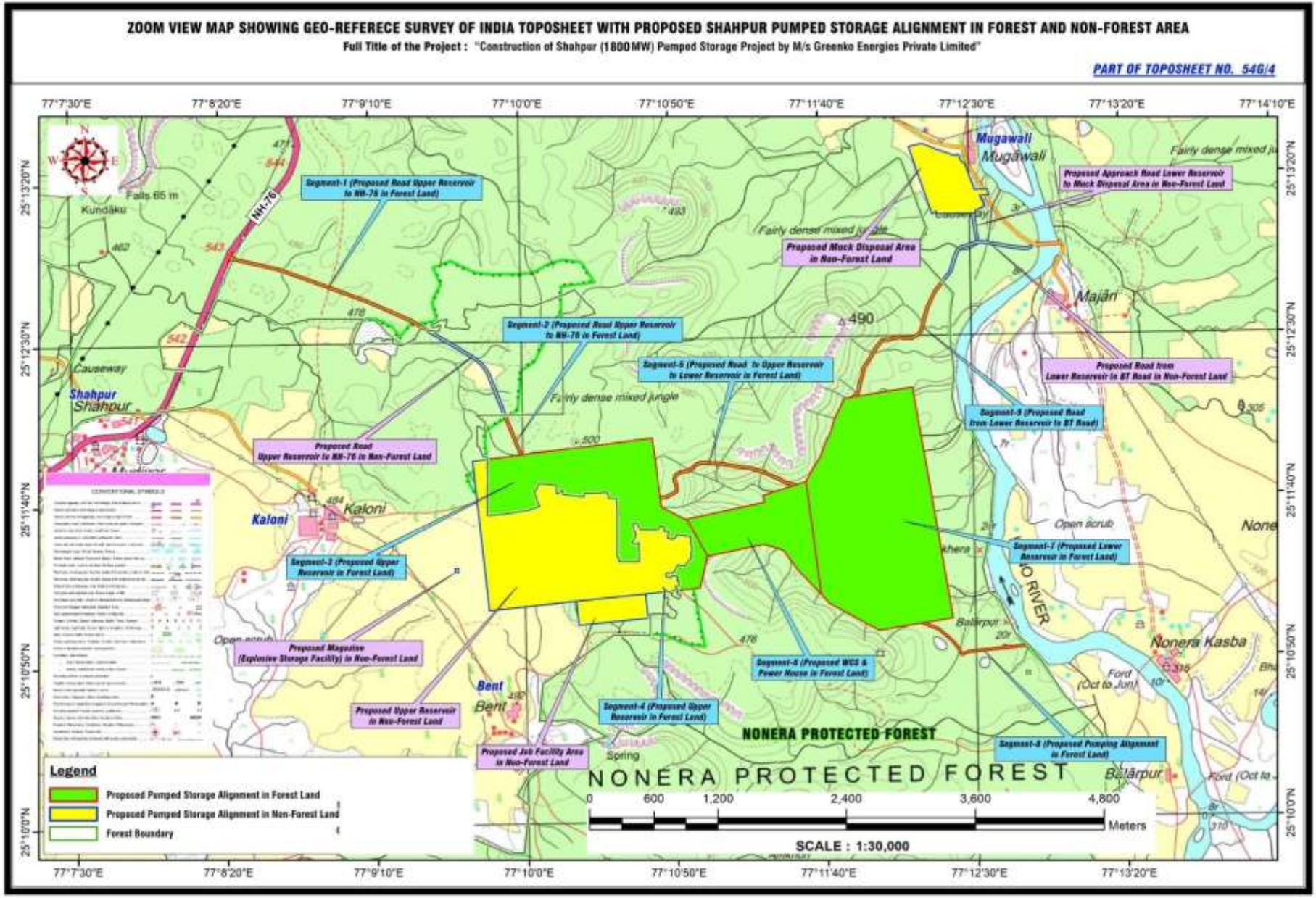

Figure 2: Project Layout on Toposheet

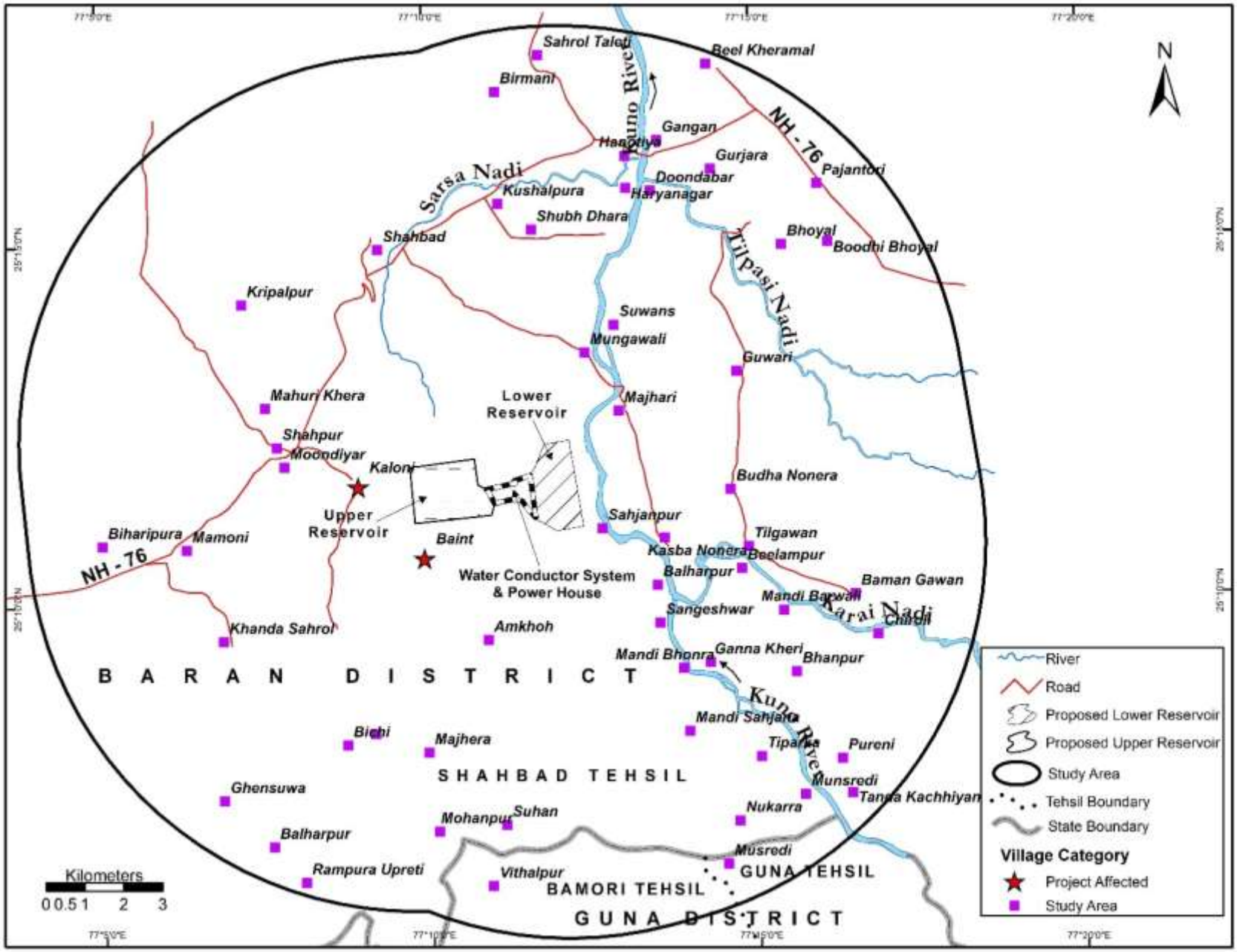

Figure 3: Village Map of the Study Area

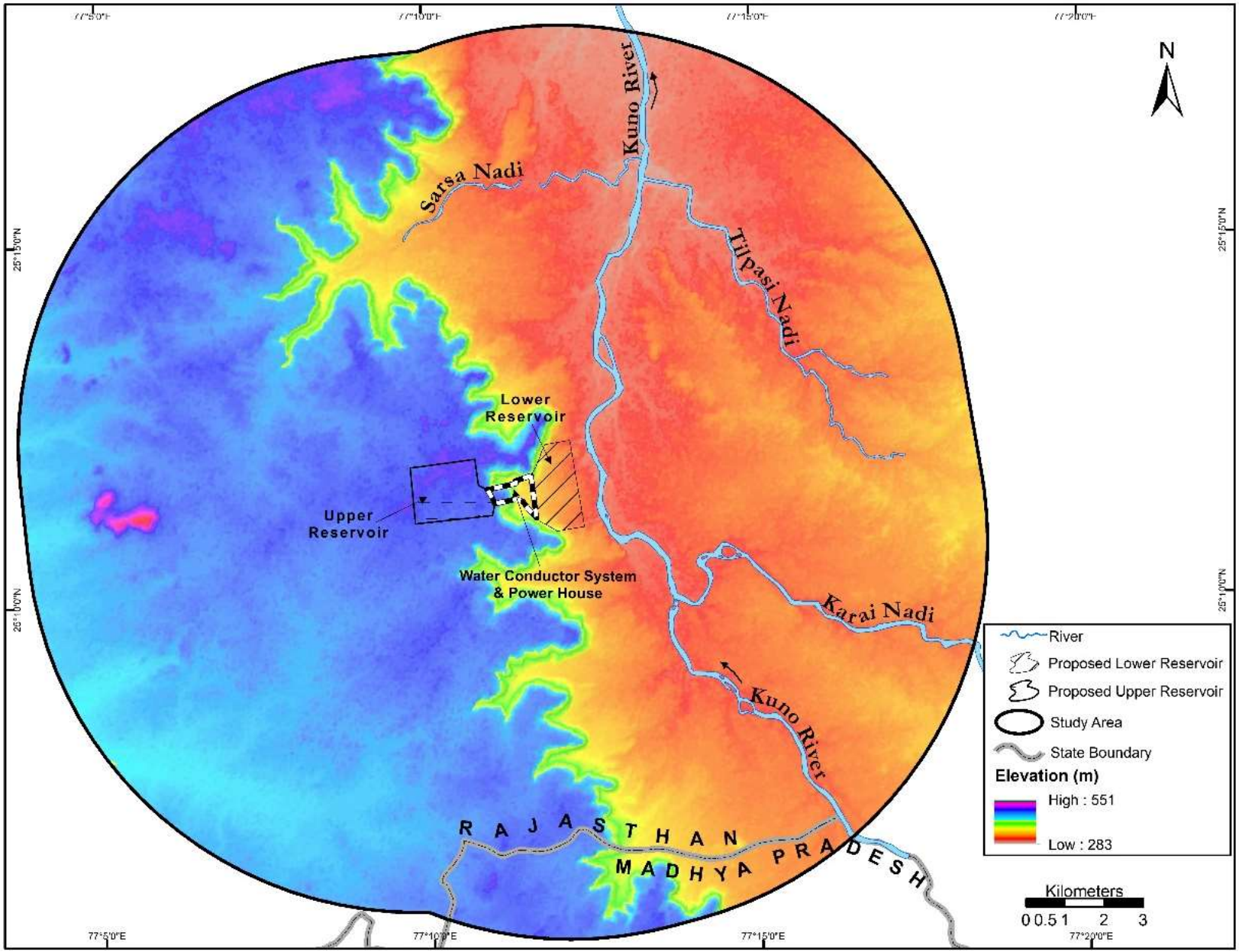

Figure 4: Digital Elevation Map of the Study Area

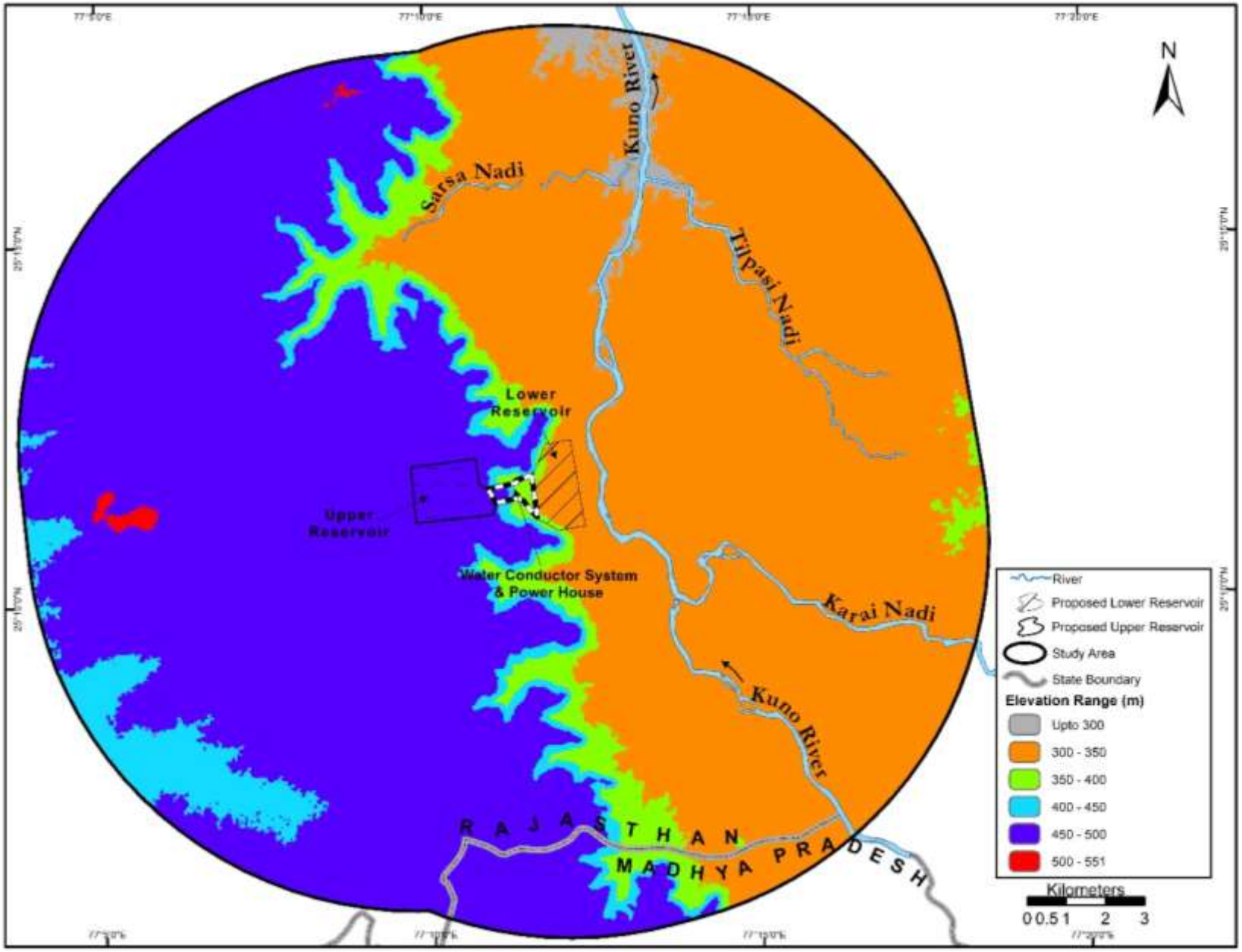

Figure 5: Relief Map of the Study Area

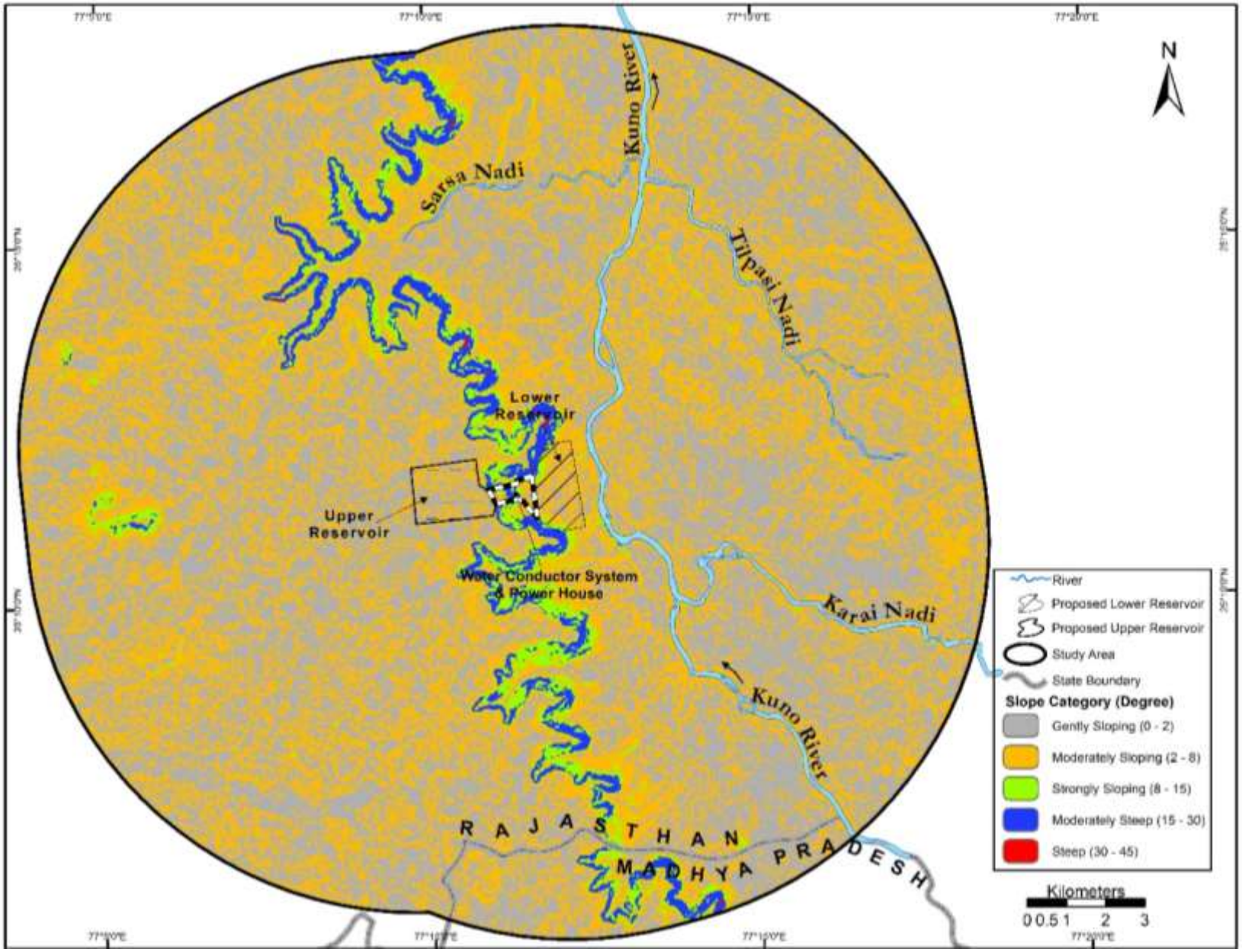

Figure 6: Slope map of the Study Area

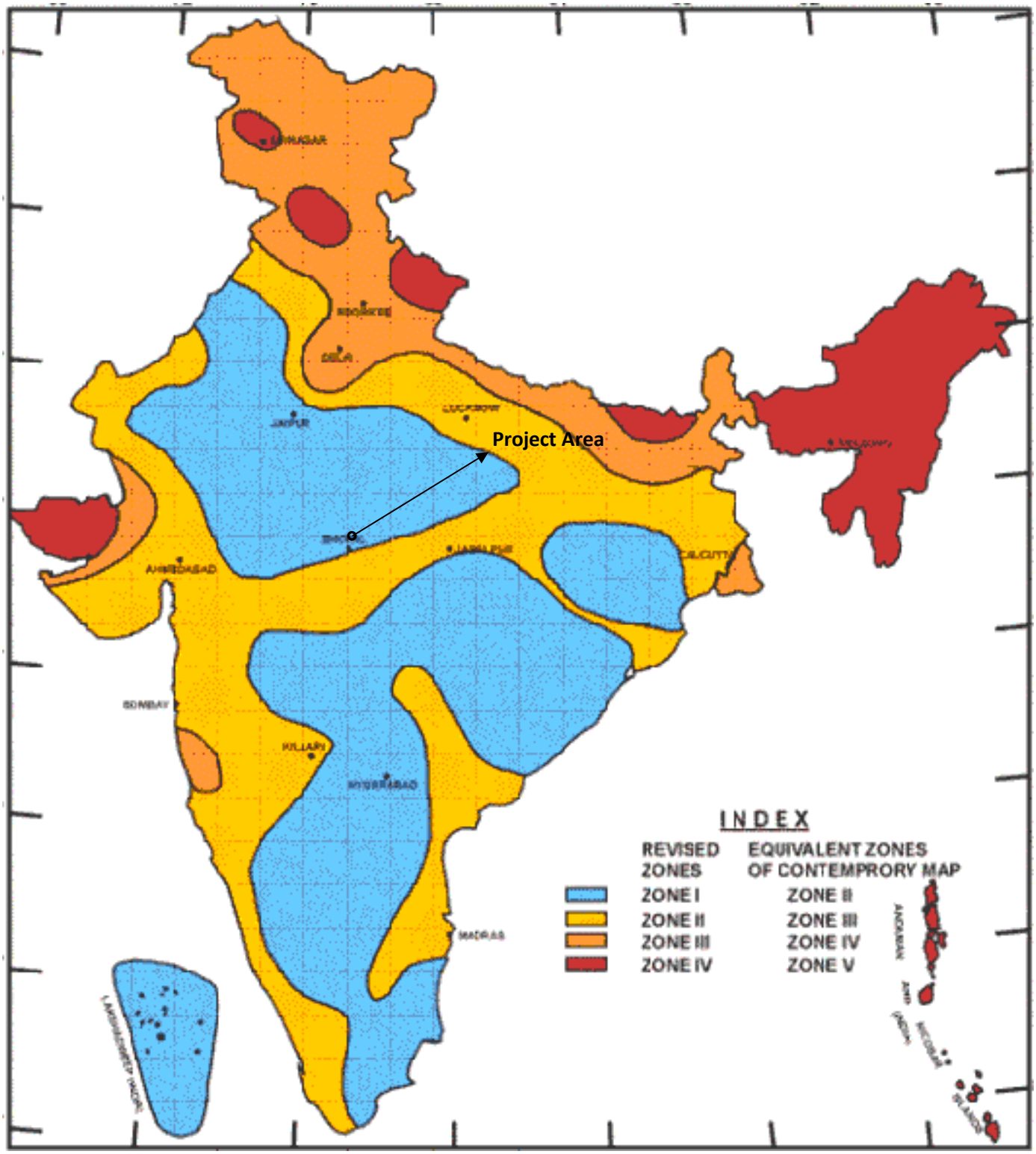

Figure 7: Seismic Zone Map of India

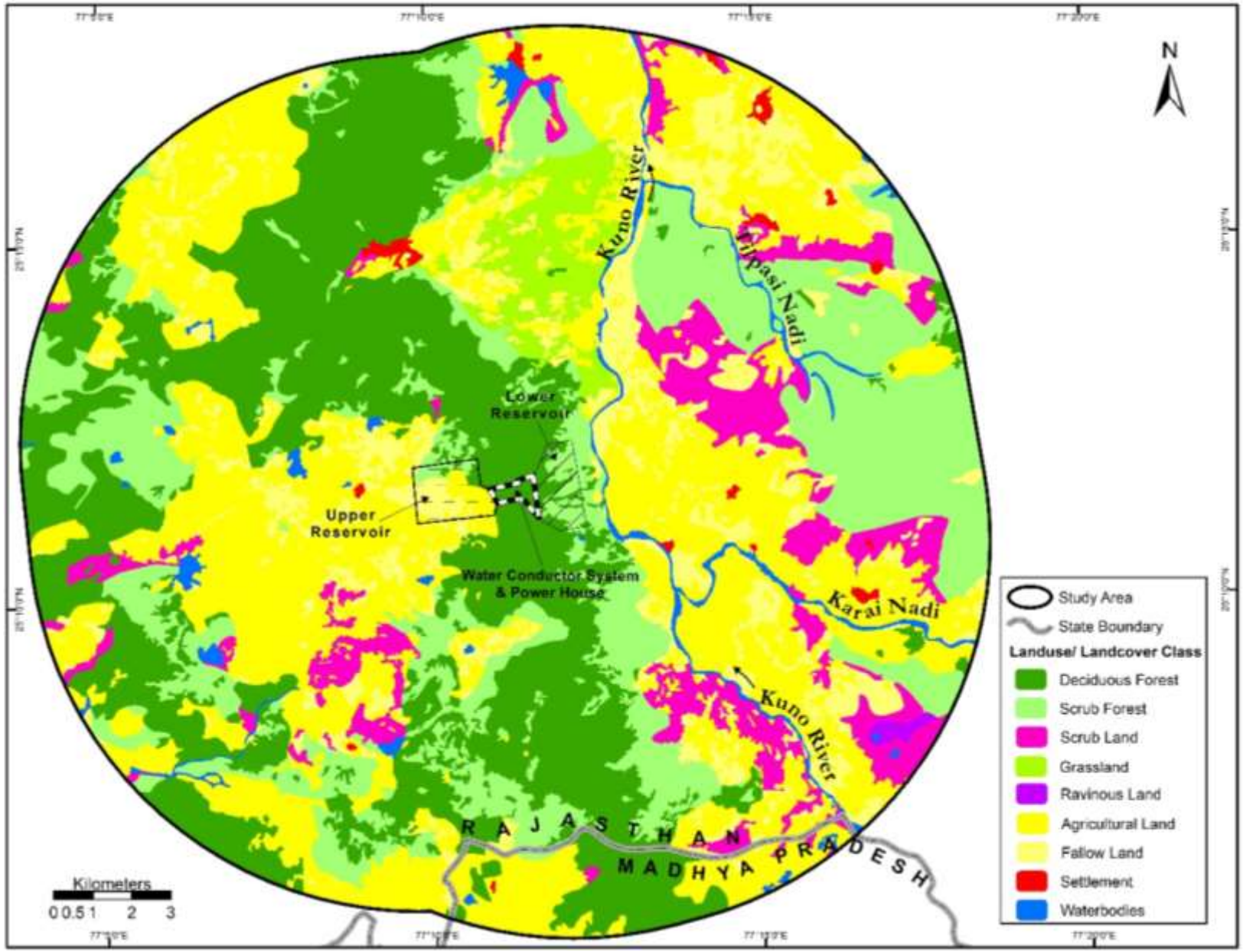

Figure 8: Land Use/ Landcover map of the study area

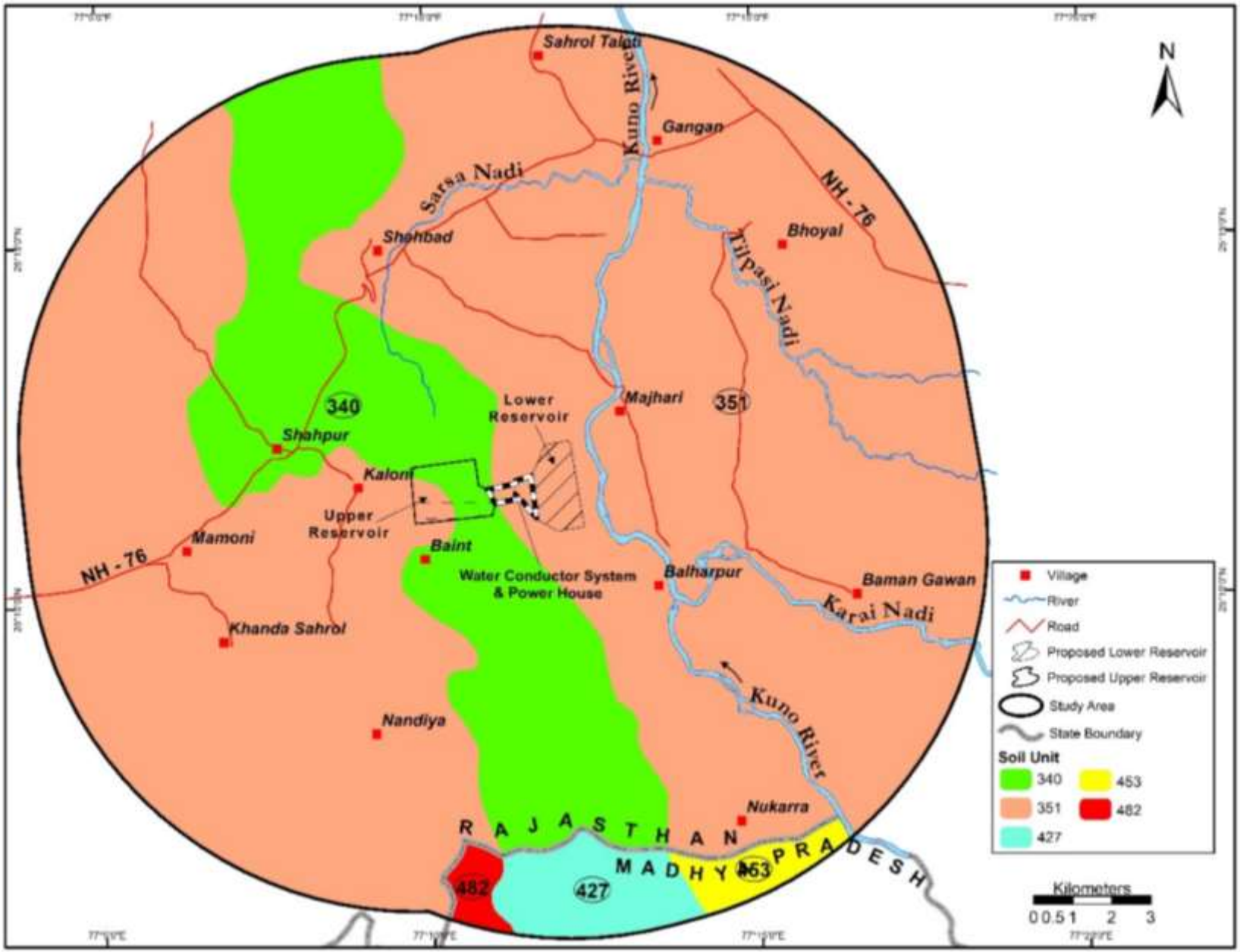

Figure 9: Soil map of the Study Area

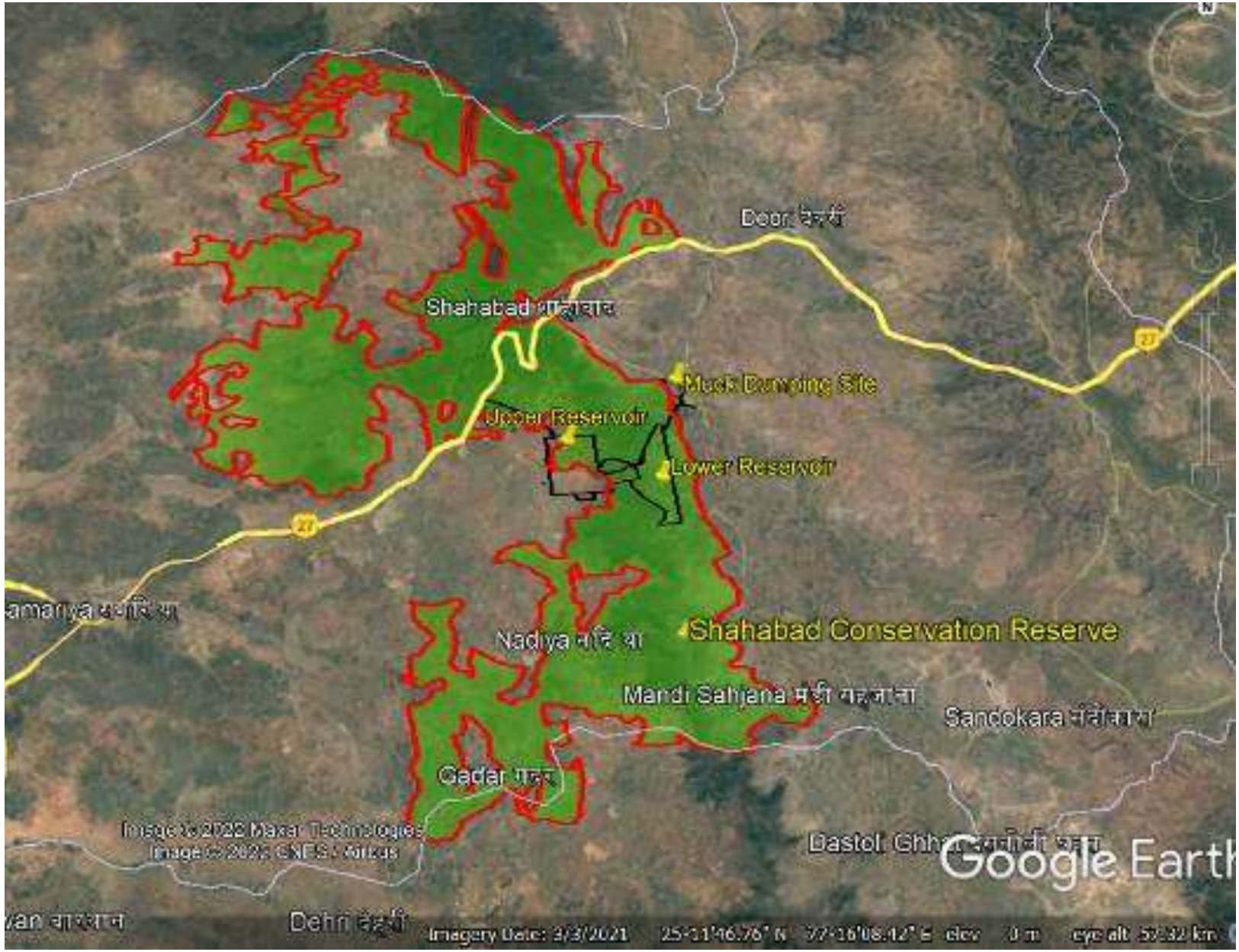

Figure 10: Map showing location of project components w.r.t. Shahabad Conservation Reserves

Figure 11: Distance of project components from Kuno National Park on Google Earth Map

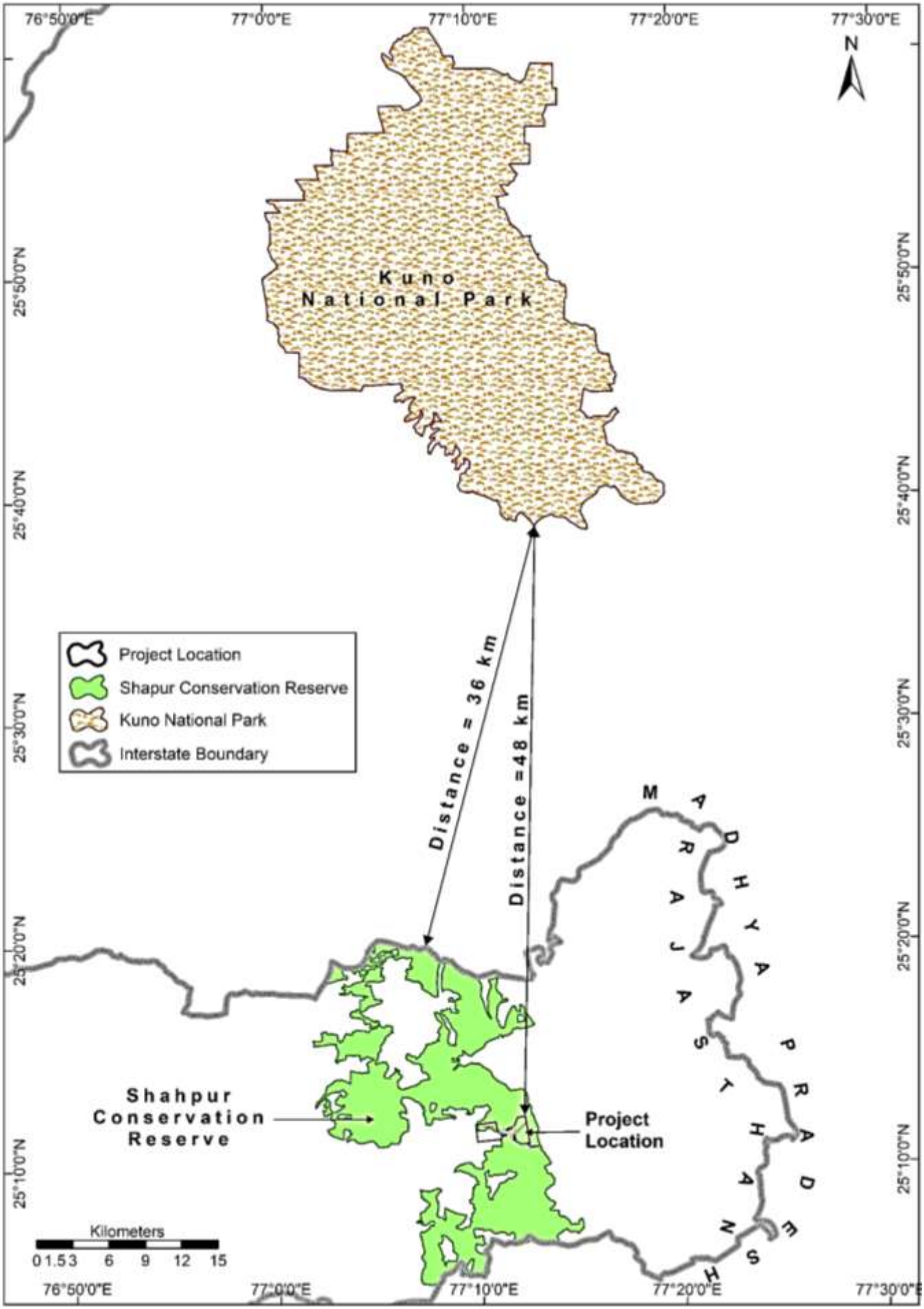

Figure 12: Map showing distance of project components from Kuno National Park

Figure 13: Location of Muck Disposal Site

7.2. ANNEXURES

Annexure I: List Of Plant Species Reported From The Study Area

a. Trees

S. No.	Family	Scientific Name
1	Anacardiaceae	*Mangifera indica*
2	Anacardiaceae	*Buchanania cochinchinensis*
3	Annonaceae	*Annona squamosa*
4	Apocynaceae	*Holarrhena pubescens*
5	Apocynaceae	*Wrightia tinctoria*
6	Arecaceae	*Phoenix sylvestris*
7	Boraginaceae	*Cordia dichotoma*
8	Burseraceae	*Bosewllia serrata*
9	Combretaceae	*Anogeissus latifolia*
10	Combretaceae	*Anogeissus pendula*
11	Combretaceae	*Terminalia arjuna*
12	Combretaceae	*Terminalia bellirica*
13	Combretaceae	*Terminalia tomentosa*
14	Cornaceae	*Alangium salviifolium*
15	Ebenaceae	*Diospyros melanoxylon*
16	Ebenaceae	*Diospyros montana*
17	Fabaceae	*Acacia catechu*
18	Fabaceae	*Acacia nilotica*
19	Fabaceae	*Acacia senegal*
20	Fabaceae	*Albizia lebbeck*
21	Fabaceae	*Albizia procera*
22	Fabaceae	*Bauhinia racemosa*
23	Fabaceae	*Bauhinia variegata*
24	Fabaceae	*Butea monosperma*
25	Fabaceae	*Cassia fistula*
26	Fabaceae	*Dalbergia sissoo*
27	Fabaceae	*Delonix regia*
28	Fabaceae	*Desmodium oojeinense*
29	Fabaceae	*Erythrina suberosa*
30	Fabaceae	*Hardwickia binata*
31	Fabaceae	*Parkinsonia aculeata*
32	Fabaceae	*Pithecellobium dulce*
33	Fabaceae	*Pongamia pinnata*
34	Fabaceae	*Prosopis cineraria*
35	Fabaceae	*Prosopis juliflora*
36	Fabaceae	*Tamarindus indica*
37	Lamiaceae	*Tectona grandis*
38	Lythraceae	*Lagerstroemia parviflora*
39	Malvaceae	*Bombax ceiba*
40	Malvaceae	*Grewia tiliifolia*
41	Malvaceae	*Kydia calycina*
42	Meliaceae	*Azadirachta indica*
43	Meliaceae	*Melia azedarach*
44	Moraceae	*Ficus benghalensis*
45	Moraceae	*Ficus hispida*
46	Moraceae	*Ficus racemosa*
47	Moraceae	*Ficus religiosa*
48	Moraceae	*Morus alba*
49	Myrtaceae	*Corymbia citriodora*
50	Myrtaceae	*Syzygium cumini*
51	Phyllanthaceae	*Bridelia retusa*
52	Phyllanthaceae	*Phyllanthus emblica*
53	Rhamnaceae	*Ziziphus jujuba*
54	Rubiaceae	*Haldina cordifolia*
55	Rubiaceae	*Mitragyna parvifolia*
56	Rubiaceae	*Neolamarckia cadamba*
57	Rutaceae	*Aegle marmelos*
58	Rutaceae	*Feronia limonia*
59	Sapindaceae	*Sapindus laurifolius*
60	Sapotaceae	*Madhuca longifolia*
61	Simaroubaceae	*Ailanthus excelsa*
62	Ulmaceae	*Holoptelea integrifolia*

b. Shrub

S.No	Family	Scientific Name
1	Acanthaceae	*Justicia adhatoda*
2	Apocynaceae	*Calotropis gigantea*
3	Apocynaceae	*Carissa carandas*
4	Apocynaceae	*Carissa spinarum*
5	Apocynaceae	*Cryptolepis buchananii*
6	Apocynaceae	*Gymnema sylvestre*
7	Apocynaceae	*Ichnocarpus frutescens*
8	Apocynaceae	*Nerium oleander*
9	Arecaceae	*Phoenix acaulis*
10	Asparagaceae	*Agave americana*
11	Asparagaceae	*Asparagus racemosus*
12	Asteraceae	*Xanthium strumarium*

S.No	Family	Scientific Name
13	Boraginaceae	*Heliotropium indicum*
14	Cactaceae	*Opuntia elatior*
15	Cannabaceae	*Trema politoria*
16	Capparaceae	*Capparis sepiaria*
17	Celastraceae	*Celastrus paniculatus*
18	Colchicaceae	*Gloriosa superba*
19	Convolvulaceae	*Ipomoea carnea*
20	Euphorbiaceae	*Euphorbia nerifolia*
21	Euphorbiaceae	*Jatropha curcas*
22	Euphorbiaceae	*Ricinus communis*
23	Fabaceae	*Acacia pennata*
24	Fabaceae	*Butea superba*
25	Fabaceae	*Caesalpinia decapetala*
26	Fabaceae	*Flemingia macrophylla*
27	Fabaceae	*Indigofera tinctoria*
28	Fabaceae	*Senna obtusifolia*
29	Fabaceae	*Senna occidentalis*
30	Lamiaceae	*Colebrookea oppositifolia*
31	Lamiaceae	*Vitex negundo*
32	Lythraceae	*Woodfordia fruticosa*
33	Malvaceae	*Abutilon indicum*

S.No	Family	Scientific Name
34	Malvaceae	*Grewia rothii*
35	Malvaceae	*Grewia tenax*
36	Malvaceae	*Helicteres isora*
37	Malvaceae	*Sida cordifolia*
38	Malvaceae	*Thespesia lampas*
39	Menispermaceae	*Tinospora sinensis*
40	Myrtaceae	*Syzygium salicifolium*
41	Oleaceae	*Nyctanthes arbor-tristis*
42	Phyllanthaceae	*Phyllanthus reticulatus*
43	Poaceae	*Dendrocalamus strictus*
44	Primulaceae	*Embelia robusta*
45	Rhamnaceae	*Ziziphus xylopyrus*
46	Rubiaceae	*Gardenia gummifera*
47	Rubiaceae	*Leptodermis lanceolata*
48	Rutaceae	*Murraya koenigii*
49	Salicaceae	*Flacourtia indica*
50	Sapindaceae	*Sapindus emarginatus*
51	Solanaceae	*Datura stramonium*
52	Solanaceae	*Withania somnifera*
53	Tamaricaceae	*Tamarix dioica*
54	Verbenaceae	*Lantana camara*
55	Vitaceae	*Leea asiatica*

c. Herbs

S.No	Family	Scientific Name
1	Acanthaceae	*Achyranthes aspera*
2	Acanthaceae	*Achyranthes bidentata*
3	Acanthaceae	*Andrographis paniculata*
4	Acanthaceae	*Eranthemum pulchellum*
5	Acanthaceae	*Rungia repens*
6	Acoraceae	*Acorus calamus*
7	Amaranthaceae	*Aerva lanata*
8	Anthericaceae	*Chlorophytum tuberosum*
9	Apocynaceae	*Catharanthus roseus*
10	Apocynaceae	*Cryptolepis dubia*
11	Apocynaceae	*Rauvolfia serpentina*
12	Araceae	*Colocasia esculenta*
13	Asparagaceae	*Drimia indica*
14	Asteraceae	*Acanthospermum hispidum*
15	Asteraceae	*Artemisia annua*
16	Asteraceae	*Aster peduncularis*
17	Asteraceae	*Bidens biternata*
18	Asteraceae	*Bidens pilosa*

S.No	Family	Scientific Name
19	Asteraceae	*Erigeron canadensis*
20	Asteraceae	*Parthenium hysterophorus*
21	Asteraceae	*Sonchus asper*
22	Asteraceae	*Tridax procumbens*
23	Cactaceae	*Opuntia stricta*
24	Cannabaceae	*Cannabis sativa*
25	Capparaceae	*Capparis zeylanica*
26	Convolvulaceae	*Convolvulus prostratus*
27	Convolvulaceae	*Cuscuta reflexa*
28	Cucurbitaceae	*Mukia maderaspatana*
29	Cyperaceae	*Cyperus rotundus*
30	Euphorbiaceae	*Baliospermum solanifolium*
31	Euphorbiaceae	*Chrozophora oblongifolia*
32	Euphorbiaceae	*Euphorbia hirta*
33	Fabaceae	*Abrus precatorius*
34	Fabaceae	*Acacia polyacantha*
35	Fabaceae	*Alysicarpus monilifer*

S.No	Family	Scientific Name
36	Fabaceae	*Alysicarpus rugosus*
37	Fabaceae	*Bauhinia vahlii*
38	Fabaceae	*Crotalaria medicaginea*
39	Fabaceae	*Desmodium gangeticum*
40	Fabaceae	*Flemingia chappar*
41	Fabaceae	*Indigofera cassioides*
42	Fabaceae	*Mimosa pudica*
43	Fabaceae	*Senna alexandrina*
44	Fabaceae	*Senna tora*
45	Fabaceae	*Tephrosia purpurea*
46	Hypericaceae	*Hypericum gaitii*
47	Hypoxidaceae	*Curculigo orchioides*
48	Lamiaceae	*Ajuga integrifolia*
49	Lamiaceae	*Ocimum basilicum*
50	Lamiaceae	*Ocimum sanctum*
51	Malvaceae	*Abelmoschus moschatus*
52	Malvaceae	*Corchorus aestuans*
53	Nyctaginaceae	*Boerhavia diffusa*
54	Papaveraceae	*Argemone mexicana*
55	Phyllanthaceae	*Glochidion lanceolarium*
56	Plantaginaceae	*Lindenbergia indica*
57	Poaceae	*Apluda mutica*
58	Poaceae	*Aristida adscensionis*
59	Poaceae	*Brachiaria eruciformis*
60	Poaceae	*Cenchrus ciliaris*

S.No	Family	Scientific Name
61	Poaceae	*Cymbopogon martini*
62	Poaceae	*Cynodon dactylon*
63	Poaceae	*Dichanthium aristatum*
64	Poaceae	*Digitaria ciliaris*
65	Poaceae	*Echinochloa colona*
66	Poaceae	*Eragrostis amabilis*
67	Poaceae	*Erianthus munja*
68	Poaceae	*Heteropogon contortus*
69	Poaceae	*Imperata cylindrica*
70	Poaceae	*Ischaemum pilosum*
71	Poaceae	*Pennisetum glaucum*
72	Poaceae	*Saccharum spontaneum*
73	Poaceae	*Setaria pumila*
74	Poaceae	*Themeda quadrivalvis*
75	Poaceae	*Vetiveria zizanioides*
76	Polygonaceae	*Rumex hastatus*
77	Primulaceae	*Anagallis arvensis*
78	Rhamnaceae	*Ziziphus nummularia*
79	Rubiaceae	*Galium aparine*
80	Smilacaceae	*Smilax macrophylla*
81	Smilacaceae	*Smilax zeylanica*
82	Solanaceae	*Datura metel*
83	Solanaceae	*Solanum americanum*
84	Vitaceae	*Leea macrophylla*
85	Xanthorrhoeaceae	*Aloe vera*
86	Zygophyllaceae	*Tribulus terrestris*

Biodiversity Management Plan

1 BIODIVERSITY MANAGEMENT PLAN

The purpose of biodiversity management and wildlife conservation plan for developmental projects is to conserve and preserve the existing biodiversity in and around the proposed project area. The proposed project area falls within newly declared Shahbad Conservation Reserve. The project related activities like road construction, the construction of dam, increased traffic, influx of labour, etc. are the general threat to biodiversity and wildlife in the area. Therefore, the effective and efficient mechanisms for conserving biodiversity is to prevent further degradation or destruction of habitats. The strategies adopted for biodiversity conservation and management are in situ conservation, ex-situ conservation, reduction of anthropogenic pressure, and protection of the species at risk.

1.1 Biodiversity Profile of the Project Area

The baseline studies undertaken for assessing terrestrial biodiversity composition (which includes forest, mammals, and birds) of the Direct Impact Area as well as the Indirect Impact Area of Shahpur PSP show that forest in the area is mainly comprised of Northern mixed dry deciduous and scrub vegetation. *Tectona grandis* and *Diospyros melanoxylon* are the dominant tree species in the forest area. Around the project area, *Anogeissus pendula, Diospyros melanoxylon, Terminalia tomentosa, Terminalia bellirica, Lannea coromandelica, Butea monosperma, Phyllanthus emblica,* are the commonly observed tree species. *Acacia nilotica*, *Butea monosperma, Bauhinia racemosa, Boswellia serrata, Cassia fistula,* and *Ziziphus jujuba* represents the vegetation of scrub forest in the study area. Overall forest in the area is in degraded condition except for patches away from habitation and human interference. In general, the project area does not harbor species of particular specific conservation interest.

According to IUCN Red List Ver. 2020-3, plant species recorded from the study area either fall under Least Concern (LC) category or have not been assessed and listed as Not Evaluated (NE).

Among the mammals, no Schedule I species was sighted in the study area. According to WPA (1972), five species of mammals are Schedule-II, and two species are Schedule III, and four species are listed under Schedule-IV. The avifaunal species recorded from the area are Listed under the Least Concern category of the IUCN Red List of Threatened Species version 2020.3. As per WPA (1972) all species are listed under Schedule IV and Schedule V.

1.2 Threats to Biodiversity & Wildlife

The fragmentation of forested landscape in the area is happening due to degradation activities encroachment into forest lands for agriculture, like clear-felling for timber, man-animal conflict, the introduction of exotic species, and uncoordinated infrastructural development. Overexploitation of forest resources, population explosion, urbanization, unscientific management, the encroachment of forest land, illicit felling, lack of regeneration of forests, lack of coordination with stakeholders, and outdated laws are major factors responsible for the degradation and depletion of forests in the area. Deforestation may lead

to increase soil erosion, loss of fertile soil, silting of rivers, reduction of rainfall, dryness in the air, and increase in temperature, adversely affecting not only forestry but also agriculture and horticulture, etc. Therefore, major threats to biodiversity and wildlife in the project area are as follows.

a) Encroachment of Forest land for Agriculture:

Agriculture is the main occupation in the study area. Conversion of forestland into agriculture is quite common in the area due to the increased population pressure. Most of the gently sloping lands and flatlands on the edges of the forest area have been converted into agricultural fields. Encroachment in forest areas is the main cause of depletion of forest cover and also leads to wildlife habitat destruction. This results in habitat loss, degradation, and fragmentation are important causes of known species-populations extinctions. Grass cutting which is carried out by villagers for cattle fodder from the forest prevents regeneration of the forest and inhibits the natural undergrowth of shrubs and herbs.

b) Human-Wildlife Conflict:

Deforestation, growing human settlements, expansion of agricultural land, and fragmentation of natural habitat and grazing ground of species like Common Langur, Rhesus macaque, Common Hare, Jackal, Blue bull, and Wild Boar are the causes behind the increase in human-wildlife conflict. In the study area, human-wildlife conflict in terms of crop damage looked more common and causing losses to the farmers.

c) Hunting and poaching:

Damage of crops by species like Common Langur, Rhesus macaque, Common Hare, Blue bull, and Wild Boar results in hunting and killing of these wild animals.

d) Illegal cutting of trees:

The stakeholders, from the study area depend upon forest for their day to day need of fodder, fuelwood, and other Non-Timber Forest products (NTFP) as well as timber wood needs. This results in tremendous pressure on the forests.

e) Grazing pressure:

The forest area is also under grazing pressure by the livestock and is susceptible to damage by livestock. It is common practice in the area. The grazing has affected the vegetation not only by preventing the accumulation of some grasses but also stimulating the regeneration of species and checks the recruitment of seedlings which are damaged by trampling by cattle.

1.3 Biodiversity Conservation & Wildlife Management Plan

The most effective ways of biodiversity conservation in the area is creating awareness among the stakeholders, joint forest management, and natural resource management by involving local peoples.

Wildlife management consists of habitat evaluation and assessment, periodic monitoring of vegetation cover and animal population status, identification of habitat factors favorable to growth & regeneration, and the factors which act against the population. Welfare factors are promoted, adverse factors are arrested, and limiting factors are mitigated so that habitat

carrying capacity is optimized and populations attain the equilibrium point intrinsic to the species. Participation and support of the local public are enlisted to make the conservation plan work and the outcome becomes sustainable.

Because of the anticipated impacts, a biodiversity conservation and management plan has been proposed. The main objectives of the plan are as follows:

i. Maintenance of ecological balance through preservation and restoration, wherever it has been disturbed due to project developmental activities,
ii. Conservation and preservation of natural habitats in project surrounding
iii. Mitigation and control of project induced biotic and/or abiotic pressures/ influences that may affect the natural habitats,
iv. Habitat enhancement in the project area by taking up afforestation and soil conservation measures,
v. Creating all-around awareness regarding conservation and ensuring people's participation in conservation efforts and minimizing human-wildlife conflict.

1.3.1 Management Measures

i. Wildlife Habitat Preservation & Improvement

a. Afforestation and Enrichment plantation

Afforestation and enrichment plantation will be carried out in the area. The area under forest and tree cover will be expanded through systematic planning and implementation of afforestation and rehabilitation programs in available community lands. Afforestation programme in the degraded Forest Compartments is also proposed to be carried out in the surrounding of the project area. The sites and species to be planted will be finalized by the state Forest Department as the program will be implemented by them.

The plantation site will be trench fenced and brushwood fence, for the protected from cattle grazing. With the improvement in the habitat of wildlife, the incidences of human-wildlife conflict will accordingly reduce. The estimated cost for plantation over about 50 ha area has been worked @ Rs. 1,00,000.00 per ha for Enrichment plantation. The enrichment plantation will be carried along the periphery of the proposed reservoirs in the adjoining forest area. As such, no additional forest land will be diverted for this purpose.

b. Farm Forestry

The project area harbours several economically important plants like *Diospyros melanoxylon, Tectona grandis, Buchanania cochinchinensis, Phyllanthus emblica, Terminalia bellirica, etc*. These valuable resources will be directly useful to the people of the area which can form the basis of economic upliftment.

To reduce dependence on the natural forests for biomass and other Non-Timber Forest Products (NTFPs) or Minor Forest Products (MFPs) alternate resources need to be building up. NTFPs/MFPs plantations will be carried out on the community land, degraded land, fallow lands which help in sustainable land management and a tool for reclamation. An area of about 5 ha will be developed.

A budgetary estimate has been made @ **Rs. 75,000.00** per ha under this head.

Decentralized nurseries will be created with the help of the forest department. Species to be raised are primarily to cater to fuel, fodder, and small timber needs. Besides, seedlings of economically important plant species like Amla (*Phyllanthus emblica*), Behda (*Terminalia bellirica*), Bamboo, etc., will be distributed every year to villagers at a nominal rate. The distribution will be facilitated through the Forest Range office in the area. The Forest department may take up a prior survey with the help of local administrative bodies/ panchayats to assess the requirement plants.

c. Sowing of Fodder and Grass species

To prevent seeds from getting washed away and to ensure uniform growth of grasses, seed pellets of grasses will be sown at regular intervals. Pellets are made by mixing powdered clay and farmyard manure into which grass seeds are mixed. The mixture is then made into balls and sun-dried in summer to be sown soon after de-weeding. This will also help in arresting erosion to a great extent. The estimated cost for the sowing of grasses is **Rs. 5.00 lakh**.

d. Awareness Programme

The success of any conservation plan of this magnitude is entirely hinged on the active support and wholehearted co-operation of all stakeholders with the members of the public playing a major role. For this purpose, meetings and workshops will be organized from village to village on regular basis. Functions like Van Mahotsav, Wildlife Week, World Forestry Day, and World Environment Day will be organized in a befitting manner to which village heads, members of public representatives' system at Gram Panchayat level, local leaders, and members of NGO will be involved. The topics should include deterioration of biodiversity, habitat loss, human-wildlife conflicts, fire damage control, and how best the vegetation can be revamped, etc. Members of the public will be encouraged to speak. The student community should also be sensitized to various conservation issues.

Considering that the wildlife populations will be impacted by project construction activities and due to the influx of migrant labour force, mitigation measures should also be taken for the larger area. The following measures are proposed:

- Control on hunting and poaching.
- Awareness campaigns are aimed at creating awareness towards respecting habitat protection in general and the protection of wildlife species.

General awareness of the Wildlife Protection Act and its rules would be spread among the locals through communication and extension services. The wildlife populations in this area are likely to be affected by project construction activities and also due to the influx of migrant labour force, awareness among them and contractors would be inculcated.

Under this programme, various activities viz. training, publishing of pamphlets, brochures, hoardings, etc. shall be carried out during the construction phase of the project. The following activities are planned under this programme:

Observance of Wildlife Week: The wildlife week will be celebrated every year in March to assess all the tasks set aside for wildlife management. Under this programme, seminars, art competitions, and awareness campaigns will be held.

Nature Club: Nature clubs will be introduced at the Higher Secondary and High school level in the project area. They will be imparted education using audio-visual aids to sensitize them about the importance of wildlife conservation.

Involvement of Village Panchayats and NGOs: The Panchayats of affected villages and active NGOs in the project area would be involved to disseminate the knowledge about the benefits of the proposed project and ensuring greater participation in the conservation efforts and safeguard the environment of the area.

For the implementation of an awareness programme an amount of **Rs. 1.00 lakh/year** has been budgeted.

1.4 Safeguards during the construction phase

During the construction phase, various adverse impacts on the wildlife are anticipated in the surrounding areas of the proposed project in terms of increased noise levels, land vibrations during underground work and blasting, the release of air and water pollutants, etc. To avoid and minimize the negative impacts of these activities, project authorities are advised to prepare strict guidelines as suggested below:

(i) Strict restrictions shall be imposed on the workers at project sites to ensure that they do not harvest any species/produce from the forests and cause any danger or harm to the animals and birds in the wild.

(ii) Minimum levels of noise during construction activities will be maintained.

(iii) The provision made for a community kitchen and ensure the supply of the free/subsidized kerosene/LPG from the depots being set up for this purpose to avoid forest degradation and destruction of forest and wildlife habitats.

(iv) The interference of the human population would be kept to a minimum in the adjacent forested areas and it would be ensured that the contractors do not set up labour colonies in the vicinity of forests and wilderness areas.

1.5 Strengthening of Infrastructural Facilities of Forest Department

Under this plan, the Project Authority would assist the State Forest Department in strengthening the infrastructure facilities, which are poorly developed in the area. Various activities that are necessary for the forest protection plan are described in the following paragraphs.

i) For improvement of vigilance and measures to check illegal tree falling, extraction of Minor forest products, and poaching, check posts and watchtowers will be needed. To strengthen the working capacity, the workforce of the State Forest/Wildlife Department must be provided with necessary equipment such as a camera, wireless, binoculars GPS, searchlights, health kits, etc. that would increase their capability and efficiency of monitoring.

ii) The construction of inspection paths and watchtowers for more effective and meaningful patrolling by the department.

iv) Creation of veterinary facilities and rescue camps for the healthcare of wild animals and disease control. For this purpose, it is essential to maintain a stock of medicines in addition to setting up a *mobile-rescue-cum-publicity-van*.

Project authorities would provide funds to the State Forest Department. Total financial

outlay under this head would be **Rs. 15.00 lakh**.

1.6 Wildlife Conservation Plan

Keeping in view of the anticipated impacts of proposed project on the biodiversity of area and the human-wildlife conflict because of habitat loss of wild animals due to fragmentation of forest and loss of agriculture crops by wild animals, a financial provision of **Rs. 20.00 lakh** has been earmarked for wildlife conservation.

1.7 Biodiversity Management Committee (BMC)

The monitoring and evaluation of the Biodiversity Conservation and Wildlife Management Plan of Shahpur Pumped Storage Project will be carried out by a Biodiversity Management Committee (BMC). The committee will follow the guidelines of the National Biodiversity Authority, State Biodiversity Conservation Strategy Action Plans (SBCSAP), and State Forest Department to implement, monitor, and evaluate the Biodiversity Conservation and Wildlife Management Plan of the proposed Project. The activities of BMC shall be under the direct administrative control of the Chief Wildlife Warden/Principal Chief Conservator of Forests, Rajasthan. The BMC will comprise of the following members:

Chief Wildlife Warden/Principal Chief Conservator of Forests, Rajasthan	Chairman
Manager (Environment) Greenko Energies Pvt. Ltd.	Member Secretary
Divisional Forest Officer of the concerned Division	Member
Experts from State University and Active NGO's	Member
Local Body's Representatives from the villages	Member

The Chairman of the committee will have the right to assign various activities to various members for proper functioning and result-oriented tasks. The committee will monitor the progress of the proposed plan. The total financial outlay for the BMC would be **Rs. 10.00 lakh** only.

1.8 Budget

The total budget for the Biodiversity Management & Wildlife Conservation Plan would be **Rs. 106.75 lakh**. The breakup of the budget is given in **Table 1.1** below.

Table 1.1 : Budget for Implementation Biodiversity Conservation Plan

S. No.	Particulars	Total Amount (Rs. in lakh)
1	Afforestation and Enrichment along the periphery of the upper reservoir in the adjoining forest area (@1,00,000/ha for 50 ha)	50.00
2	Farm forestry for fuelwood and timber (@75000/ha for 5 ha)	3.75
3	Sowing of Grass (lump sum)	5.00
4	Awareness Program @ Rs. 1 lakh/year for 3 years	3.00
5	Strengthening of Infrastructural Facilities of Forest Department	15.00
6	Biodiversity Management Committee (BMC)	10.00
7	Wildlife Conservation Plan	20.00
	Total	**106.75**